HANDICAP INTERNATIONAL PHYSICAL THERAPY ASSISTANT MANUAL

VOLUME 1

THEORY AND BASIC ANATOMY

ACKNOWLEDGEMENTS

The preparation and production of this Manual has only been made possible through the efforts of the Handicap International team in Thailand composed of Physical Therapists, Occupational Therapists, and office support personnel.

During the process of developing appropriate and standardized training courses for Physical Therapy Assistants (PTA), the following key contributors devoted countless hours of both their work and leisure time to the wide range of tasks involved.

Sophie Bouchet, Occupational Therapist
Marie-Francine Demarecaux, Physical Therapist
Peter De Roo, Physical Therapist
Sue Eitel, Physical Therapist
Patrick Girault, Physical Therapist
Jill Graebner, Physical Therapist
Patrice Renard, Physical Therapist
Krista Viaene, Physical Therapist

Other individuals who provided valuable assistance were:

Sonia Bertrand
Myriam Houtart
Frederic Banda
Jean-Christophe Latteur
Maite Idiart
Martine Relyveld
Thierry Mulpas
Valerie Bernard
Serge Rochatte
Luci Standley
Pierre Janssens
Claudie Montaufray
Sumitra Jantham
Claude Magnier

The coordinator of the project was Sue Eitel. The complete manuscript was typed and set out by Luci Standley.

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Appreciation is also extended to Susan Walker, the Regional Director of Handicap International, for her continued support throughout the project.

The illustrations used in this Manual were assembled from a variety of sources. Some of these illustrations have been modified and others have been directly incorporated. David Werner's publication, "Disabled Village Children", was extensively utilized for this purpose.

Appreciation is extended to all authors listed in the Reference Section provided at the end of each Volume.

INTRODUCTION

Handicap International came to Thailand in 1981 with the purpose of meeting the need for low cost prosthetic devices using appropriate technologies for amputees in camps and evacuation sites along the Thai-Cambodian border. In 1984, Handicap International expanded its operations to include Physical Therapy and rehabilitation. The current program at this border has the objective of training Khmer refugees and displaced persons in the basic techniques of Physical Therapy.

From 1984 to 1988, the expatriates working within this program developed individual course work in each of those camps having a Physical Therapy Assistants (PTA) training program. This process was often very time-consuming. There was little or no continuity between the consecutive missions of the expatriates, and there was no standardization between the different camps in order to integrate the activities of the program as a whole.

In 1989, a decision was made to develop a standardized PTA curriculum in the camps along the border. The team of Physical Therapists and Occupational Therapists working for Handicap International in Thailand cooperated in the preparation and application of this curriculum. This Manual is the result of the first comprehensive attempt at meeting this need.

The manual is composed of 3 Volumes that should preferably be used in the order as numbered. However, the content has been developed in such a way that individual chapters or combinations of chapters may be extracted and applied as self-sufficient units in accordance with the varying needs of each group of users. Examination and evaluation material covering all 3 Volumes is provided as a separately bound document.

In order to avoid confusion in terminology which may possibly arise from the combination of French, Belgian and American nationals who worked together in the development of the Manual, it should be noted that the following terms are directly interchangeable.

Term used in the Manual	Common European equivalent
Range of Motion (verb)	Mobilization
Range of Motion (noun)	Amplitude
Strengthening	Musculation
Stretching	Posture

In using the Manual in the field, it may be found that certain topic areas are too detailed and others too generalized. As a pilot exercise, the team in Thailand is currently testing the manual in order to identify those areas requiring future modifications.

Through a continuing process of monitoring, evaluation and feedback, it is intended that the Manual may be progressively improved in order to meet the basic training needs of the Physical Therapy Assistant.

All users and other interested individual and groups are invited to send comments, suggestions as well as descriptions of appplication experiences, to:

Serge Rochatte
Handicap International
18 rue de Gerland
69007 Lyon
France

Sue Eitel
May 1990

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VOLUME 1: THEORY AND BASIC ANATOMY

1.

INTRODUCTION TO PHYSICAL THERAPY

PHYSICAL THERAPY makes the body better by using movement and motivation.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. compare curative, preventative, and adaptive treatment.
2. explain Physical Therapy and how a Physical Therapist uses movement and motivation to help others.
3. describe the 4 steps in the rehabilitation process.
4. explain autonomy and state why it is important.
5. describe a medical team and why communication is important between members of a medical team.

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A. INTRODUCTION

B. WHAT IS A PATIENT?

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D. TYPES OF TREATMENTS

E. PHYSICAL THERAPY

F. REHABILITATION

G. MEDICAL TEAM

H. CHAPTER SUMMARY

A. INTRODUCTION

The work of Physical Therapy is new in many countries.

More information about Physical Therapy and demonstration of Physical Therapy work is needed to help people understand and accept Physical Therapy.

This chapter is written to help explain what Physical Therapy is, and how Physical Therapy can help others.

Before discussing Physical Therapy in detail, basic information for all health professionals (doctors, nurses, health workers) will be presented.

B. WHAT IS A PATIENT?

When a person feels he has a problem with his body, he may ask for help.

If a person receives help from a hospital or medical professional, he is called a patient.

A patient is a word used to identify a person who receives medical care to help make his body problems better.

A patient must be cared for as a whole person ... the problem with his body is only a part of who this person is.

REMEMBER ...

Not every person is a patient,
but every patient is a person.

C. CAUSES AND CONSEQUENCES OF BODY PROBLEMS

In this section we will present:

1. causes of a patient's body problem
2. consequences of a patient's body problem (what happens after the patient has a problem).

1. CAUSES OF A PATIENT'S BODY PROBLEM

Questions:

1. Think about the people you have seen in a hospital. List 5 different types of problems that these patients had.

____

____

____

____

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2. Look at the problems in question #1. What are the causes of these problems?

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There are many, many different kinds of problems that a person can have with his body.

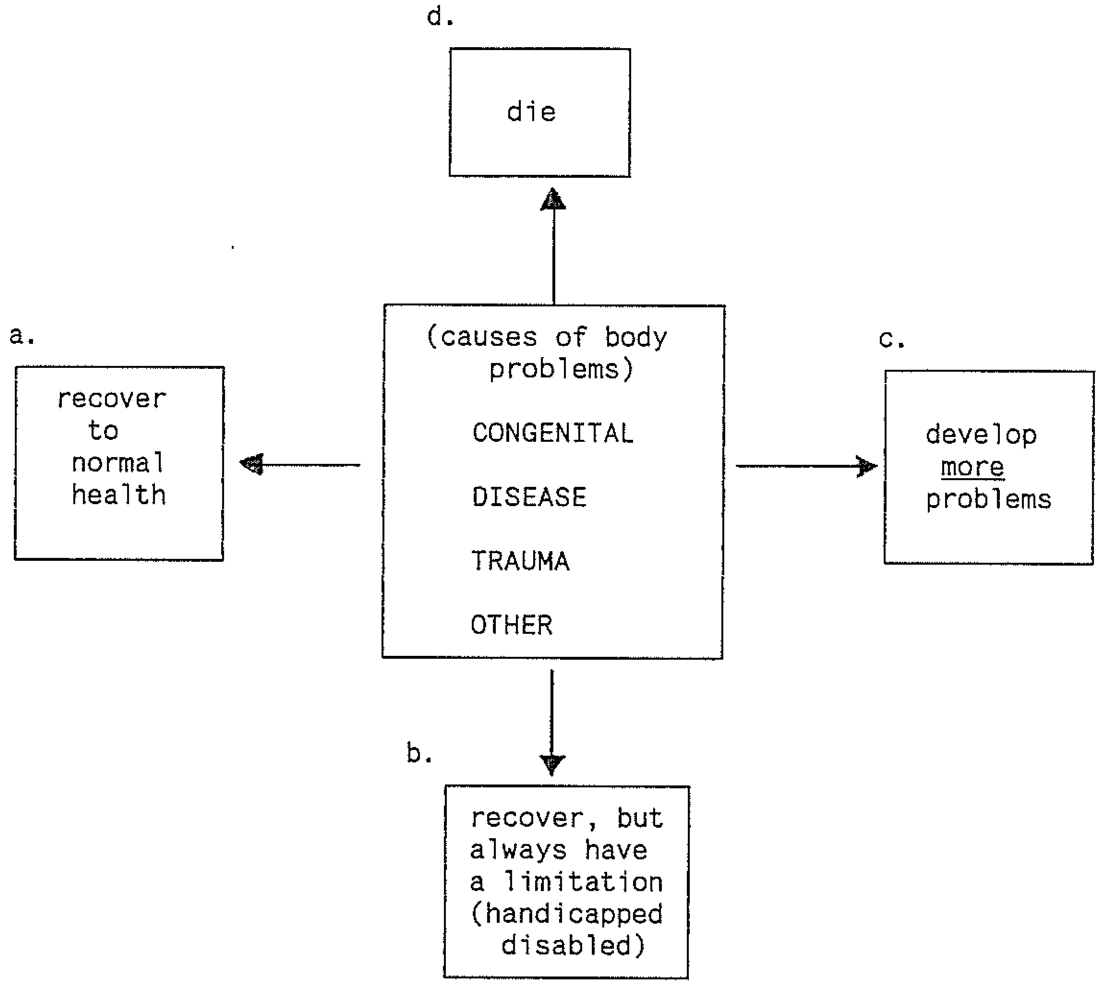
The main causes of a person's body problems could be:

CONGENITAL	---------->	problems you have when you are born (abnormal body shape, or movement)
DISEASE	---------->	problems caused from small body attackers inside your body (TB, Leprosy, Polio)
TRAUMA	---------->	problem from direct injury to the body (mine injury, car accident, bullet wound)
OTHER	---------->	problems from unknown reasons psychological, lack of food

2. CONSEQUENCES OF A PERSON'S BODY PROBLEM
(what happens after the body has a problem)

After your body has a problem, four things could happen.

a.	your body can recover (get better) and be normal	------>	for simple problems and with good care, many people recover to normal
b.	your body can recover (get better), but will always have a limitation	------>	some people have body problems that are so severe that the body can never become normal (disabled, handicapped)
c.	your body can develop more problems	------>	if a patient does not have good care, he can develop new diseases or problems with movement
d.	you can die	------>	some problems are so severe that the patient will die because of these problems



D. TYPES OF TREATMENTS

A treatment is working with a person to help him decrease, avoid, or adapt to a body problem.

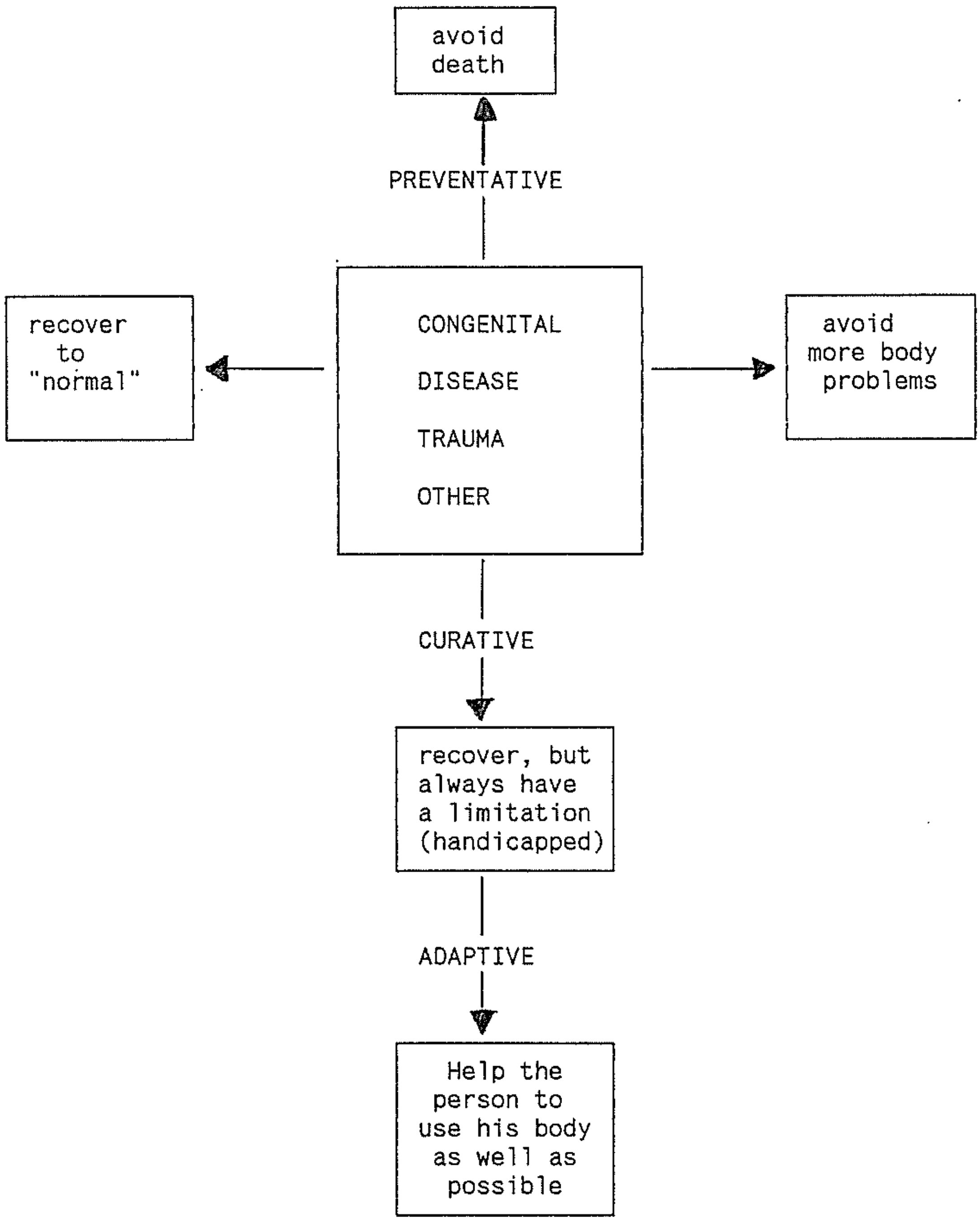
3 types of treatments used with patients are:

1. CURATIVE TREATMENT
   Help a person recover as much as possible after he has a problem.

2. PREVENTATIVE TREATMENT
   Help a person avoid a body problem before it starts.

3. ADAPTIVE TREAMENT
   Help a person with permanent limitations to use his body as well as possible (equipment).

The chart below shows where preventative, curative, and adaptive treatments are used AFTER a patient has a problem.



PREVENTATIVE	- want to avoid death - want to avoid more body problems
CURATIVE	- want to recover to normal - want to recover as much as possible
ADAPTIVE	- (for handicapped) want to use his body as well as he can

Activity:

Below is a list of specific treatments for patients. For each treatment, please write if it is adaptive, preventative, or curative treatment. There may be more than one answer for each question.

1. giving medicine ______________________

2. teaching about TB ______________________

3. giving a wheelchair ______________________

4. turning a patient in bed ______________________

5. braces for walking ______________________

6. wound care ______________________

7. food supplement ______________________

8. movement for the limbs ______________________

9. breathing exercises ______________________

10. hand device for eating ______________________

11. changes in the house for the patient ______________________

12. washing a patient ______________________

After answering all questions, discuss your answers with others in your class. Include what is prevented, what is cured, or what is adapted.

E. PHYSICAL THERAPY

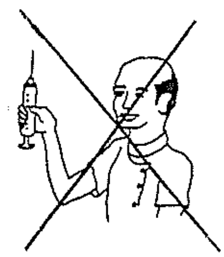
As we have said before, Physical Therapy makes the body better by using movement and motivation.

Specific information given in this section includes:

1. What Physical Therapy does <u>not</u> use in working with patients.
2. Different movements to prevent and cure patients' body problems.
3. Motivation as a part of treatment.
4. Summary of types of patients that need Physical Therapy.

1. WHAT PHYSICAL THERAPY DOES <u>NOT</u> USE IN WORKING WITH PATIENTS

* Physical Therapy does not use injections.
* Physical Therapy does not use pills.
* Physical Therapy does not use herbs.
* Physical Therapy does not use surgery.
* Physical Therapy does not use magic.



2. DIFFERENT MOVES TO PREVENT AND CURE PATIENT'S BODY PROBLEMS

Doctors use different <u>medicines</u> to treat different patients.

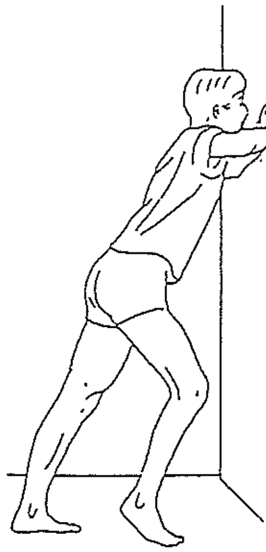
In the same way, PTAs use different <u>movements</u> to treat different patients.

The movements that a PTA uses will depend on what a patient needs.

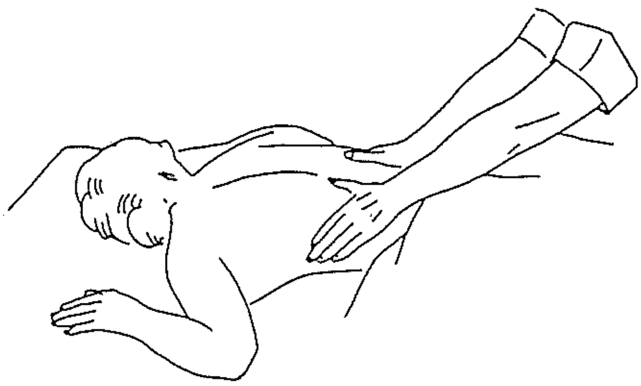
A PTA can lift, pull, push, massage, turn, and position patients.

PICTURES OF DIFFERENT PHYSICAL THERAPY TREATMENTS AND TECHNIQUES

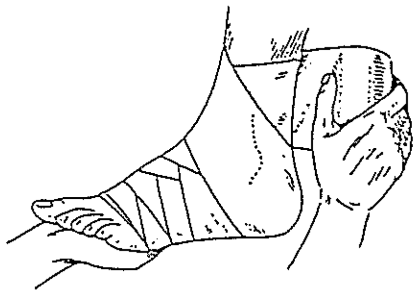
LIFTING



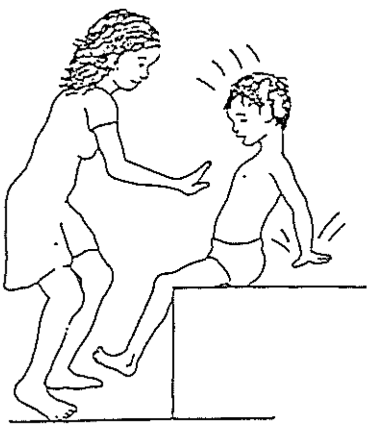
STRETCHING



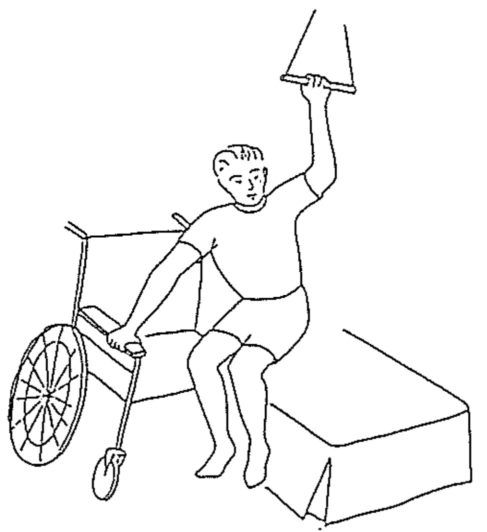
MASSAGE



BANDAGING



BALANCE



AUTONOMY/TRANSFERS

When the PTA applies movements correctly, these movements can:

* make a patient stronger
* prevent tightness or stiffness
* increase the control of movement
* help blood circulation and wound healing
* increase the amount of movement
* prevent pressure sores
* make breathing easier
* increase balance
* prevent respiratory problems
* help the patient stand and walk

The chart on the following page gives examples of specific Physical Therapy techniques and what problems that these techniques can help <u>avoid</u> and <u>cure</u>.

PHYSICAL THERAPY	PREVENTATIVE (helps to avoid)	CURATIVE (helps to cure and recover)
STRENGTHENING	- muscle weakness - dependent patient	- increase strength - increase blood circulation
STRETCHING	- more deformities and joint tightness	- increase movement at a joint
RANGE OF MOTION	- joint tightness - contractures	- maintain the movement at a joint
MASSAGE	- hard, tight skin - pressure sores - immovable scar	- soften hard skin areas - increase wound healing - relax tight muscles - increase blood circulation - decrease swelling
RESPIRATORY TRAINING	- respiratory problems (breathing)	- remove secretions - increase air in and out of the lungs
POSITIONING	- pressure sores - respiratory problems - contractures	- decrease pressure sores - remove secretions - decrease contractures - improve psychology - decrease swelling
TRANSFERS	- harmful movements - to patient or helper	- help patient move more independently - make transfers more easy, quick and safe
BALANCE TRAINING	- patient falling	- increase balance in in sitting or standing
GAIT TRAINING (walking)	- bad habits in walking - joint damage from bad walking	- help patient walk safely, correctly and effectively

<u>Questions</u>:

1. A patient has stiffness in his arms and legs. Can Physical Therapy help this patient?

   Yes _____ No _____

   If no, why not? ______________________________

   ____

   If yes, how? ______________________________

   ____

2. What is a Physical Therapy treatment used to <u>prevent</u> joint stiffness?

   ____

   ____

   Why is it important to prevent joint stiffness?

   ____

   ____

3. What are 2 Physical Therapy techniques used to prevent pressure sores?

   ____

   ____

4. A patient has respiratory problems. How can Physical Therapy help this patient?

   ____

   ____

Specific information and instruction about each of these techniques is given in Volume 2 - Physical Therapy Treatments and Devices.

3. MOTIVATION AS A PART OF ALL PHYSICAL THERAPY TREATMENT

We have said that Physical Therapy uses different movements to treat different patients.

In addition, Physical Therapy uses MOTIVATION in the treatment of all patients.

Motivation is a way to help someone want to do something. If someone is "motivated", he will want to do something more completely, correctly, and more reliably.

If the patient is "motivated" to recover, he will follow the treatments and instructions more completely, correctly, and reliably.

In other health areas the patient needs little or no motivation because he can passively receive treatment.

Example:

* The doctor gives an injection, the patient does nothing.
* The laboratory man takes blood, the patient does nothing.
* The nurse gives pills, the patient swallows them.

In Physical Therapy, the PTA and patient (and family) WORK TOGETHER. In most Physical Therapy treatments, the patient must be active to help recover or maintain normal body movement.

A small effort by the patient or family will generally cause a small result in the recovery of the patient.

The PTA can use many different methods to help motivate the patient (and family) to follow treatments as well as possible.

Suggestions to increase patient motivation are:

* Showing interest in the patient and his progress
* Showing encouragement and energy in treatments
* Clearly explaining each treatment (to the patient and family)

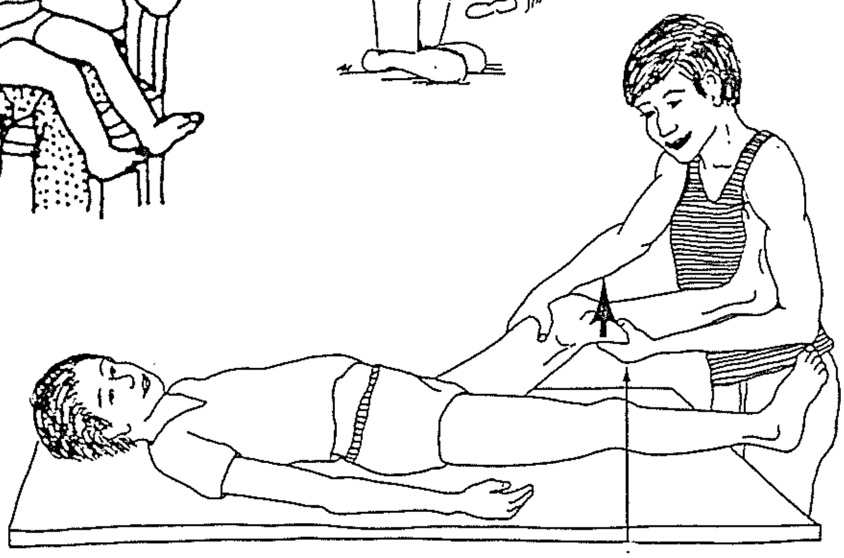
* Showing interest in the patient and his progress

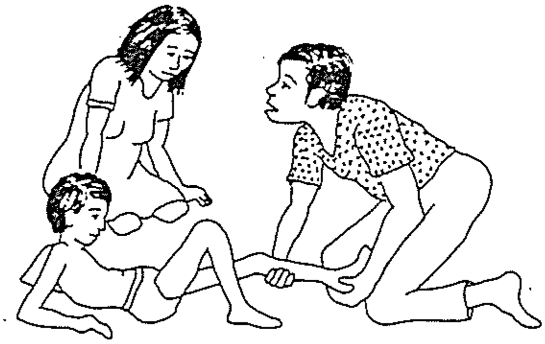
The PTA can help to motivate a patient if the PTA takes care of the whole person and not just the specific body problem.

Showing interest includes:

- speaking to the patient about his problem and about other topics
- giving the patient attention and eye contact when working with him
- speaking with or greeting the patient informally outside of treatment times
- identifying areas of recovery (even small ones) and responding positively to these improvements

Examples of showing interest in a patient are given in the pictures below.





* giving encouragement and energy in treatments

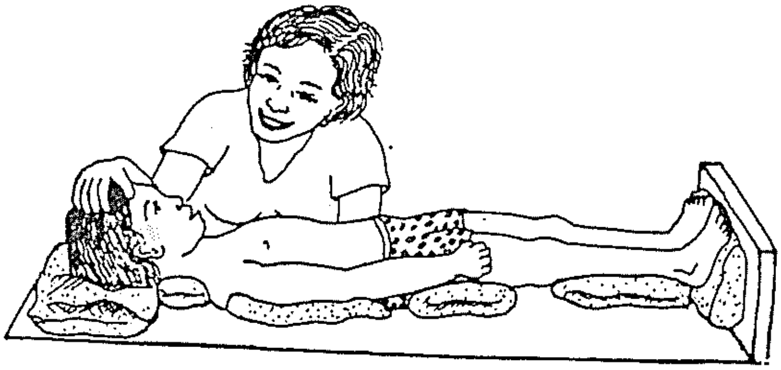
Many times when a person has a problem with his body, he may feel depressed and not want to do much.

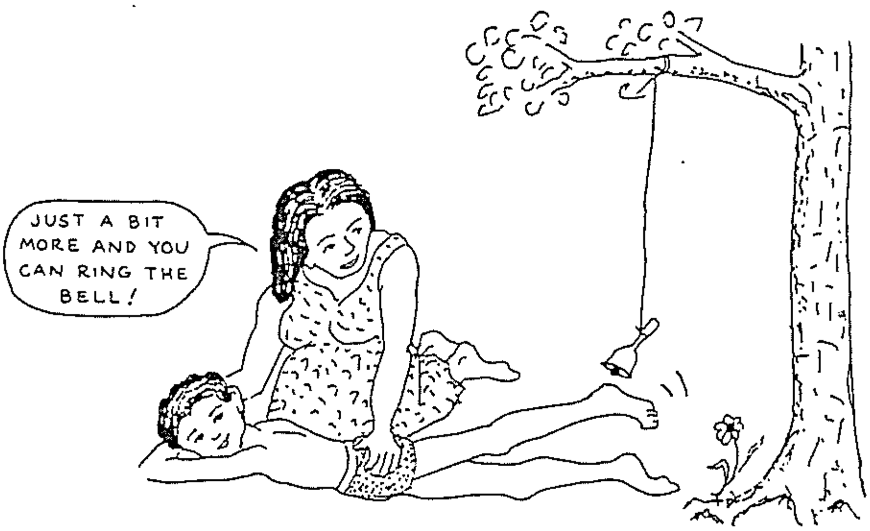
The PTA must help to support and encourage the patient to work to recover as much as possible.

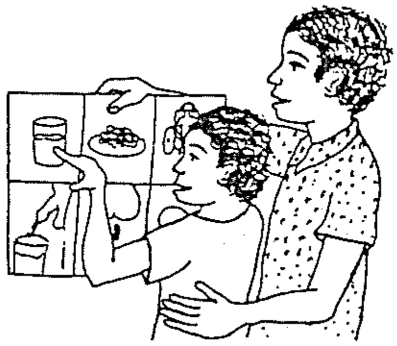
Encouragement and energy includes:

- eye contact and attention during treatment
- friendly smile when greeting the patient
- giving positive response to hard work
- using a voice with energy when "coaching" different activities

Examples of giving encouragement and energy in treatment are given in the pictures on the following page.




JUST A BIT MORE AND YOU CAN RING THE BELL!



* clearly explaining each treatment (to the patient and family)

The PTA must use simple language when working with a patient or the patient's family.

The patient/family will not understand medical words. Medical words can make an explanation more difficult than it needs to be.

The goal of explaining is to have the patient and family <u>understand</u>.

The PTA can explain by simple words, demonstration, example, or other ways that will help the patient and family understand.

When the PTA explains treatment, he should include:

- what the treatment is
- why the treatment is given
- what the goal is
- what would happen if this treatment wasn't given
- what the patient is expected to do
- what the family is expected to do
- how often the treatment needs to be made
- how the treatment can be changed and still have the same result.

After explanation, the PTA must ask if the patient or family has questions.

If the patient/family are expected to continue this treatment independently, the patient/family should <u>demonstrate</u> the treatment while the PTA observes to see that they understand.

<u>REMEMBER !</u>

MOVEMENT is the heart of Physical Therapy, but without MOTIVATION, the heart stops beating.

F. REHABILITATION

Rehabilitation is a step-by-step process to help the patient recover and have a "normal" life as much as possible.

There are 3 steps in the rehabilitation process:

1. Physical Therapy treatments using movement and motivation.

2. Equipment for autonomy.

3. House/community adaptations.

4. Social integration.

1. PHYSICAL THERAPY TREATMENTS USING MOVEMENT AND MOTIVATION

Physical therapy treatments using movement and motivation are the first step toward successful rehabilitation.

For some patients, treatment with movement is the <u>only</u> step needed to help the patient recover and have a "normal" life.

<u>Example</u>:

* A young man had a broken leg. He wore a plaster cast for 3 months. At the end of 3 months he had stiffness of his knee and weakness in hig leg.

  Physical therapy used strengthening and stretching exercises to help this boy. After 2 months, both legs worked equally well.

For other patients, treatment using movements helps to <u>prepare</u> the patient for the next step in rehabilitation.

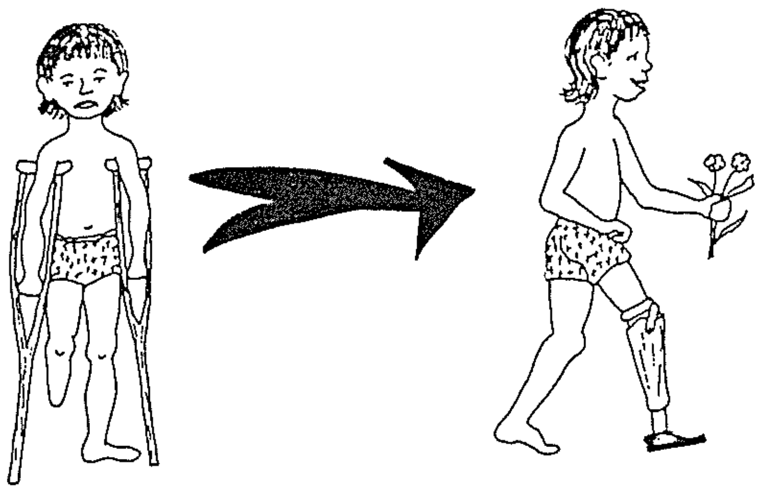
Preparing the patient means to try to help the patient be as strong as possible, have normal movements in the joints, good skin condition, and good motivation.

<u>Example</u>

* A man has lost his leg below the knee. The PTA works with him to strengthen the leg and body, massage to help heal the wound and to prevent the scar from becoming hard, range of motion to prevent joint stifffness, and balance exercises.

  After all of this preparation, the patient's body has recovered as much as possible, but will continue to have a limitation .. in this case, no leg.

  Equipment (artificial leg-prosthesis) can be given to help this patient have a normal life as much as possible.



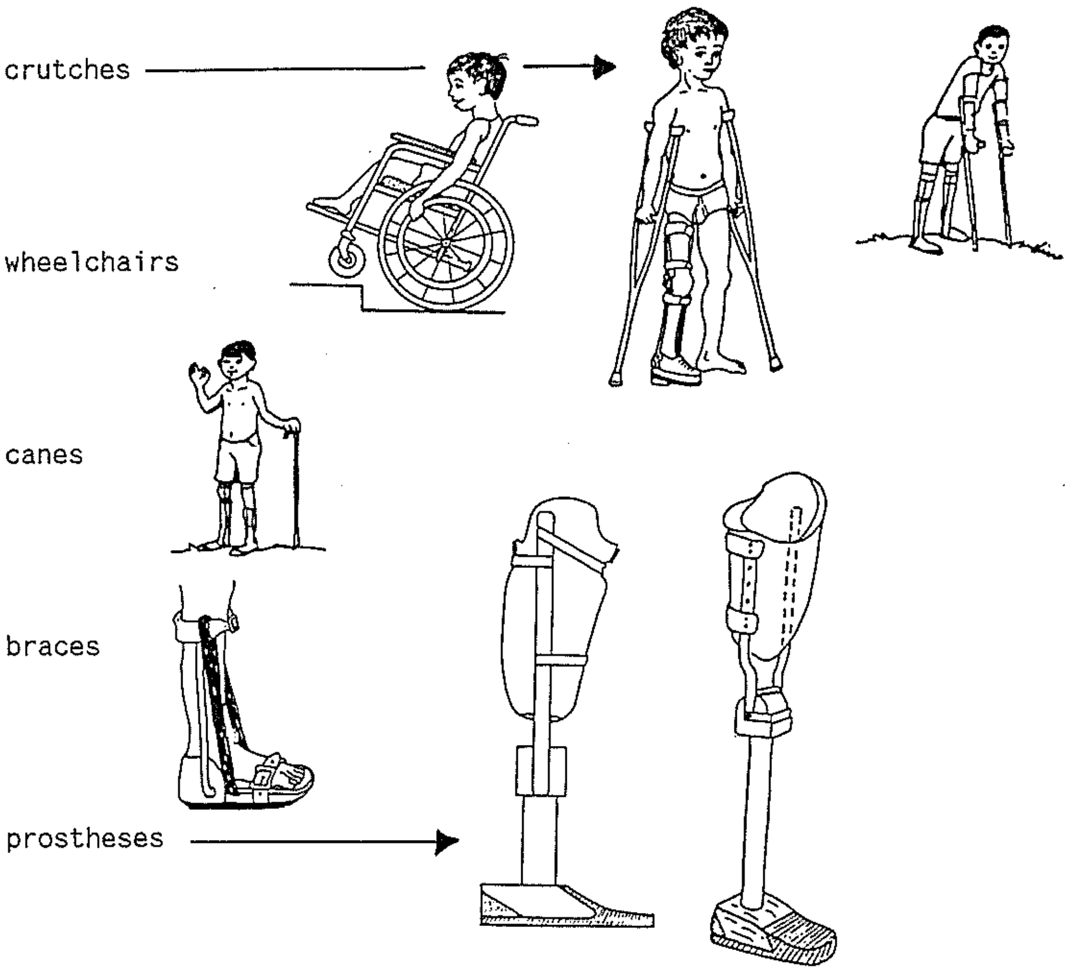
2. EQUIPMENT FOR AUTONOMY

<u>Equipment</u> is something added to the patient's body to help the body work (function) better. Another name for equipment is "device".

Autonomy is the idea to have the patient do as much as possible without help from someone else.

<u>Equipment for automony</u> is anything applied to the patient's body that will help the patient do as much as he can without help from soneone else.

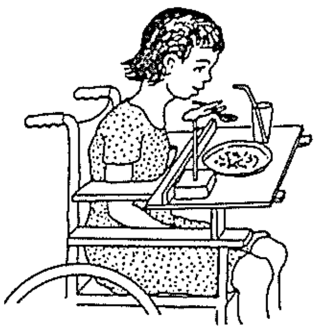
Different types of equipment that will help the patient to be more idendependent in moving from one place to another are:

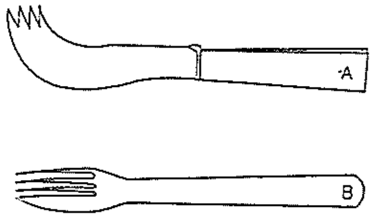


For more details see WALKING AIDS, BRACES FOR THE LOWER LIMBS, and WHEELCHAIRS chapters.

Different types of equipment that will help the patient to be more independent in eating, dressing and bathing.

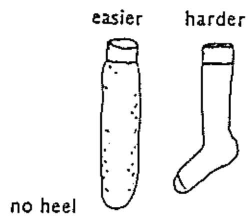
devices for eating

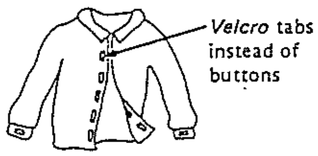


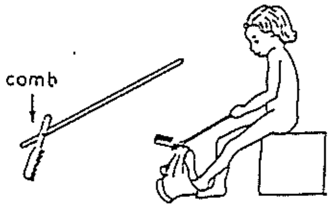


Knife-fork combinations. A. Rocker knife. B. Cutting fork.

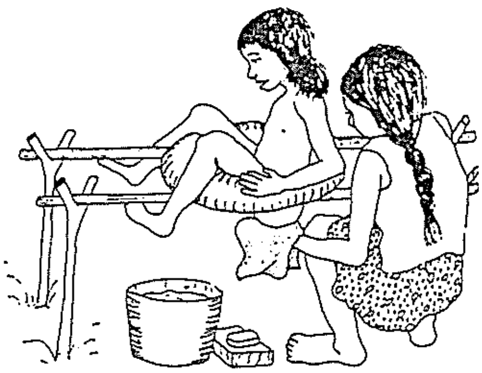
devices for dressing







devices for bathing



For more details see DEVICES FOR AUTONOMY.

In some cases, the PTA may be able to make the equipment. In most cases (especially for devices that help in moving from place to place), a <u>TECHNICIAN</u> must work together with the patient and the PTA to make a device.

avoid death

↑ PREVENTATIVE

recover to "normal" ← CONGENITAL / DISEASE / TRAUMA / OTHER → avoid more body problems

↓ CURATIVE

recover, but always have a limitation (handicapped)

↓ ADAPTIVE

have a normal life as possible.

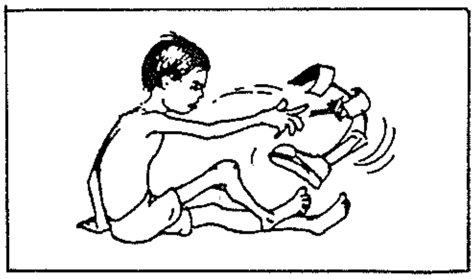
If we return to the diagram given earlier, equipment for autonomy is given to patients who will always have a limitation with their body.

This is called adaptive treatment. Equipment given is sometimes called adaptive equipment.

NOTE:

Not all patients will want or need equipment. The PTA must explain what the equipment is for and how it can help.

A patient should be motivated - never forced - to wear equipment.



3. HOUSE/COMMUNITY ADAPTATIONS

When a patient returns home, there may need to be some changes made in the house and community to continue to help the patient be as independent as possible. (See HOUSE ADAPTATIONS)

<u>Question</u>:

A patient had an accident and he will never walk again. He returns home in a wheelchair. Please list 3 things that need to be adapted in the home to make him independent in his wheelchair.

____

____

____

____

4. SOCIAL INTEGRATION

Social integration is the way of helping a person be accepted within a community.

As much as possible, the PTA must work together with the patient, family, and community to help with this integration.

Ways to help integrate a person into a community are:

* education
* finding work or ways the person can <u>contribute</u> to the community
* follow-up

* education

The PTA must take time to explain to the local health worker and members of a community about a patient with a disability.

This explanation should include:

- causes of the patient's limitation

- STRONG messages that the disibility is not contagious (cannot be given to others)

- emphasis on what a patient CAN do

- remind others that he is a person with a limitation; (he continues to feel, think, learn and laugh)

- answer questions so that there is no fear or big mystery that follows the patient.

Questions:

1. A patient had a disease that caused damage to the skin. This patient continues to take medicine and cannot give the disease to others. The community was afraid of this man and forced him to live alone in a house far away. Is this a good example of successful integration?

   Yes _______ No _______

   Explain your answer.

____

____

____

Questions: (continued)

2. A patient had an accident and now she cannot move her legs at all. She has no wheelchair and see remains in her bed all day. What things can you do to help "rehabilitate" this woman.

____

____

____

____

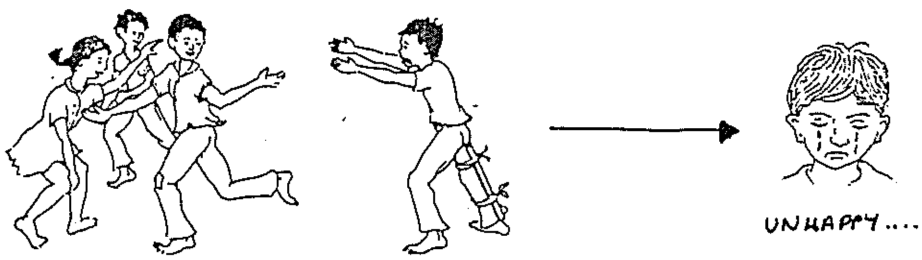
* finding work or ways the person can contribute to the community

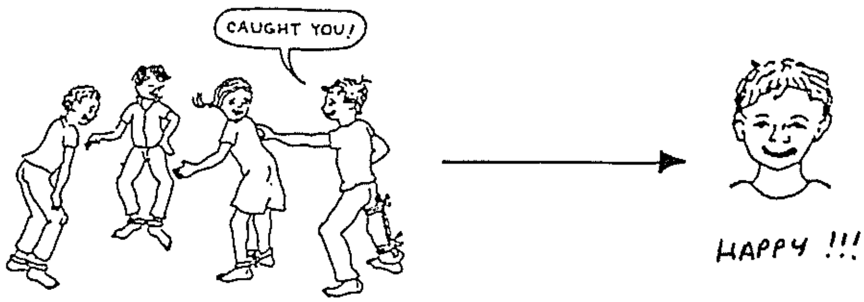
A very good way to be accepted by a community is to be able to help the community.

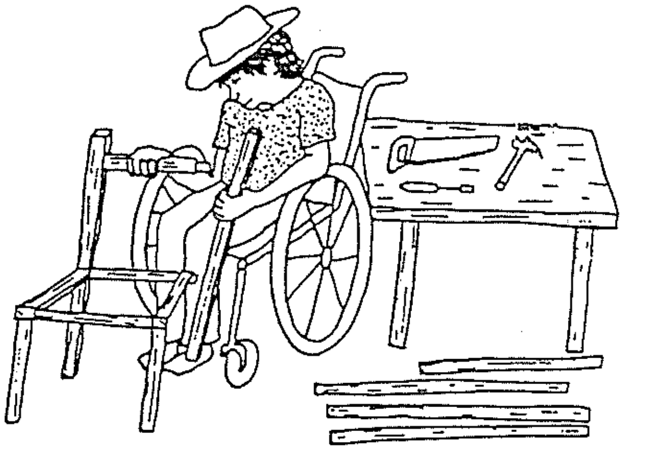
A person with a handicap can work or help a community in many different ways. It only takes a little time to find the right activity for the right person!

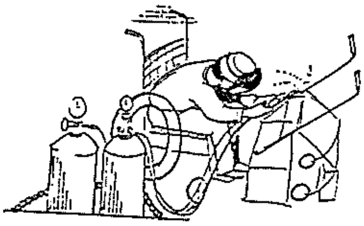
The PTA should help identify ways that the patient can help within the community.

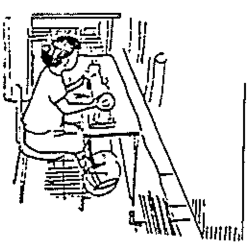
With this work, the patient's ABILITIES will be reinforced and his DISABILITIES less important.

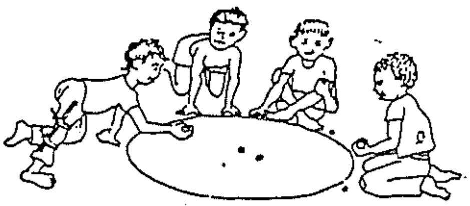












Questions:

1. A man lost his leg above the knee. He received a prostheses, was instructed how to use it and then sent back home to his village. One month later the PTA sees the patient without his prosthesis and begging for money in the street. Was this successful integration?

   Yes _______ No _______

   Explain your answer.

   ____
   ____
   ____
   ____
   ____

2. Return to Question #1. Explain what you would do to try and prevent this person from having a life as a beggar.

   ____
   ____
   ____
   ____
   ____

Example: A woman with no movement or feeling in his legs.

NO

POOR SOCIAL INTEGRATION

YES

GOOD SOCIAL INTEGRATION

* follow-up

The PTA should continue to visit the patient and patient's family to observe the patient's physical condition AND the integration of the patient into the community.

After leaving the hospital it is best if the PTA can visit 1-2 times each week.

After 1-2 months, these visits can be decreased as the PTA feels confident that the patient is integrated, active, and managing well.

IN SUMMARY

Rehabilitation is not limited to decreasing the patient's problem.

Rehabilitation is the process to help the patient recover and have a "normal" life as much as possible.

This process includes Physical Therapy treatment and may also include equipment, house adaptations, and assistance to help be accepted by the community.

G. MEDICAL TEAM

A "team" is 2 or more people working together for a common goal. One person is not a team!

A medical team is people working together for a common goal. The goal of a medical team is to help the patient.

The medical team works together to help the patient recover as much as possible while helping to prevent more problems or death.

Questions:

1. Why is a team needed to help treat patients?

___

___

___

2. Would it be better to have only one person to take care of ALL of the patient's needs?

   Yes _______ No _______

   Explain your answer.

___

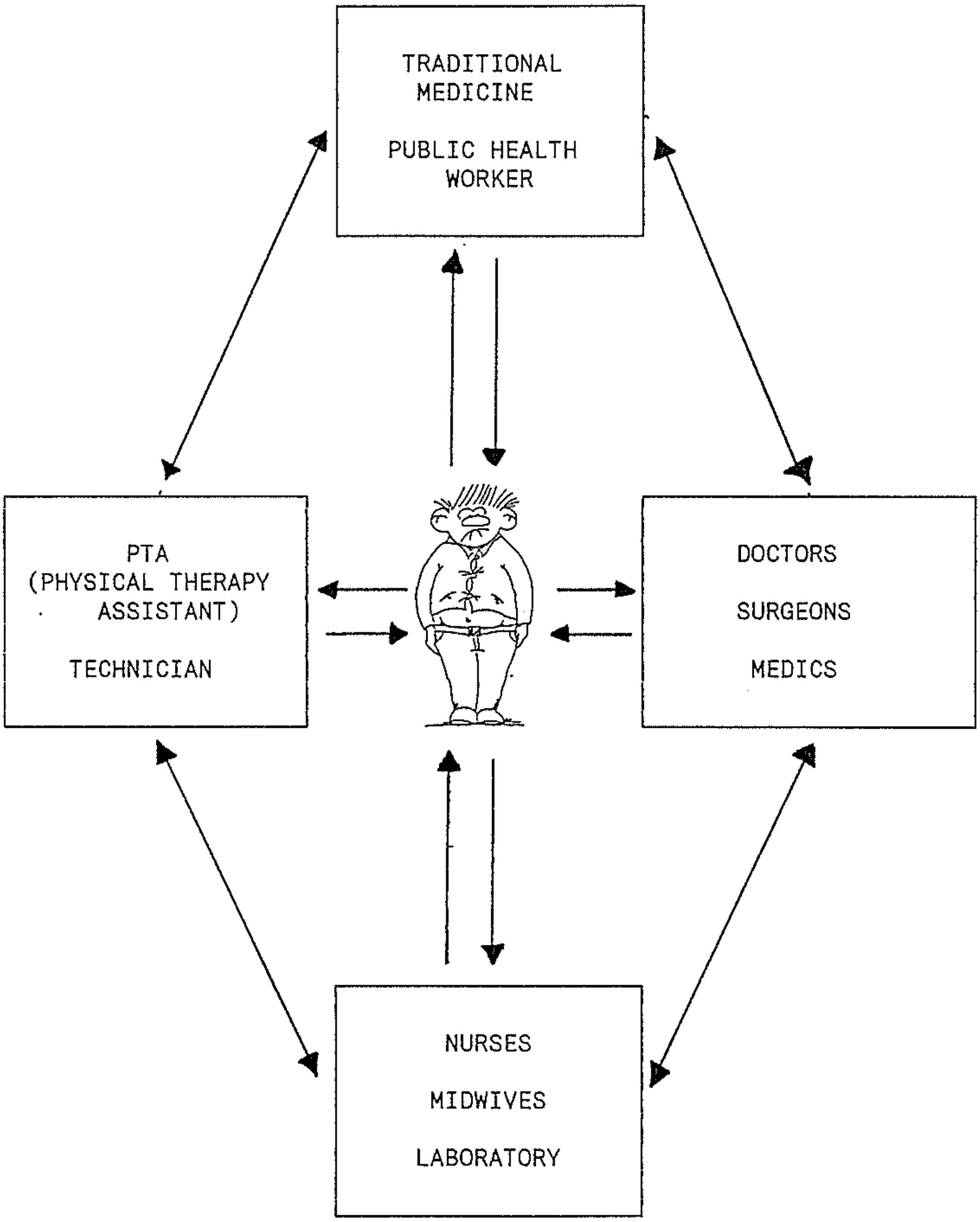
___

___

There are many different members of a medical team. Each member is responsible to HELP THE PATIENT.

Below is a diagram showing the different members of a medical team.

Note: The medical team that you work with may be different from the one shown in the diagram.



Question:

Look at the diagram on the previous page and compare this with the medical team that you will work with.

What is different?

___

___

___

What is the same?

___

___

___

All the members of the medical team canp help the patient in different ways.

Examples:

* A surgeon will make surgery to try and help the patient.

* A nurse will do wound care.

* A PTA will stretch tight muscles/joints.

* A Public Health Worker will teach the patient how to prevent diseases.

For some work, different members of the medical team can help the patient in the same ways.

Examples:

* Doctors and nurses can give injections.

* Nurses and PTAs can help to position and turn the patient in bed.

* PTAs and Public Health Workers can travel to the patient's home to help integrate the patient into society.

The following pages help to summarize the work of a HEALTH WORKER, DOCTOR, NURSE, and PTA.

These are general work descriptions; the specific work of these team members may or may not be the same with each medical team.

<u>Medical Team Member</u>	<u>how they help the patient</u>
1. HEALTH WORKERS	* prevent a patient's body problem by educating about how to avoid disease * can send people with body problems to a doctor so they can receive treatment
2. DOCTORS	* prevent some patients' body problems (diseases) by giving medicine (pills or injections) * cure some patients' body problems by giving medicine (pills or injections) * cure some patients' body problems by <u>surgery</u> (removing or repairing a body part)
3. NURSES	* help the doctor prevent some patients' body problems (diseases) by giving medicine (pills or injections) * help the doctor cure some patients' body problems by giving medicine * help the doctor cure some patients' body problems by helping with surgery * help prevent more problems by taking good care of the patient in bed

Medical Team Member	how they help the patient
4. PHYSICAL THERAPY ASSISTANTS	* prevent more problems by moving and positioning the patient in bed. * cure some patients' body problems by motivating the patient and helping him move as normally as possible * help people adapt when they have body problems that can never recover to normal

Communication is very important.

All members of a medical team must work TOGETHER to share information, ideas, and provide more complete care for the patient.

Examples of why COMMUNICATION between members of a medical team is important.

* A doctor sees a patient with a broken leg. The doctor tells the patient not to put any weight on this leg for 1 month because the bone will break again.

  The doctor does not tell this to the PTA. When the patient comes for physical therapy, the PTA asks the patient to walk normally. The patient is afraid to say what the doctor told him. The patient walks and the bone rebreaks.

  Question:

  How could this can have been prevented?

  ____

  ____

  ____

* A midwife helps a woman deliver her baby. When the child is born, the midwife sees that the baby's foot has an abnormal position. The midwife tells the PTA and the PTA begins treatment to correct the position of the foot. After many months of treatment the foot is in a good position.

<u>Question</u>:

How did good communication help this child?

----

* A health worker visits the home of a family and sees a person who cannot move his legs. This patient stays in bed all day.

<u>Question</u>:

How can the public health worker help this patient?

There are many more examples of how communication with the patient/ family and communication between members of a medical team can only <u>help</u> the patient.

Again, Physical Therapy is new in many countries. A PTA is an important member of a medical team.

Other members of a medical team must know the work of Physical Therapy to know <u>what</u> to communicate and know <u>how</u> Physical Therapy can help.

It is the PTA's responsibility to explain and demonstrate the work of Physical Therapy.

H. CHAPTER SUMMARY

A patient is a person who receives medical care to help make his body problem better.

Treatment is working with a person to help him decrease, avoid, or adapt to a body problem.

3 types of treatments are:

CURATIVE	help a person recover as much as possible after he has a problem
PREVENTATIVE	help a person avoid a body problem before it starts.
ADAPTIVE	help a person with permanent limitations use his body as well as possible.

Physical Therapy makes the body better by using movement and motivation.

Movement includes application of pushing, pulling, lifting, turning, massaging, positioning. Different movements are used with different patients.

Motivation is a way to help someone want to do something. The PTA must help to motivate all patients so that they follow treatments more correctly, completely and reliably.

3 suggestions to help motivate patients are:

* showing interest in the patient and his progress
* giving encouragement and energy in treatments
* clearly explaining each treatment to the patient and family

What Physical Therapy does NOT use:

- injections
- pills
- herbs
- surgery
- magic

Rehabilitation is a step-by-step process to help the patient recover and have a "normal" life as much as possible.

4 steps in the rehabilitation process are:

- movement and motivation (Physical Therapy)
- equipment for autonomy
- house/community adaptations
- social integration

A medical team is people working together to help the patient recover as much as possible while helping to prevent more problems of deaths.

Communication is very important. All members of a medical team must WORK TOGETHER to share information, ideas, and provide more COMPLETE care for the patient.

2.

BODY PARTS AND MEDICAL VOCABULARY

BODY PARTS and MEDICAL VOCABULARY are explained to help ensure good professional communications.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify all main body parts presented in this chapter.
2. describe anatomical position and explain why it is important.
3. apply medical vocabulary for locations.
4. apply medical vocabulary for body positions and directions of body movements.

CHAPTER CONTENTS

A. INTRODUCTION

B. MAIN PARTS OF THE BODY

C. ANATOMICAL POSITION

D. MEDICAL VOCABULARY

E. CHAPTER SUMMARY

A. INTRODUCTION

The first chapter discussed patients, types of treatment, Physical Therapy and rehabilitation.

We have also said that the PTA will be part of a medical team working together to help a patient recover.

The members of a medical team need to be able to communicate with each other.

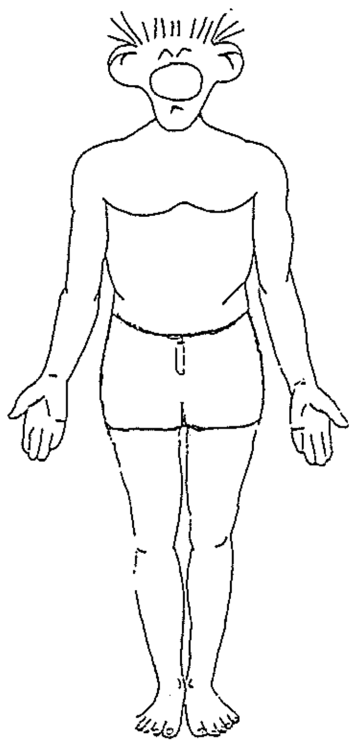
This chapter provides names of main body parts and specific medical vocabulary that will help the PTA communicate with other members of a medical team.

B. MAIN PARTS OF THE BODY

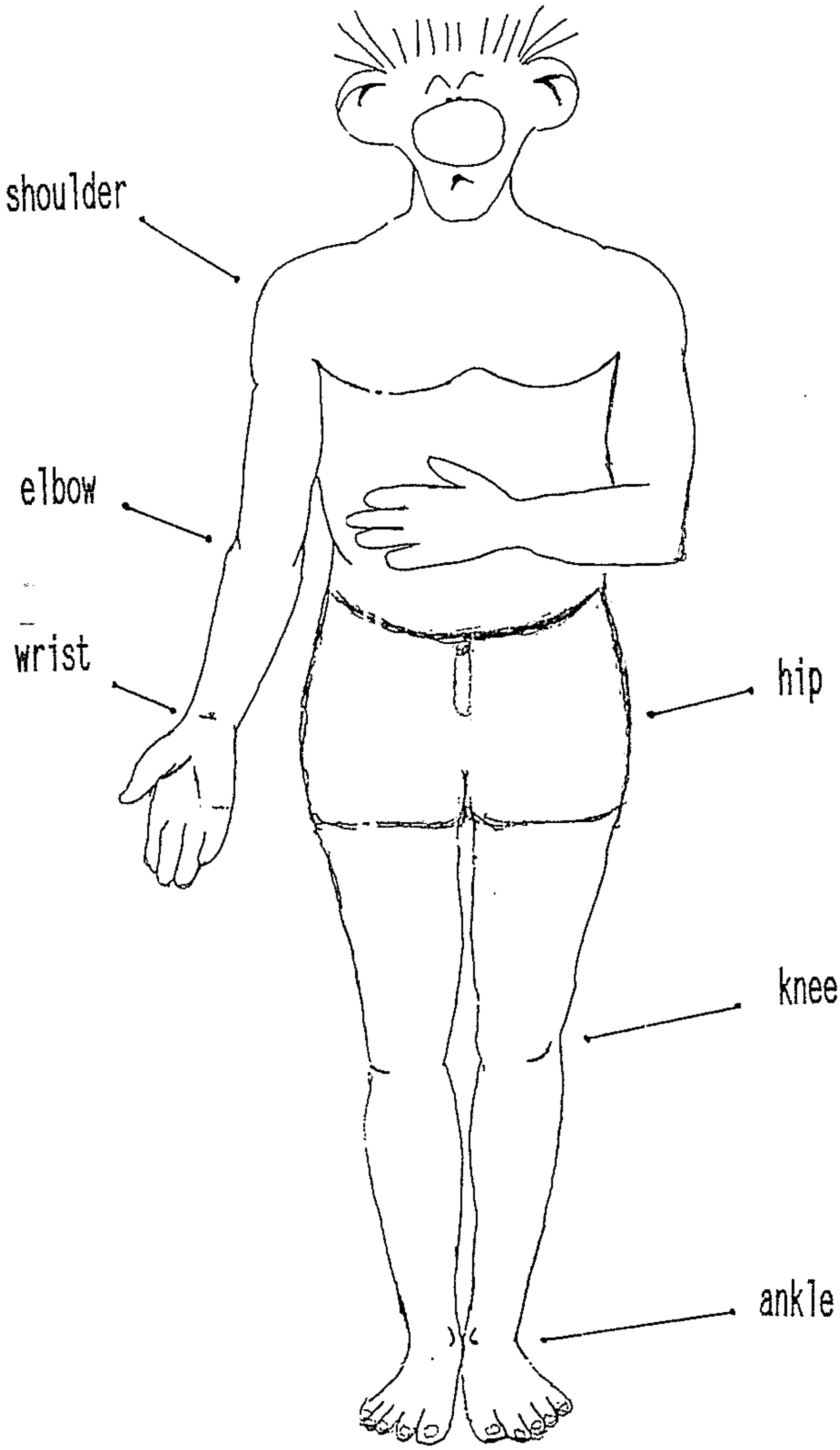
Activity:

Here is a picture of a human body.

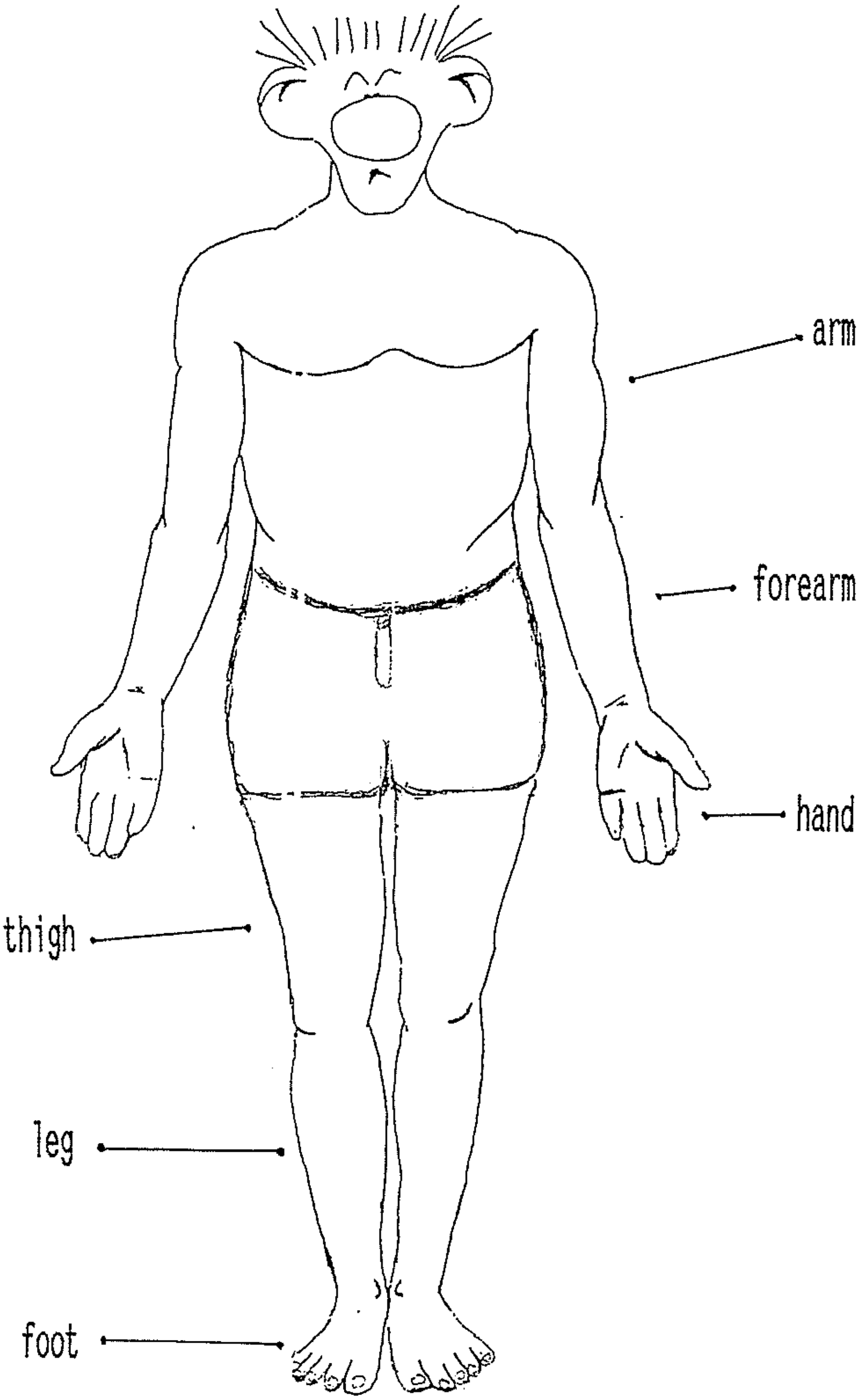
On this picture, please name as many body parts as you can.



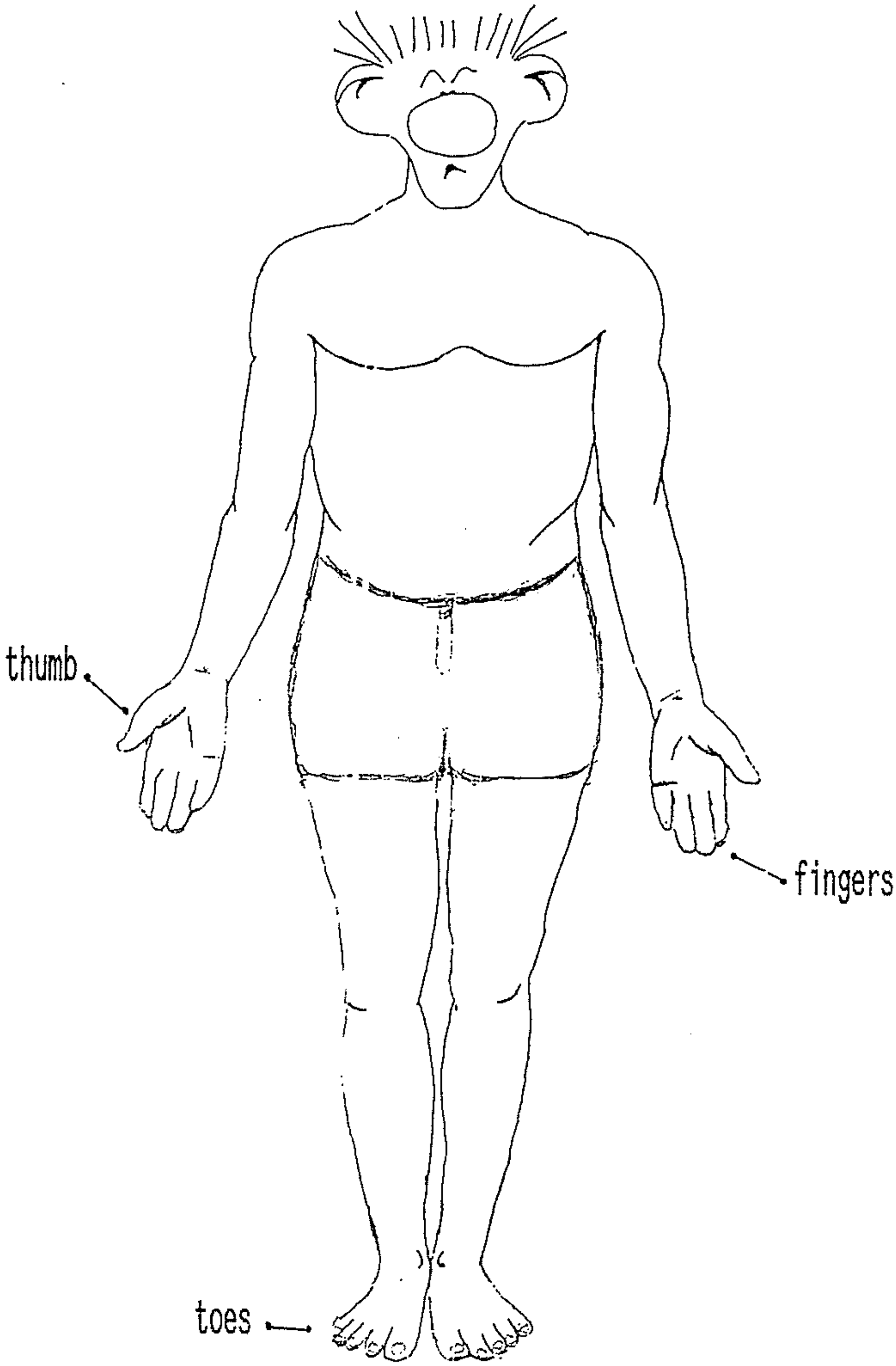
The main parts of the body can be seen on the next four pages.



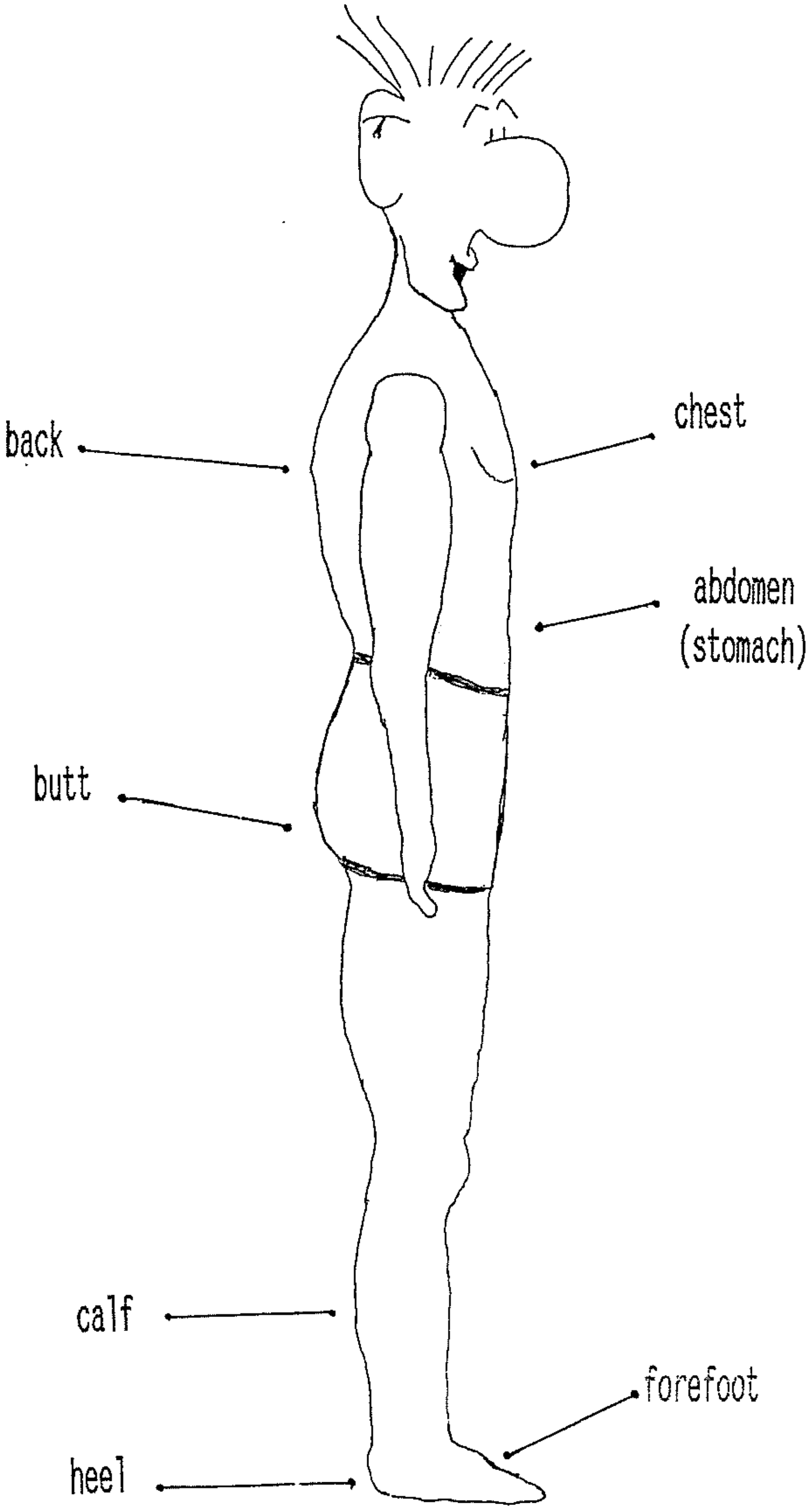
(______________ view)



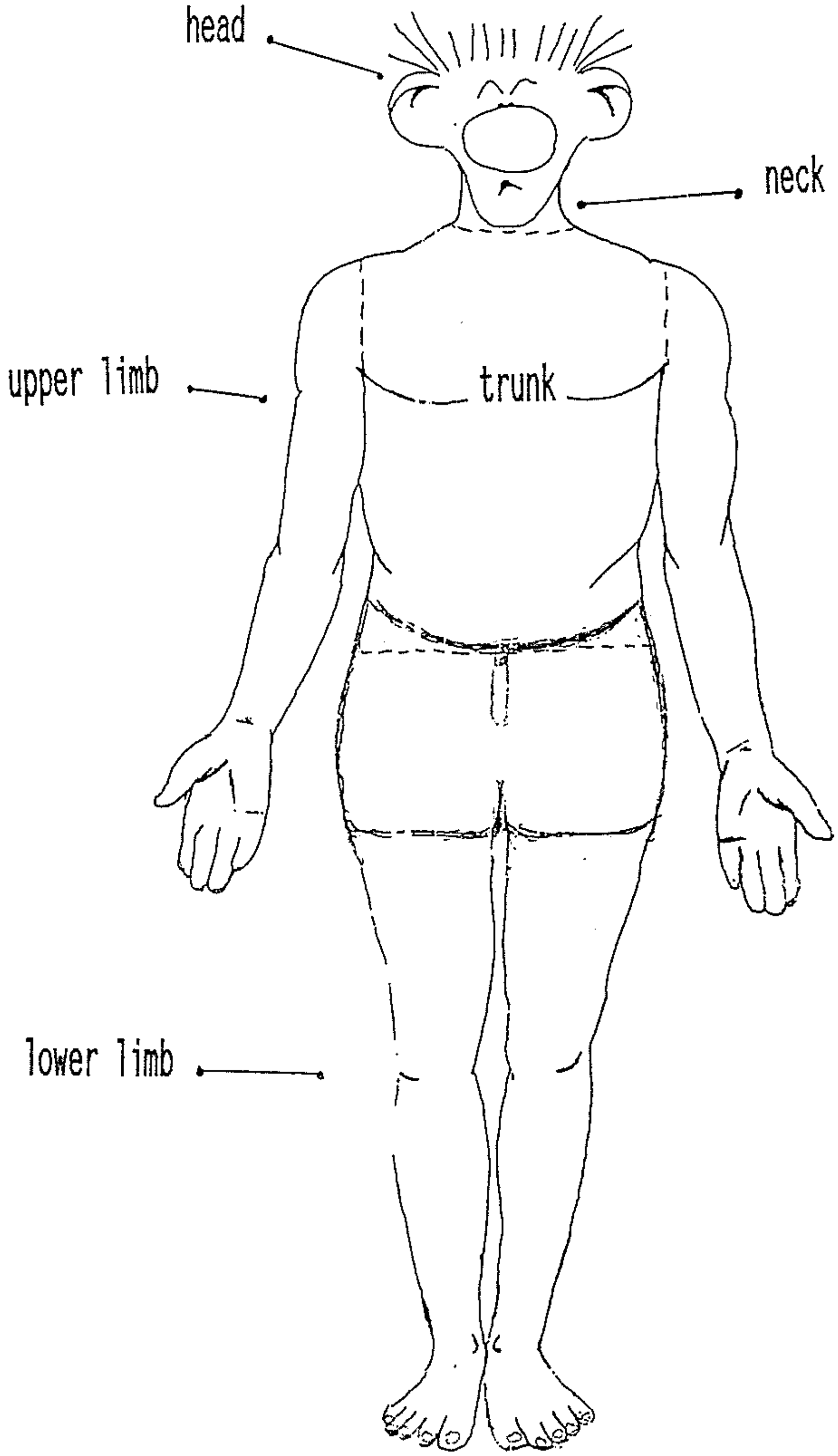
(______________ view)



(______________ view)



(______________ view)



(____________ view)

Questions:

1. A man is sitting in a chair. Please list 2 body parts that contact the surface on the chair.

____

2. What is the name of the body part that is between the knee and the hip?

____

3. What is the name of the body part that connects the arm to the forearm?

____

4. What is the name of the body part that includes the thumb and the fingers?

____

5. How many toes does a normal person have on one foot?

____

6. What is the name of the body part that connects the head to the trunk?

____

7. Please list 8 different parts of the upper limb.

____

____

8. Where is the calf located (in the upper limb or lower limb)?

____

9. What part of the foot touches the ground first when you walk?

____

10. Please list the 3 different parts of the trunk.

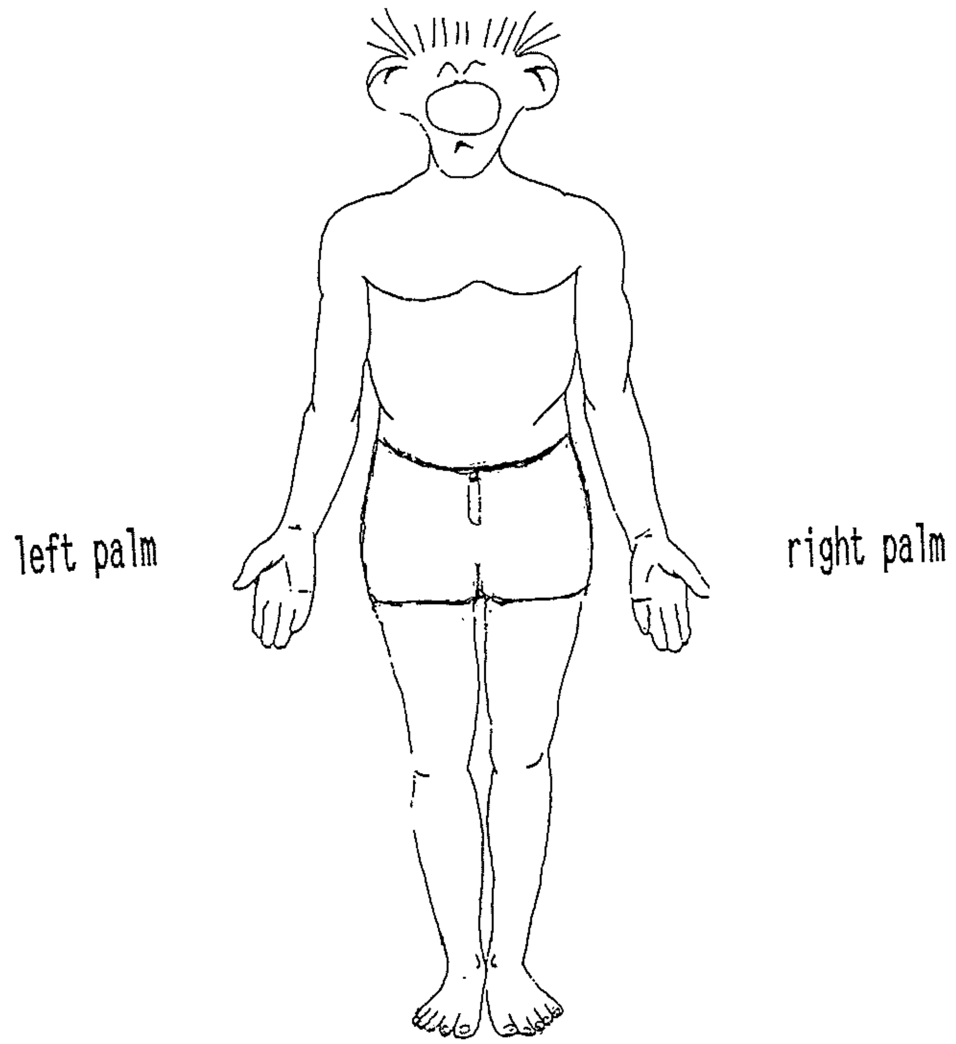
____

C. ANATOMICAL POSITION

Anatomical position is:

* standing position with the back straight
* head and feet facing forward
* PALMS FACING FORWARD
* elbows and knees are straight

Anatomical position is used as the reference position when describing locations and positions of the body. (See following pages.)



ANATOMICAL POSITION

D. MEDICAL VOCABULARY

Information given in this section includes:

1. when to use medical vocabulary
2. medical vocabulary for locations
3. medical vocabulary for body positions and directions of body movements.

1. When to use medical vocabulary

Physical Therapy Assistants (PTAs) will work with medics, nurses and other health workers.

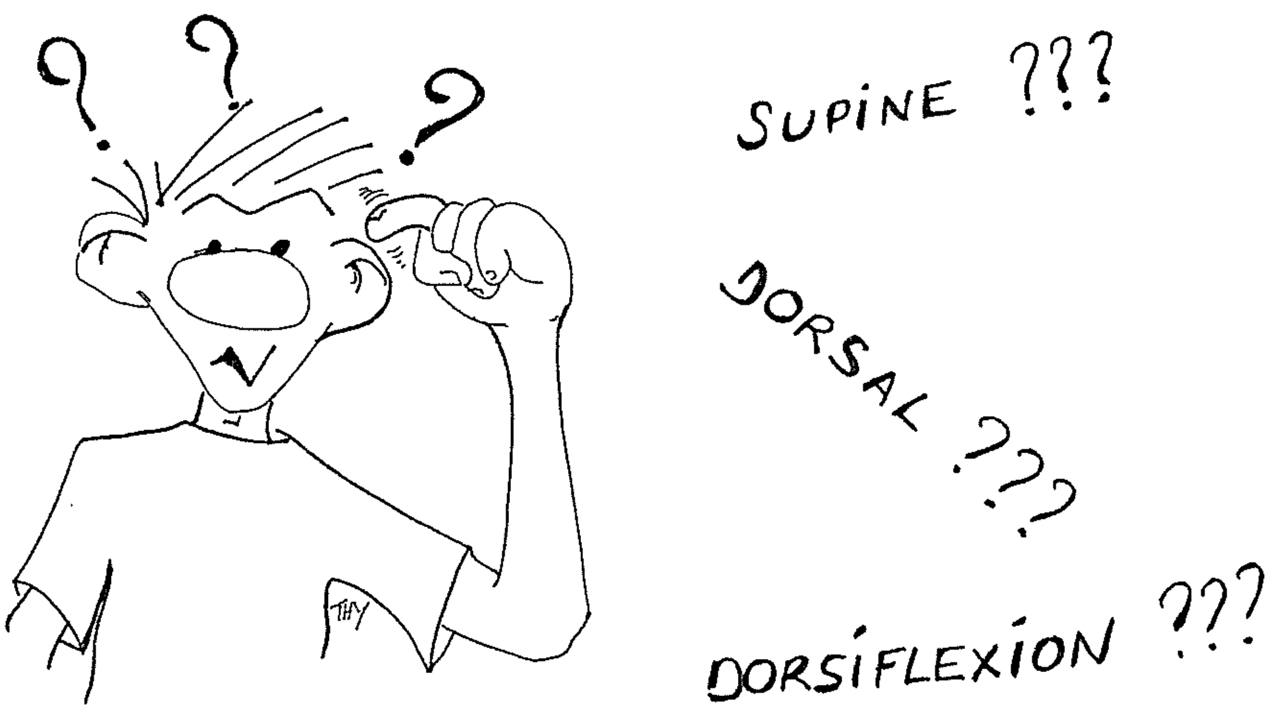
These people will use special medical language to describe locations of problems, positions, movements, and patient diseases.

The PTA must learn this medical language to be able to communicate with the people that they work with.

Patients will NOT know this special language.

The vocabulary used with patients must be very simple and clear.

It is important that patients understand what you tell them.



In summary, medical vocabulary is used with health professionals.

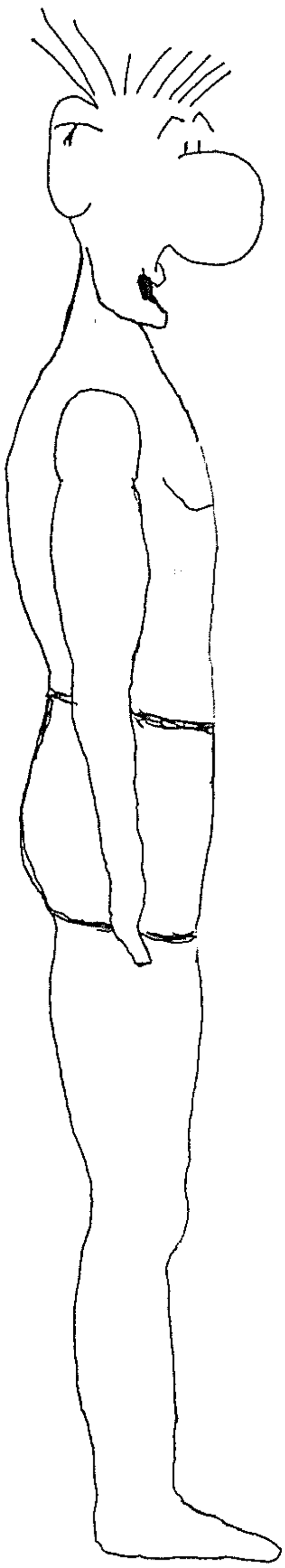
Medical vocabulary is <u>not</u> used with patients and families because they will not understand what you tell them.

2. <u>Medical vocabulary for locations</u>

Medical vocabulary for locations describe <u>where</u> something is.

The PTA must learn the meaning of the medical vocabulary for locations that are given below.

Medical vocabulary	Simple (common) vocabulary
Anterior (Ventral)	in front of
Posterior (Dorsal)	in back of (behind)
Distal	farther from the <u>trunk</u>
Proximal	nearer to the <u>trunk</u>
Superior	above
Inferior	below
Medial (Internal)	to the inside
Lateral (External)	to the outside



(____________ view)

Activity:

Anterior view means you are looking at the front of someone.

Posterior view means you are looking at the back of someone.

Lateral view means you are looking at the side of someone.

Turn to pages 3, 4, 5, 6, 7, and 12, and on each page write the type of view that you see.

Questions:

1. Are your eyes on the ventral or dorsal side of your head?

   ____

2. Are your feet superior or inferior to your knees?

   ____

3. What body parts are proximal to your wrist?

   ____

   ____

4. In anatomical position, is the palm facing anteriorly or posteriorly?

   ____

5. A person is sitting on your posterior side. Describe (in your own words) where this person is.

   ____

6. Is the calf on the anterior or posterior side of the leg?

   ____

<u>Questions</u>: (continued)

7. Compare the location of the arm with the forearm.

____

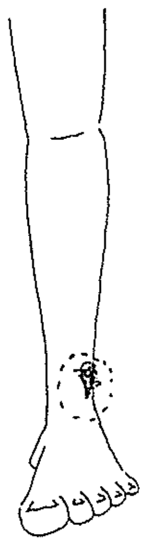
____

8. Compare the location of the thigh with the leg.

____

<u>Activity</u>:

Check (✓) the correct answer to identify where the dark area is on the left leg.



internal (medial) side of leg ______

distal to ankle ______

dorsal side of leg ______

ventral side of leg ______

proximal to knee ______

superior to ankle ______

posterior side of leg ______

proximal to ankle ______

distal to knee ______

superior to knee ______

anterior side of leg ______

lateral (external) side of leg ______

Activity:

Draw a picture (anterior view) of the right upper limb in anatomical position.

Draw a triangle (△) on the proximal part of the forearm.

* Is the triangle (△) superior or inferior to the shoulder?

____

* Is the triangle (△) on the dorsal or ventral side of the arm?

____

* Is the triangle (△) proximal or distal to the wrist?

____

3. Medical vocabulary for body positions and directions of body movement.

Our body parts can rest in many different positions and move in many directions (see ARTHOLOGY chapter, volume 1).

The PTA needs to be able to describe these positions or movements clearly to other health professionals.

The PTA must learn the meaning of the medical vocabulary given for positions and body movements.

Medical vocabulary	Simple (common) vocabulary
Flexion	bending
Extension	straightening
Rotation	turning
Internal Rotation (IR)	turning the limbs to the inside
External Rotation (ER)	turning the limbs to the outside
<u>AB</u>duction	bringing the limbs <u>away from</u> the midline of the body
<u>ADD</u>uction	bringing the limb <u>towards</u> the midline of the body
Pronation	Palm down (hand)
Supination	Palm up (hand)
Prone	lying on stomach
Supine	lying on back
Inversion	internal side of foot up
Eversion	external side of foot up
Opposition	thumb contacts fingers of same hand

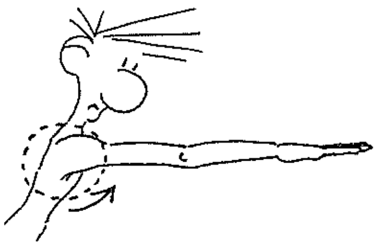
Activity:

Below are pictures used to show some body positions/movements. The student will draw the position/movements that are opposite to these.

FLEXION

EXTENSION

shoulder

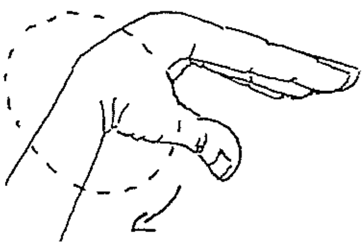


shoulder

elbow

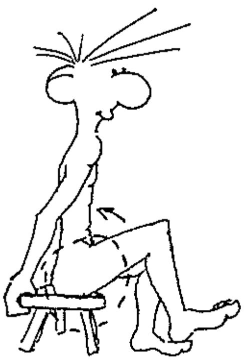
elbow

wrist



wrist

hip

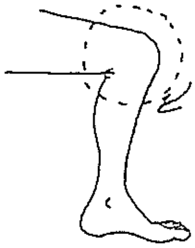


hip

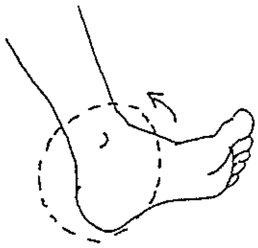
Activity: (continued)

FLEXION

knee



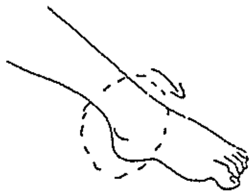
ankle
(dorsiflexion)



EXTENSION

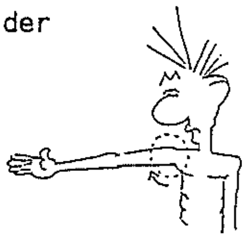
knee

ankle
(plantar flexion)

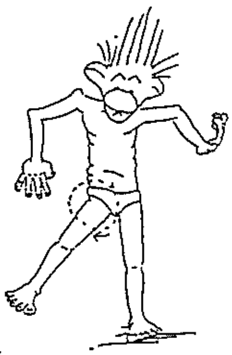


ABDUCTION

shoulder



hip

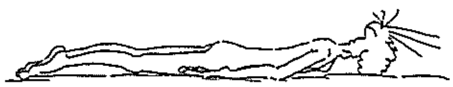


ADDUCTION

shoulder

hip

PRONE



SUPINE

Activity:

Put your right wrist on your left shoulder.

Describe the position of your:

RIGHT SHOULDER ______________________

____

____

RIGHT ELBOW ______________________

____

RIGHT FOREARM ______________________

____

Activity:

In sitting, put the external side of your left ankle on top of your right knee.

Describe the position of your:

LEFT HIP ______________________

____

____

LEFT KNEE ______________________

____

Activity:

1. Draw a picture of a man in standing position with his right shoulder abducted and externally rotated.

2. Draw a picture of a person in supine position that has both hips and knees flexed.

3. Draw a picture of a person that has both upper limbs abducted and both lower limbs abducted.

Both elbows and knees are extended.

Questions:

1. A man would like to drink water from the palm of his hand. What hand position is best for this (pronation or supination)?

____

2. A boy walks on the external side of his foot. What is the position of the foot when he walks (inversion or eversion)?

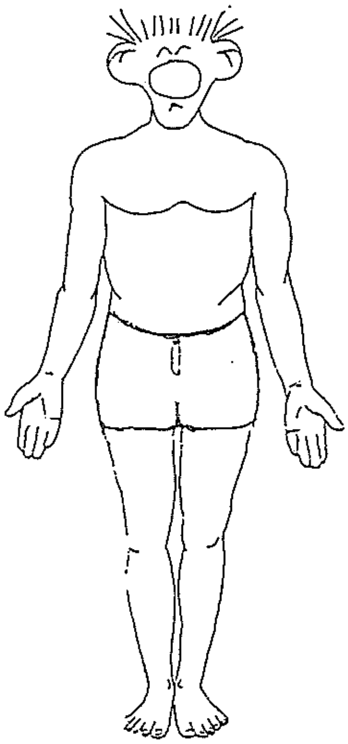
____

3. What is the opposite movement of plantar flexion?

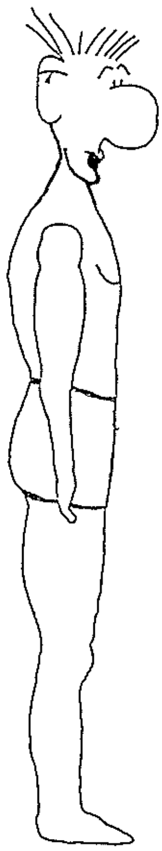
____

<u>Activity</u>:

As a review of this chapter, for the pictures given below, please name all the body parts that you know.



(Anterior View)



(lateral view)

E. CHAPTER SUMMARY

Pictures and names of the following body parts are given:

SHOULDER	ELBOW	WRIST	FINGERS
THUMB	CHEST	BUTT	HEAD
PALM	HIP	KNEE	ANKLE
TOES	FOOT	ABDOMEN	CALF
NECK	ARM	FOREARM	HAND
THIGH	LEG	BACK	HEEL
TRUNK	UPPER LIMB	LOWER LIMB	FOREFOOT

ANATOMICAL POSITION is:
* standing position with the back straight
* head and feet facing forward
* palms facing forward
* elbows and knees straight

Medical vocabulary is used so that all health professionals can understand each other. Medical vocabulary is <u>not</u> used with patients.

Language for patients must be simple and clear.

Medical vocabulary for locations includes:

Anterior (Ventral)	Superior	Proximal
Posterior (Dorsal)	Inferior	Distal
Medial (Internal)	Lateral (External)	

Medical vocabulary for body positions and directions of movement includes:

Flexion	ABduction	Pronation	Prone
Extension	ADDuction	Supination	Supine
Inversion	Eversion	Opposition	Rotation
Internal Rotation (IR)		External Rotation (ER)	

3.

GENERAL BODY SYSTEMS

GENERAL BODY SYSTEMS are the parts of our body that work together to keep us alive.

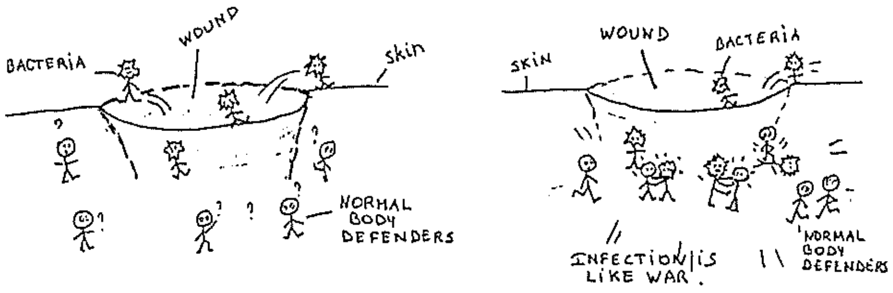
OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify three important functions of the skin.
2. describe what happens to the food we eat (to include used and unused parts).
3. describe how air is pulled into the body.
4. describe how blood moves through the body and how waste is removed from the blood.
5. identify three systems directly responsible for movement of the body.

CHAPTER CONTENTS

An infection is like a war between the normal parts of our body and the unwelcome harmful things.



The skin also protects the body by acting as a cushion for different parts (thick skin on the heel).

It can also prevent too much water from leaving our body (it will release water only when it needs to ... see next section).

2. Temperature regulation

Normally the temperature on the inside of our body should always be around 37 C.

The body can become hot from exercise, hot weather or disease. When this happens, normally we <u>sweat</u>.

SWEAT is the body releasing water through the skin. As the sweat dries, it makes the skin more cool.

<u>Activity</u>:

Wet the back of your right hand. Then move both hands through the air. Which hand feels more cool?

____

When there is an infection or disease in the body, the temperature may increase to more than 37 C. An increase in the body temperature is called a FEVER.

A fever is the result of the body trying to fight infection or disease. The body becomes hot in trying to kill the bacteria or trouble makers.

If a person's fever is too high (over 40 C) for too long, he may die.

Questions:

1. A person has a fever. What will keep him more cool - a wet towel or a dry towel?

   ____

2. Water that has been boiled is more safe to drink than water that has not been boiled. Why?

   ____

   ____

3. Sensation

The skin provides us with information from our environment. It can tell us if something is hot, cold, sharp, soft or smooth.

It helps us to know better what we are touching and helps us to know if something is touching us.

Question:

What are three problems that could occur if you have severe damage to the skin?

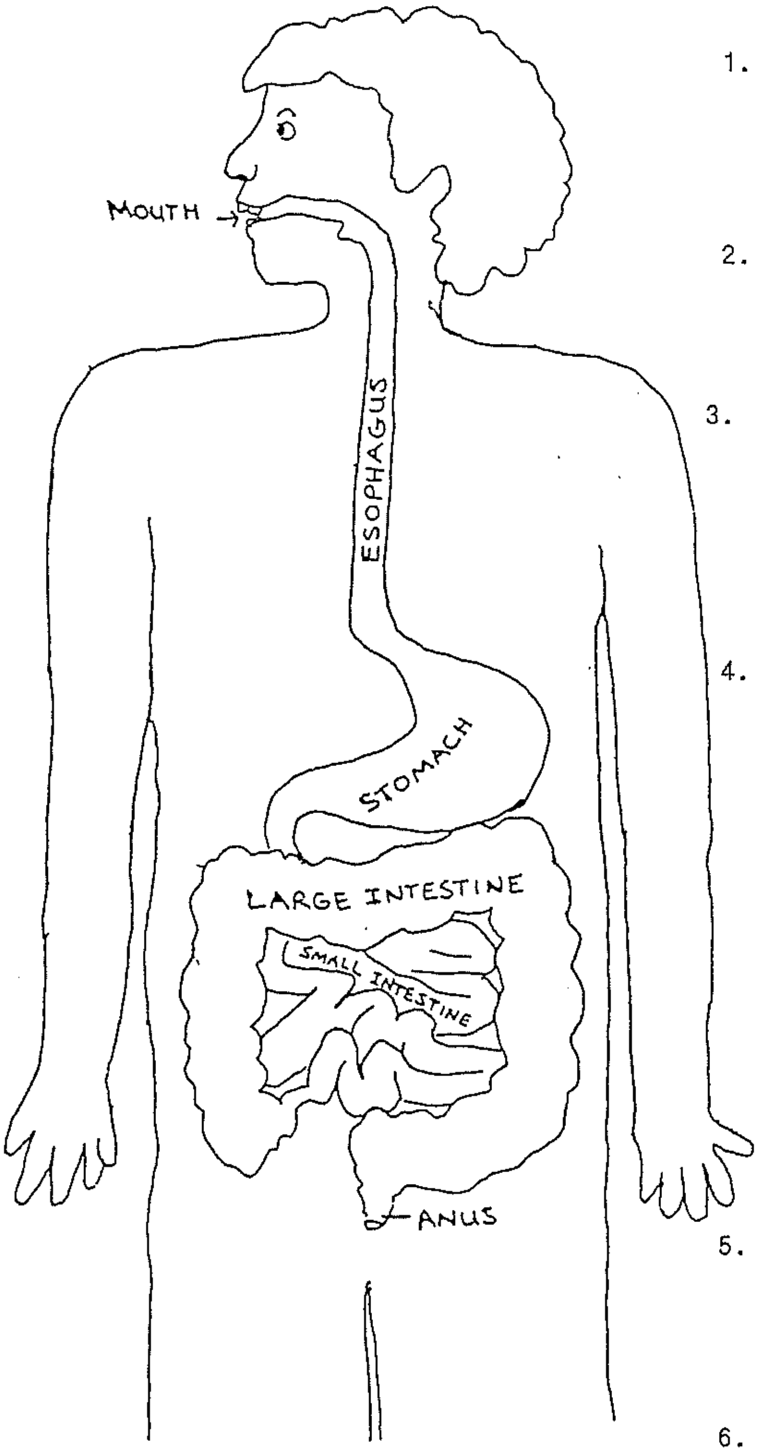
____

____

C. THE DIGESTIVE SYSTEM

The digestive system is actually one long tube that begins at the mouth and ends at the anus.

The function of each main part will be given in the same order as it travels through the digestive system.



1. MOUTH - the place where we chew foot to make it more soft and break it into smaller parts.

2. ESOPHAGUS - carries food from the mouth to the stomach.

3. STOMACH - like a box that holds the food. The food is mixed with stomach liquids (acid) that turn almost all food into thick liquid.

4. SMALL INTESTINE - the "decision maker". This part of the digestive system decides what part of food the body can use, and what parts are not useful (waste).

   The small intestine will give important parts of food to the blood that passes by. The less useful parts of food will continue through the tube to the large intestine.

5. LARGE INTESTINE - in this area some water is removed so that the unused food becomes more solid.

6. ANUS - place where waste (stool, shit) leaves the body.

<u>Questions</u>:

1. Where does food enter the digestive system?

   ____

2. Where does food exit the digestive system?

   ____

3. Why is the small intestine called the "decision maker"?

   ____

   ____

4. If there is too much water in your stool (diarrhea), do you expect a problem in the small intestine or the large intestine?

   ____

D. THE RESPIRATORY SYSTEM

The <u>respiratory system</u> brings good air (oxygen) into the body and carries used air (carbon dioxide) out of our body.

In this chapter, the PTA will receive an introduction to the respiratory system. The respiratory system will be discussed in more detail in the RESPIRATORY CHAPTER in Volume 2.

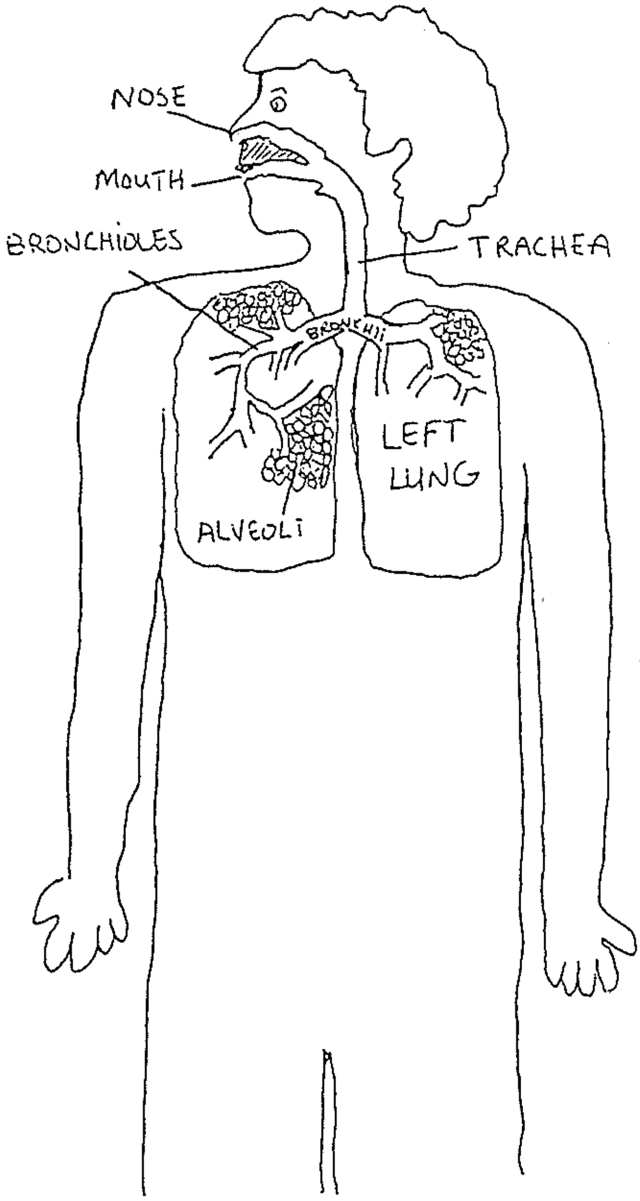
This section includes:

1. Anatomy of the respiratory system
2. How food is prevented from entering the respiratory system
3. Air exchange in the respiratory system
4. How we breathe.

1. Anatomy of the respiratory system

The respiratory system is many tubes that carry air to and from small air sacs.

The main parts of the respiratory system are given below. The parts are given in the order that air passes as it goes into the body.



1. NOSE and MOUTH - the places where air enters and leaves the body.

2. TRACHEA - big air tube that travels through the neck.

   (You can feel this tube on the front of the neck.)

3. BRONCHII - two smaller air tubes that connect the trachea to the lungs.

4. LUNGS - each person has two lungs. One on the left side and one on the right side.

   The lungs are made of:

   BRONCHIOLES - small air tubes inside the lungs that connect the bronchii and alveoli.

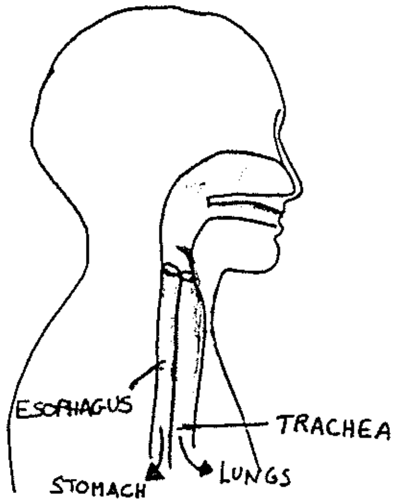
   ALVEOLI - small air sacs where good air is exchanged for used air.

2. How food is prevented from entering the respiratory system

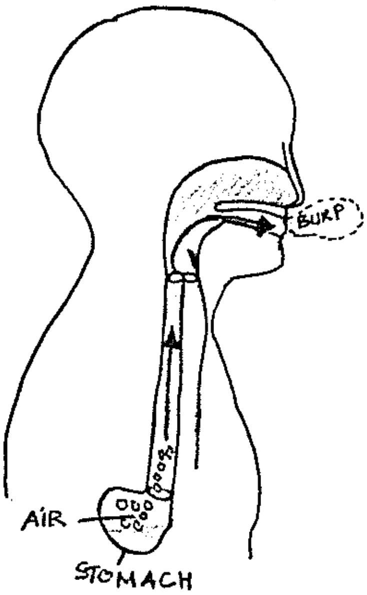
If you remember, the mouth is the place where food, water, and air enter the body.

After the mouth, there are two different tubes that pass through the neck.

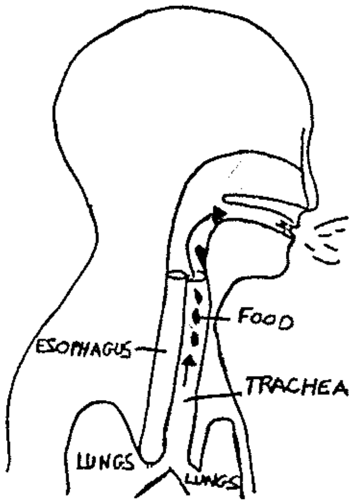
One tube (esophagus) carries food and water to the stomach, and the the other tube (trachea) carries air to and from the lungs.



If air enters the food tube, we can burp and it will come back up.



If food or water enters the air tube, we cough to try to remove it.



<u>Question:</u>

A man swallowed a piece of meat and it went down his trachea. What problems will this man have if the meat is not removed?

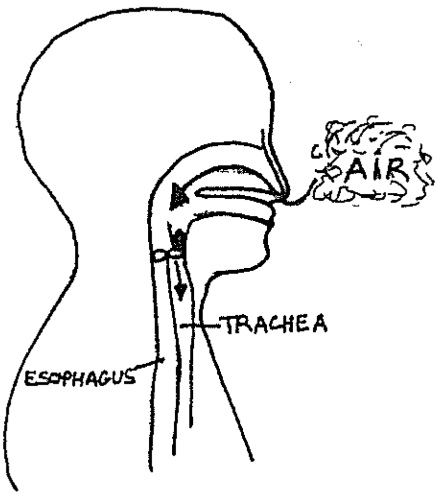
____

____

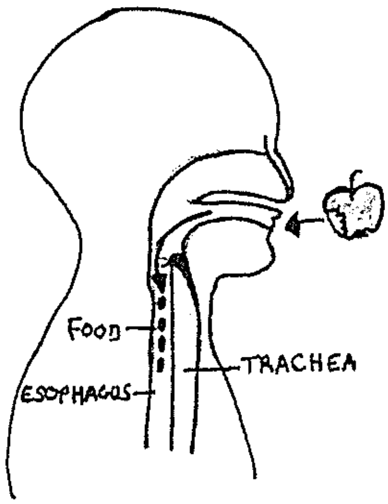
Our body has a special protective door that prevents food or water from entering the air tube (trachea).

When we breathe, normally both tubes (esophagus and trachea) are open. (A)

When we eat or drink (swallow), there is a special piece of skin that covers the trachea to prevent food or water from entering the air tube. (B)



(A)



(B)

<u>Activity</u>:

Take a deep breath in (fill your lungs with air). As you slowly let the air out (exhale), swallow.

What happens to your breathing as you swallow?

____

____

Why? ____________________________________

____

3. Air exchange in the respiratory system

Air exchange is the reason why we breathe.

We want to bring good air (oxygen) into the body, and remove used air (carbon dioxide) from the body.

It is important for the PTA to know:

a. where air exchange happens

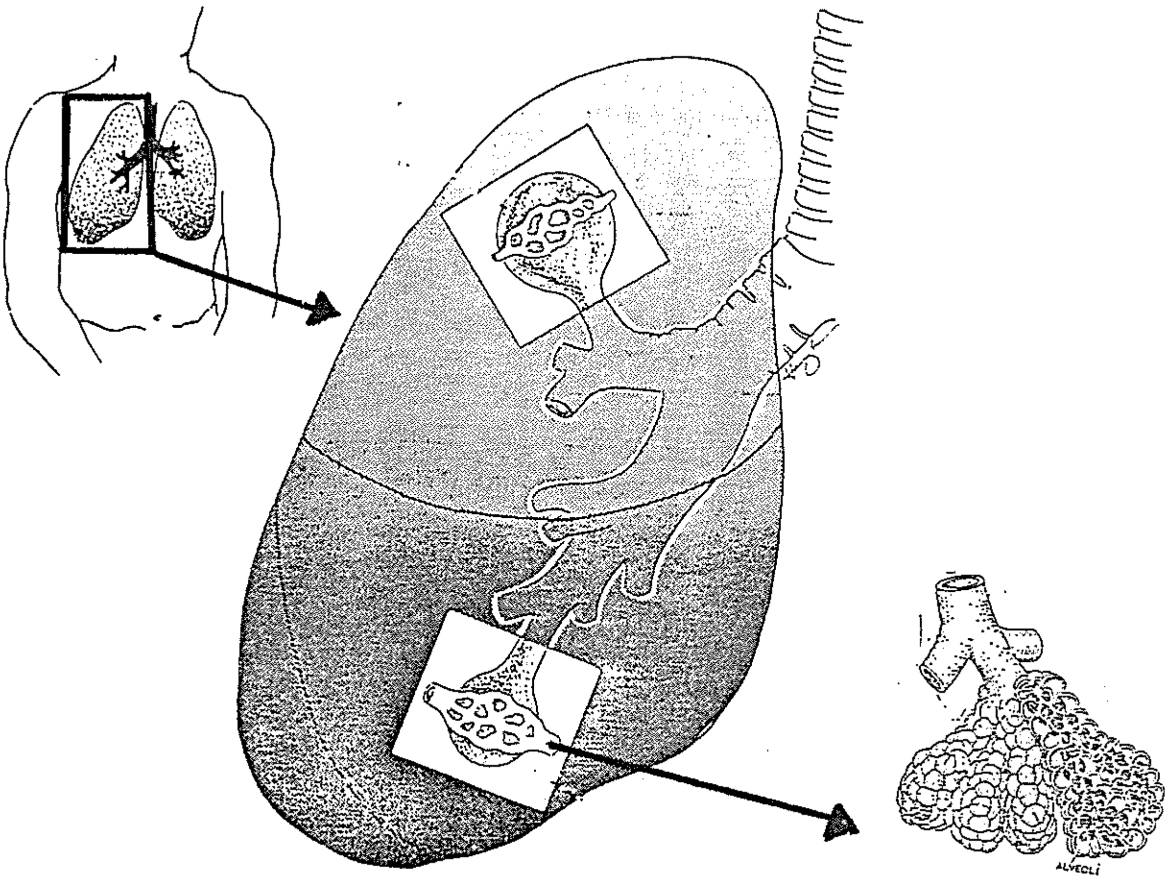
b. how air exchange happens

c. why air exchange happens

<u>a. where air exchange happens</u>

Air exchange happens in the alveoli.

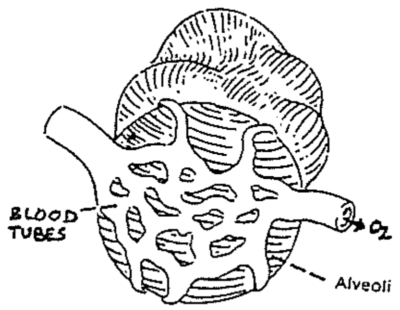
The alveoli are the smallest parts of the lungs. Alveoli look like small balloons.

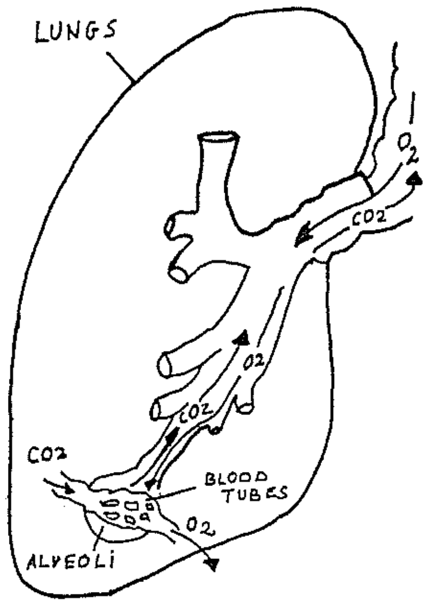


b. how air exchange happens

The walls of the alveoli are so thin that air can pass through them.

Very small blood tubes pass each alveoli and can collect oxygen (O2) and release carbon dioxide (CO2).





c. why air exchange happens

The body needs oxygen to live.

Oxygen is a type of food for the body. If there is no oxygen, we will die.

After the body uses oxygen, it releases carbon dioxide (CO2).
CO2 is waste. CO2 must be removed from the body.

If there is too much CO2, there is no space for oxygen.

If there is too much waste (CO2) and not enough food (O2) we can have severe problems or die.

3. How we breathe

Air is pulled into our lungs and pushed out of our lungs. This coming and going of air is called BREATHING or RESPIRATION.

<u>Activity</u>:

Sit with your mouth open. Do not move any part of your body. Are your breathing?

Yes _______ No _______

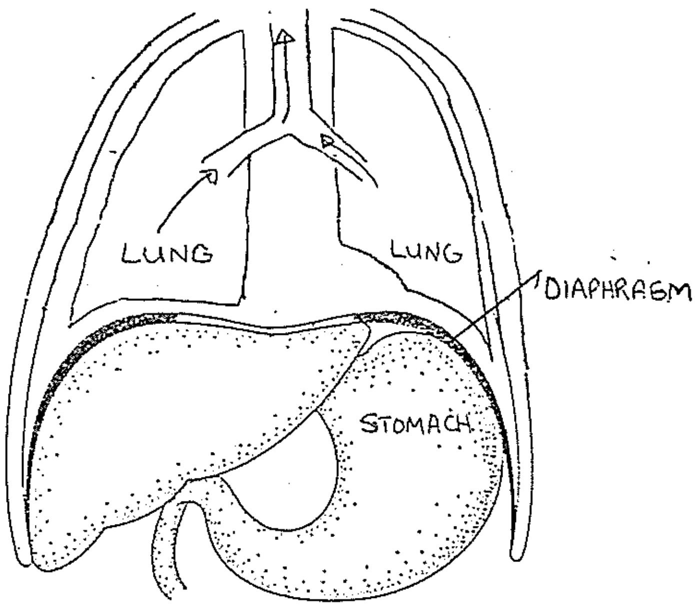
From the above activity the PTA should understand that:

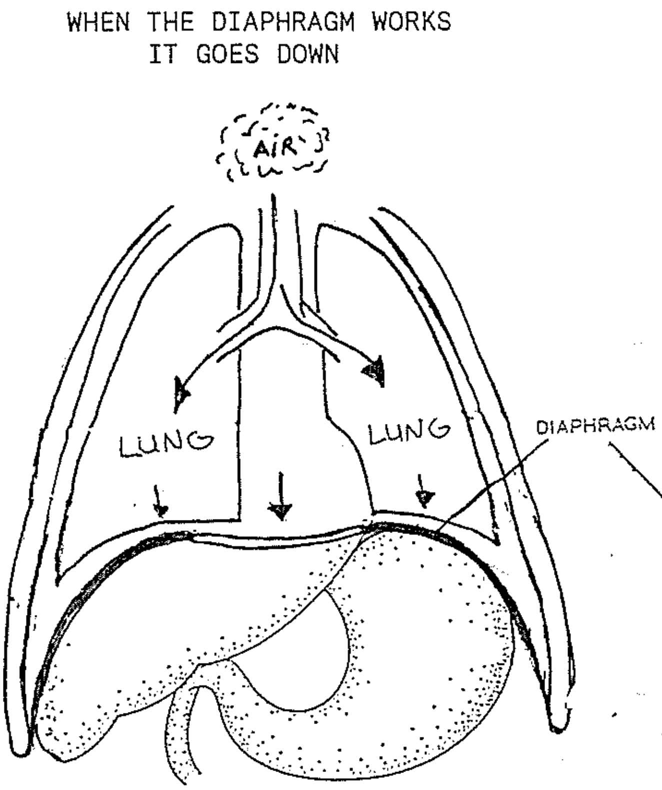
<u>TO TAKE AIR INTO OUR LUNGS, THE BODY MUST DO SOME WORK</u> !!

The part that works the most to bring air into the lungs is called the DIAPHRAGM.

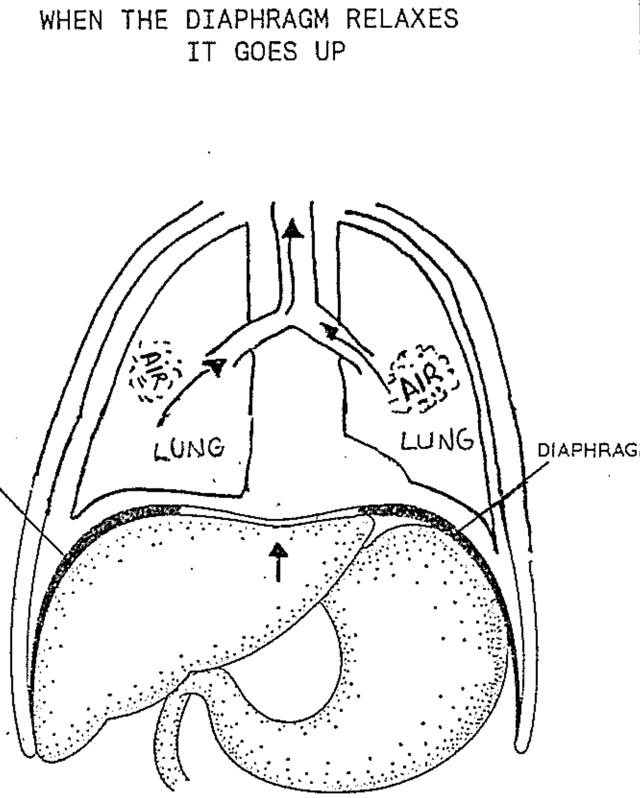
The diaphragm is a muscle located below the lungs and above the stomach.

It is like a long wide piece of elastic; it is like a movable floor that the lungs are attached to.





Diaphragm works, pulls lungs down, and this pulls air IN.

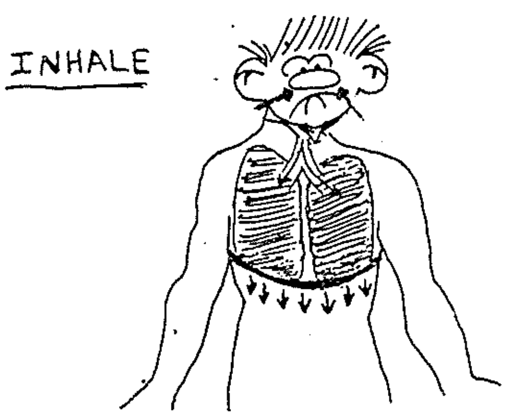


Diaphragm relaxes, pushes lungs up, and this pushes air OUT.

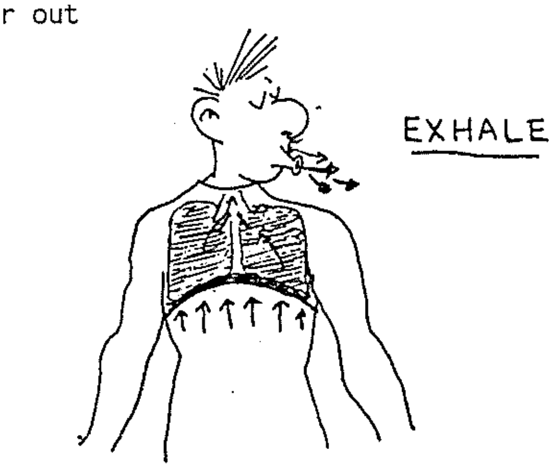
There are other parts of the body that can help with breathing. They will be discussed in RESPIRATORY CHAPTER in Volume 2.

For now, the PTA should understand that:

* when the diaphragm works it pulls air in
* when the diaphragm relaxes, it pushes air out



DIAPHRAGM WORKS, PULLS LUNGS DOWN, AND THIS PULLS AIR IN.



DIAPHRAGM RELAXES, PUSHES LUNGS UP, AND THIS PUSHES AIR OUT.

<u>Activity</u>:

You have just finished eating a very big meal and your stomach is full of food and water.

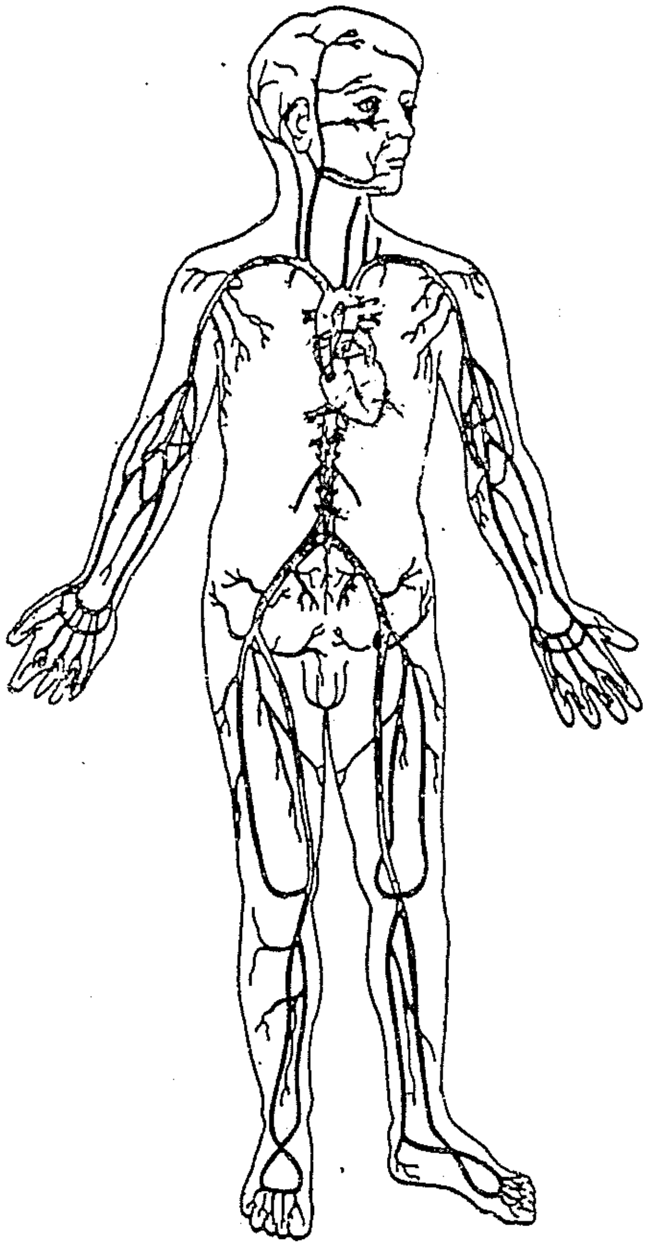
Because your stomach is so full, you have difficulty breathing air into your lungs,

Draw a picture to show why a full stomach may limit the amount of air your can take into your lungs.

E. THE CIRCULATORY SYSTEM

The circulatory system gives food to all living parts of the body.

It also removes waste from these working body parts.



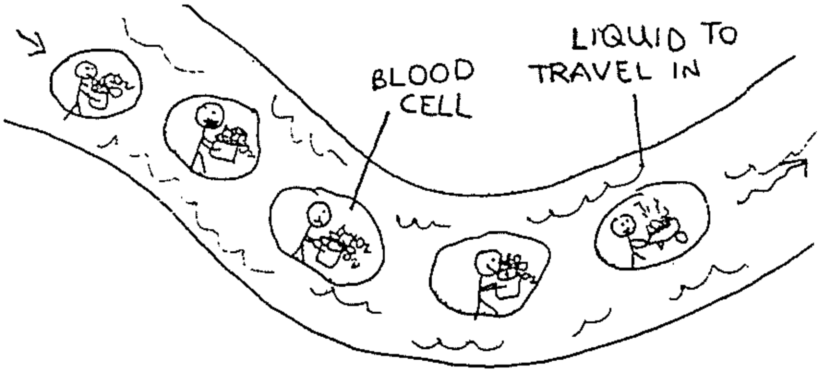
The circulatory system is made up of the following parts:

1. BLOOD
2. HEART
3. BLOOD TUBES

1. BLOOD

BLOOD IS VERY IMPORTANT !

The function of the blood is to transport food and waste to and from all living parts of the body.



Blood is made up of two things:

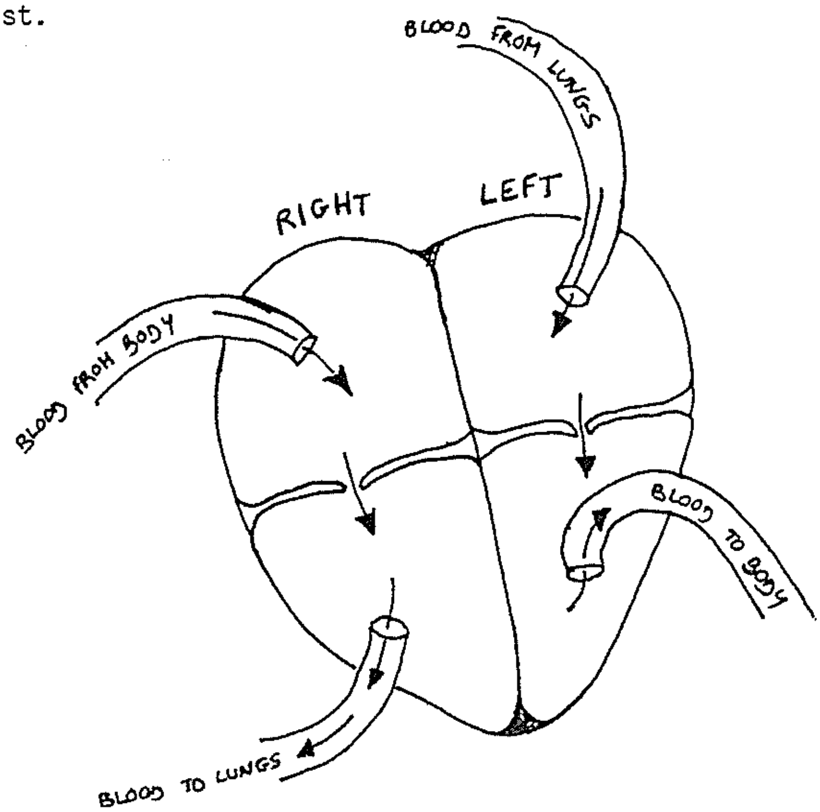
* very small blood cells which carry the food, oxygen and waste

* clear liquid that acts as a river for the blood cells to travel in

2. HEART

> Activity:
>
> Bend all your fingers and keep them close together; this is about the same size as your heart.

The heart is a muscle. The strong muscle is found near the middle of your chest.



The heart has a left side and a right side.

Each side has space to hold blood.

When the heart muscle is relaxed, these spaces fill with blood.

When the heart muscle contracts, blood is pushed out of these spaces.

The heart has two functions:

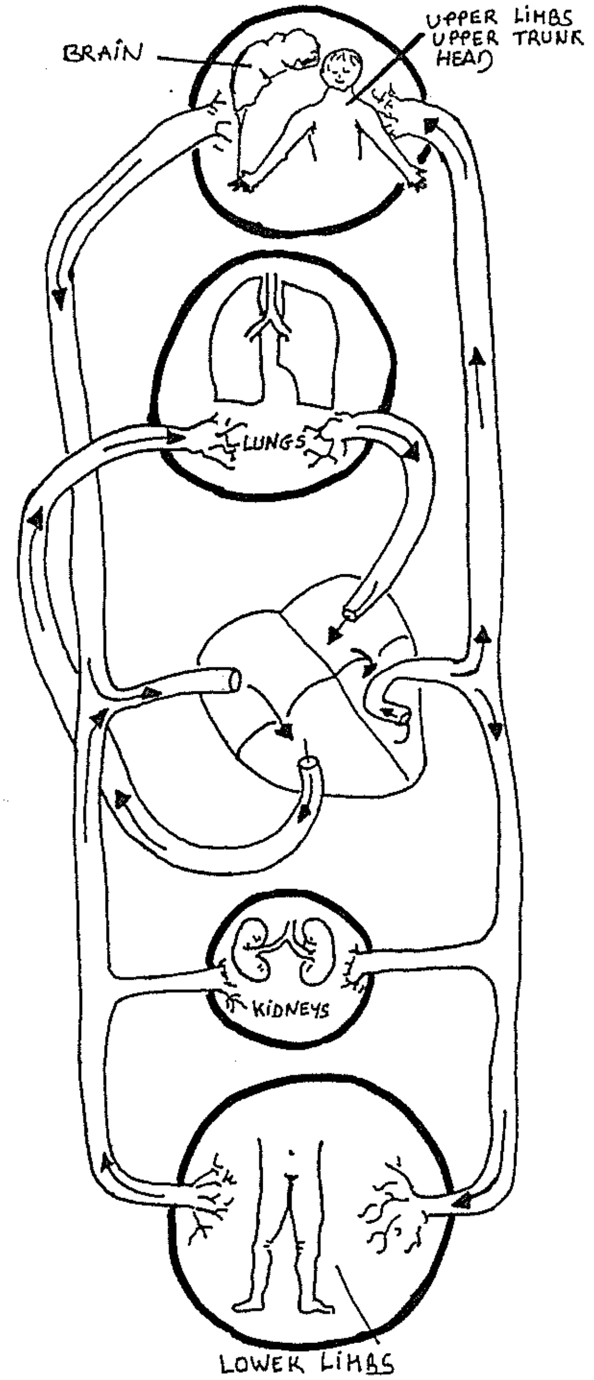
a. receive blood

b. send blood

Each side receives and sends blood.

* THE RIGHT SIDE OF THE HEART RECEIVES USED BLOOD FROM THE BODY AND SENDS IT TO THE LUNGS.

* THE LEFT SIDE OF THE HEART RECEIVES FRESHENED BLOOD (lots of oxygen) FROM THE LUNGS AND SENDS IT TO THE BODY.



REMEMBER!

To <u>receive</u> blood, the heart must <u>relax</u>;
to <u>send</u> blood, the heart must <u>contract</u>.

Activity:

Bend your fingers together so that your hand forms a type of cup. Pour water into this "cup". Now squeeze your fingers and bend them as much as you can.

What happens? ______________________________

____

This filling action and squeezing action is similar to how the heart receives and sends blood.

A heart contraction is called a heart BEAT. Every time your heart contracts (beats), you can be sure it is pushing blood.

In summary:

* A blood cell hungry for oxygen and full of waste (carbon dioxide) arrives at the heart.

* It is received by the right side of the heart and sent to the lungs.

* In the lungs it releases waste (carbon dioxide) and picks up oxygen.

* The blood cell leaves the lungs and goes back to the heart.

* It is received by the left side of the heart and then sent back to the body.

3. BLOOD TUBES

Blood tubes carry oxygen, food and waste to and from all parts of the body.

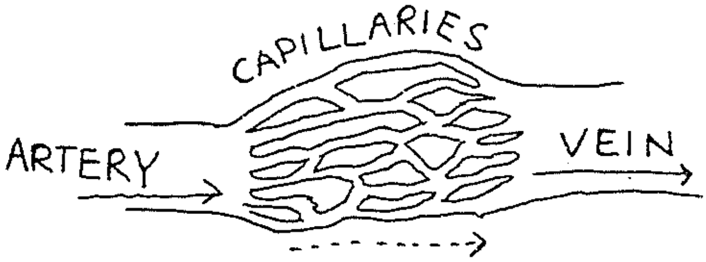
There are three types of tubes that all blood travels in when it is pushed around the body.

These tubes are:

a. ARTERIES

b. CAPILLARIES

c. VEINS

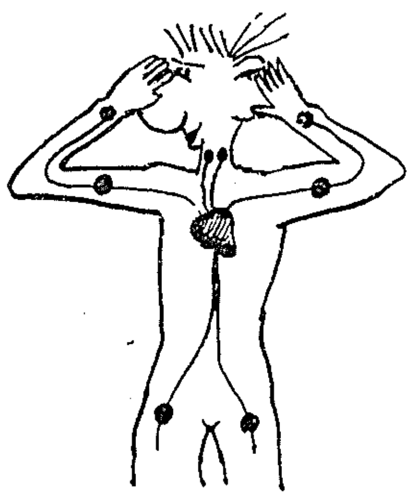


ARTERIES

When the blood leaves the heart, it is pushed directly into tubes called <u>arteries</u>.

Arteries are thick and elastic and they help the heart to push the blood to the places that it needs to go.

In some places of the body, the arteries are near the surface of the skin; in these places you can feel every time the heart contracts and pushes more blood through them.



The number of beats that you count is called your PULSE.

Activity:

Your heart rate (pulse) is the number of heart beats in one minute. Count your heart rate.

What is it? ______________________

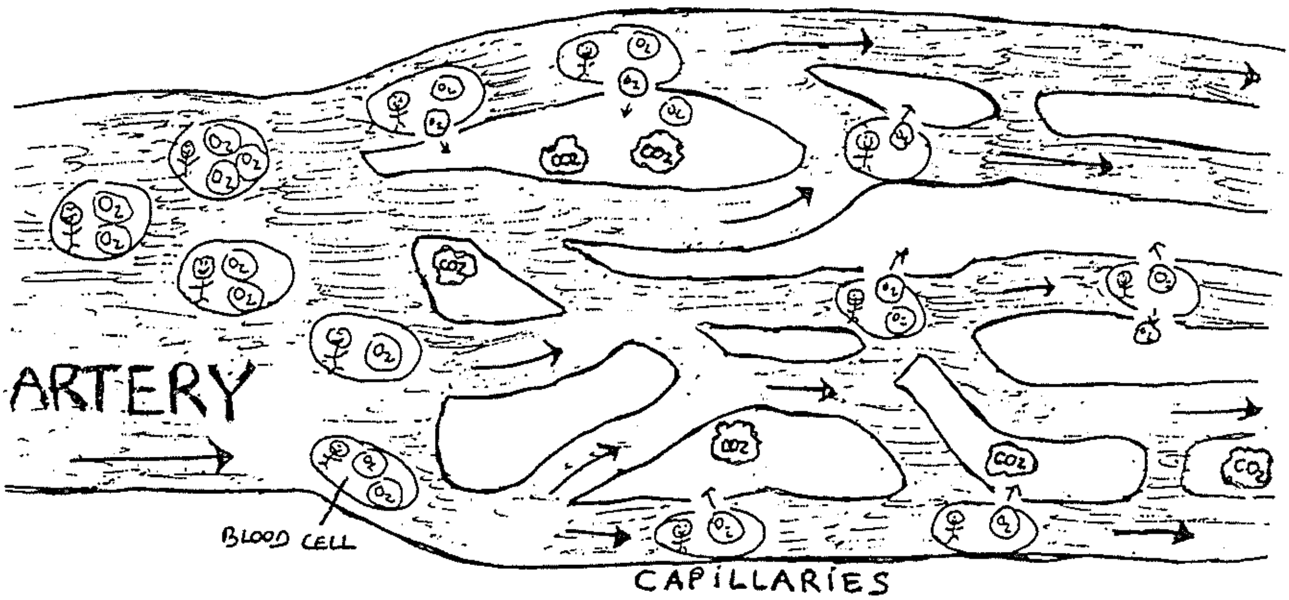
CAPILLARIES

We have said that arteries carry blood from the heart to the different body parts that need food.

When arteries arrive at the body part, they divide into millions of very tiny tubes called capillaries.

The capillaries are so small that only one blood cell can fit through at a time.

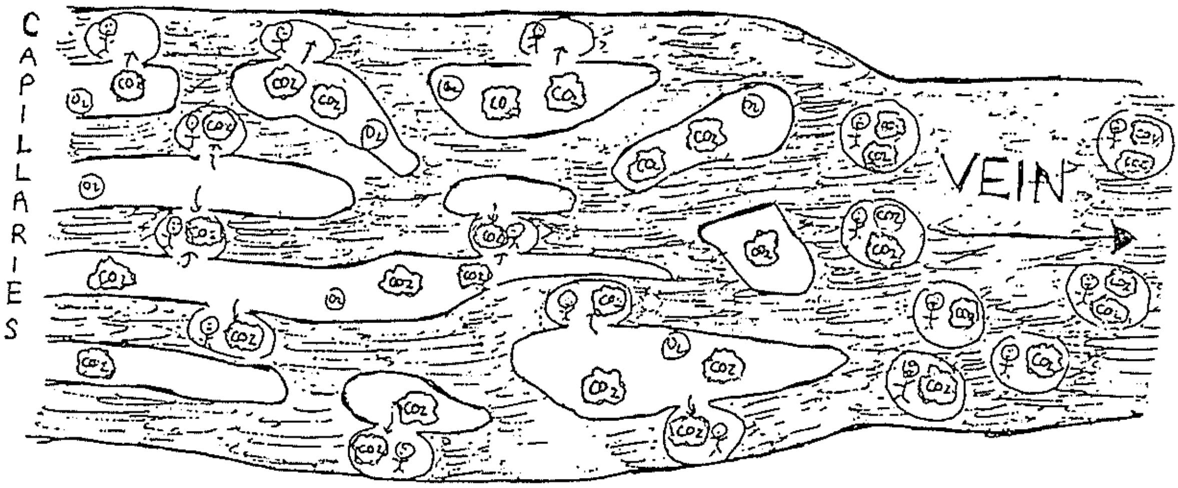
It is through the capillaries that the blood can give the food and oxygen (O2) to the tissues and pick up waste, carbon dioxide (CO2) from the tissues.



> Activity:
>
> You can sometimes see capillaries in the white part of the eye. They will look like very small red lines.
> Get into groups of two and look for capillaries in the eyes of your partner.

VEINS

After going through the capillaries (to give food and oxygen and pick up waste), the blood again enters bigger tubes called veins.



Veins return blood to the heart.

Veins are not thick and strong like arteries.

Blood that travels in veins moves more slowly than the blood in the arteries.

Because veins cannot push the blood well by themselves, active body movement helps them return the blood to the heart.

Most often, veins carry "used blood" and so look more blue in color.

You can see veins easily on the back of the hand, front of the wrist, and under the tongue.

In summary:

* The heart contracts and pushes blood into strong arteries.
* Arteries continue to push blood to specific body parts.
* At these parts the arteries divide into small tubes called capillaries.
* Blood cells travel one by one through capillaries. Here they give food and oxygen and pick up waste.
* Capillaries enter into bigger tubes called veins.
* Veins return blood to the heart.

F. THE URINARY SYSTEM

The urinary system helps to remove waste (used food) from the blood.

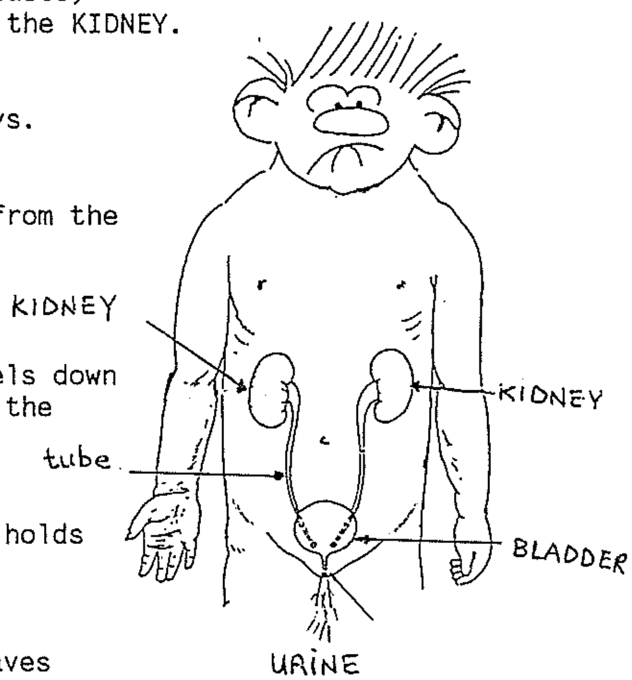
We have said that the blood receives <u>new air</u> (oxygen) in the lungs. Blood also releases <u>used air</u> (carbon dioxide) in the lungs.

We said that blood picks up <u>new food</u> from the <u>small intestine</u>.

The blood releases food (waste) in a special place called the KIDNEY.

Each person has two kidneys.

The kidneys remove waste from the blood.



The water-like waste travels down two tubes that empty into the BLADDER.

The bladder is a bag that holds this waste (URINE).

When we pee, the urine leaves the bladder and passes through another tube that carries urine to the outside of the body.

Questions:

1. The body needs oxygen and food to live. What 2 systems help bring this oxygen and food into the body?

____

____

2. The blood carries the oxygen and food to all body parts. What system helps to move the blood through the body?

____

3. The blood also carries waste (CCO2 and used food) away from all body parts. What two systems help to remove used air and used food from the blood?

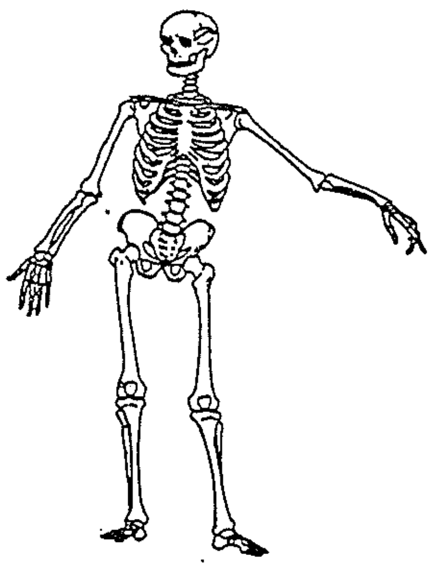
____

____

4. What system removes unused food from the body?

____

G. THE SKELETAL SYSTEM



The skeletal system is made of the BONES is the body.

Bones are strong and hard.

They protect the body, support the body, and help the body in movement.

Bones will be discussed in detail in the chapter on Osteology.

H. THE MUSCULAR SYSTEM

The muscular system includes all the muscles in the body.

Muscles make movement.

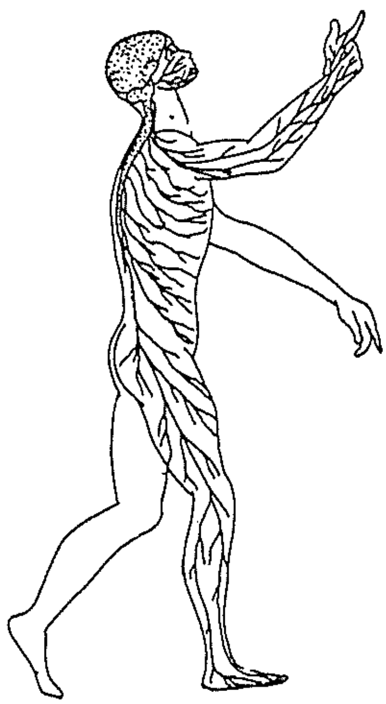
Muscles make our bones move.

Muscles move blood through our body..

Muscles move food through our body.

Muscles will be discussed in the chapter on Myology.

I. THE NERVOUS SYSTEM



The nervous system includes the brain, spinal cord and nerves.

The nervous system can make messages, send messages, and receives messages for all parts of the body.

Many of these messages direct the movements that our muscles make.

The nerves and brain and spinal cord will be discussed in the chapter on Neurology.

J. CHAPTER SUMMARY

General body systems are the parts of our body that work together to keep us alive.

The PTA must understand the normal body so that he/she can help a patient when the body is not normal.

The following systems were discussed:

* SKIN SYSTEM (body covering)
* DIGESTIVE SYSTEM (moves food through our body)
* RESPIRATORY SYSTEM (moves air in and out of our body)
* CIRCULATORY SYSTEM (carries blood to and from all our body parts)
* URINARY SYSTEM (removes food waste from the blood)
* SKELETAL SYSTEM (bones)
* MUSCULAR SYSTEM (muscles)
* NERVOUS SYSTEM (nerves)

SKIN

The skin protects against infection, helps us to feel, and can help keep our temperature normal.

DIGESTIVE

Food enters our body through the mouth. Next it moves through the esophagus to the stomach to the large intestine and small intestine. Waste (used food) leaves the body through the anus.

RESPIRATORY

Air enters and leaves our body through our nose and mouth. Next it moves through the trachea and then to the lungs. In the lungs there are little air sacs called alveoli.

There are two parts of air: oxygen (O_2) and carbon dioxide (CO_2). Our body used oxygen (like food) and releases carbon dioxide (like waste).

We take air in by the DIAPHRAGM pulling the lungs down and air going into the lungs. When the diaphragm relaxes, air is pushed out.

CIRCULATORY

Blood moves through out body in many small tubes called arteries, capillaries and veins. The heart is the muscle that pushes blood through our body.

URINARY

The kidney helps to remove waste (used food) from the blood. The bladder is the bag that holds this waste (URINE). When we pee, urine is released from the bladder.

SKELETAL, MUSCULAR, NERVOUS

These three systems responsible are for movement. The skeletal, muscular and nervous system will be discussed in more detail in future chapters.

4.

OSTEOLOGY

OSTEOLOGY is the study of bones.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe (in own words) the three functions of bone.

2. explain (in own words) how normal bone grows longer and thicker.

3. apply bone growth principles to broken bones and amputations.

4. identify major bones of the body on paper, x-ray, and human models.

5. describe the normal curves of the vertebral column and how they were formed.

CHAPTER CONTENTS

A. INTRODUCTION

OSTEOLOGY is the study of bones. From this study we should learn that bone is hard, bone is strong and bone cannot bend.

All of the bones of the body together are called the skeleton. The PTA should learn the bones presented in this chapter to be able to communicated with other members of the medical team.

B. FUNCTION OF BONES

Bones have many functions (or jobs) in our body.

Activity In the space provided, draw a picture if you had no bones. Compare your picture with the other pictures in your class and discuss what you see.

The first important function of bone is to SUPPORT THE BODY (and give each of us the same general shape).

Another function of bone is for PROTECTION.

We have many important parts inside of us (our brain, heart, lungs); for these special parts there are bones that cover them to prevent injury.

The last main function of bone is to allow MOVEMENT.

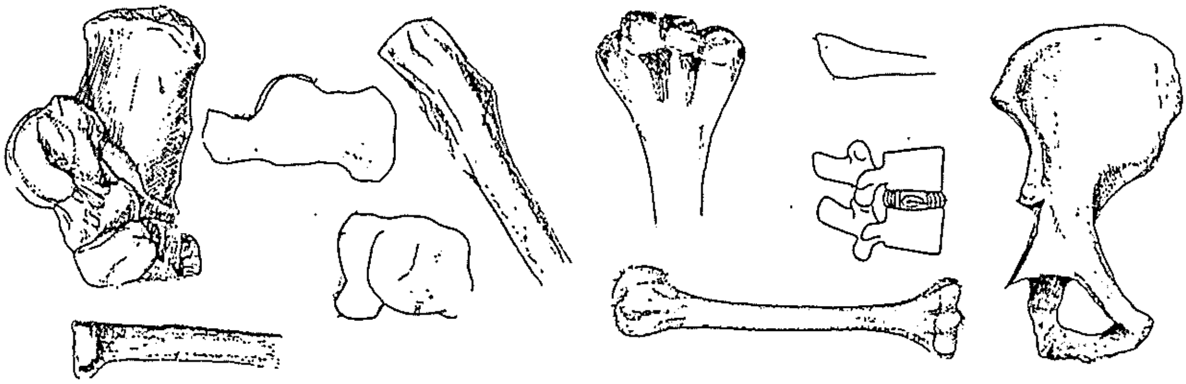
The skeleton has many separate bones (206 of them!); this is what allows us to make the many movements that we do (bending, brushing our hair, walking, etc.).

If we have only one bone, we cannot bend or move in many directions. If we have more than one bone, it can meet with another bone and allow movement.

In summary, the three main functions of bone are to SUPPORT the body, PROTECT the special parts of the body, and allow us to make the MOVEMENTS that we normally do.

C. GENERAL BONE STRUCTURE

In the human body there are many different shapes and sizes of bones. They may be long, short, flat, or irregular in shape.



Generally, there are two parts of a bone.

There is an outer part that is compact which makes the bone very strong.

There is an inner part that is less compact (less close together) called spongy bone,

Some bones (like the arm or the leg) may even be hollow on the inside (like bamboo is hollow -- an empty space on the inside).

Questions:

Imagine you are a person with only 6 bones in your body.

1. Describe how you will brush your teeth.

____

____

____

____

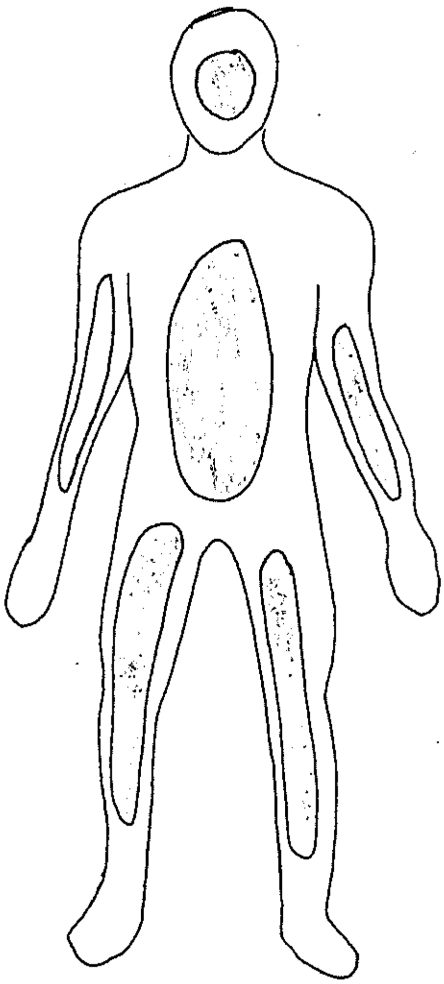
2. Describe how you sit on a chair.

____

____

____

____



Remember! Many bones allow many movements.

D. BONE GROWTH

Our bones are alive! They need food the same as other parts of the body, and they receive this food from the blood that is carried to them.

Bone is very busy. When we are young, our bones are very active and want to grow bigger. Our body is able to tell these bones <u>how</u>, to grow and <u>how much</u> to grow.

This is important so that we keep a normal shape as we change from a baby to an adult.

<u>Activity</u>: Draw a picture of your body with the bones of your <u>right leg</u> the same as a one year old baby. The other parts of your body are the same size and shape as they are now.

It is very special that our bones know how much to grow and also when to stop.

Bone growth is important for two reasons:

1) to grow larger from the size of a baby to an adult ....
see explanation to follow

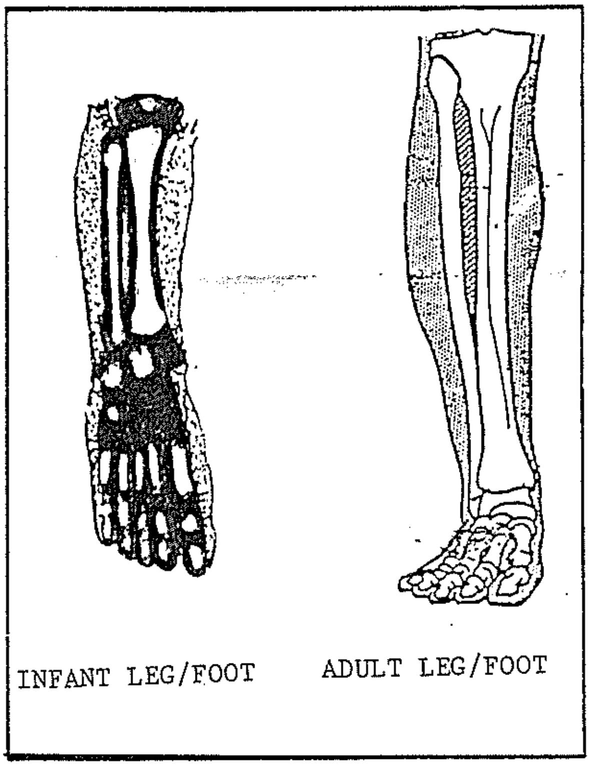
2) if a bone breaks, it can repair itself.

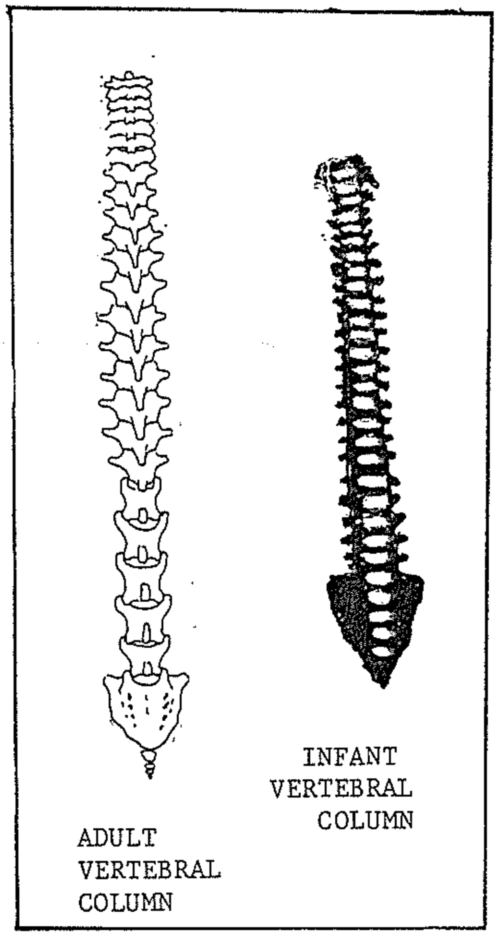
* Bones of a Baby *

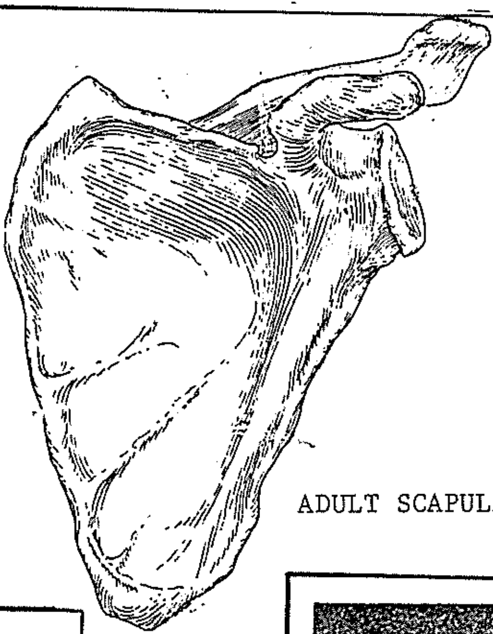
The bones of a baby are softer than the bones of an adult.

They are smaller and more flexible. The very soft parts you cannot see on x-ray, and so the shape of the bones does not look exactly the same as the adult bones.

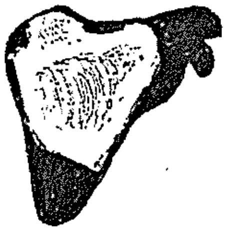
Below are pictures to help see these differences.





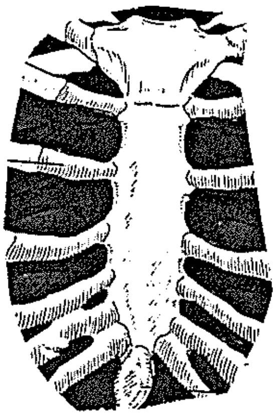


ADULT SCAPULA

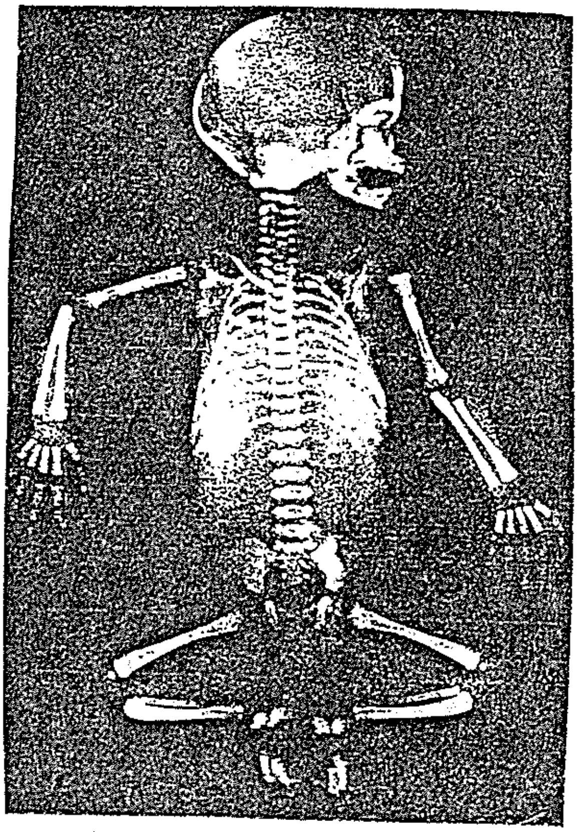


INFANT SCAPULA

INFANT STERNUM



ADULT STERNUM



X-RAY OF A TEN MONTH OLD INFANT.
HARD BONES ARE SEEN IN WHITE COLOR.

TYPES OF BONE GROWTH

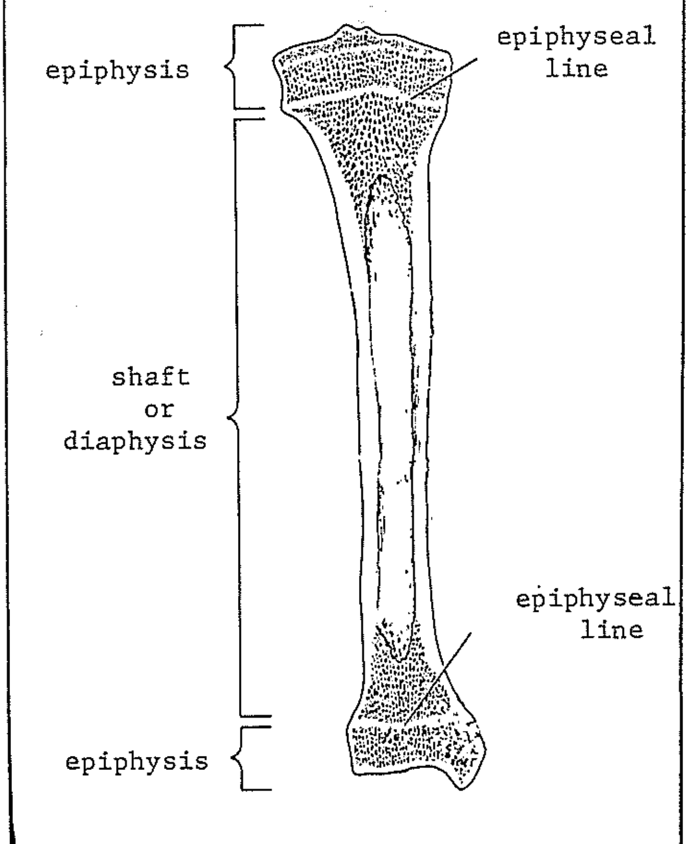
There are two different ways a bone can grow; it can grow in <u>length</u> (to become longer) or in <u>width</u> (to become thicker).

1. BONE GROWTH: LENGTH

For a bone to grow longer, it must grow from the ends of the bone only.

The middle of this bone will not move; it is the ends of the bone that will grow longer.

There is one special place in the ends of bone that is the most active; it is the place that makes all the new bone for increased length.



(picture of a bone in the lower leg)

As we have said before, PTAs will be working with doctors. It is important for the PTA to know some medical vocabulary about bones.

The ends of the bone are called EPIPHYSES

The middle of the bone (or the area between two epiphyses) is called the SHAFT or DIAPHYSIS.

The place where all of the bone growth for length happens is called the EPIPHYSEAL PLATE or EPIPHYSEAL LINE.

The epiphyseal line is very active from birth until about age 18 years old because this is when most of our body growth occurs.

By age 25, the growth of the length of the bone is complete and the epiphyses and diaphysis grow together, and there is no longer the active area of the epiphyseal plate.

<u>Questions</u>:

1. A boy (age 11) was boxing and broke the <u>shaft</u> of a bone in his leg, will this step the growth of his leg <u>length</u>?

Yes ________ No ________

Explain your answer.

____

____

____

2. A boy (age 7) broke the bone in his left left and destroyed the epiphyseal line 15 years after (now age 22). This man has one leg shorter than the other. What leg is shorter, left leg or right leg?

____

Explain your answer.

____

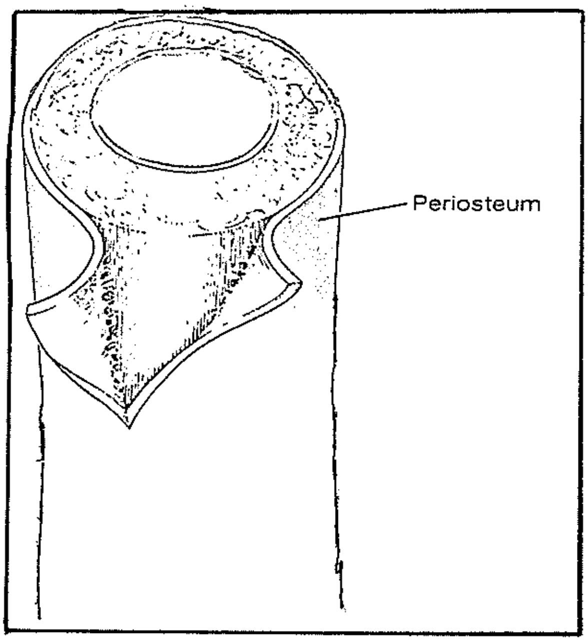
____

____

2. BONE GROWTH: WIDTH (THICKER)

To understand how a bone becomes more thick, it is important to learn about the <u>PERIOSTEUM</u>. The periosteum is much like bark on a tree.

The periosteum is a covering of the outside of the bone.



The periosteum has three very important functions:

* nutrition
* bone growth
* control of bone shape

Nutrition:

The outer part of the periosteum has many blood vessels that bring food and oxygen to keep the bone alive.

Bone Growth

The inner part of the periosteum is where new bone is made to increase the width of the bone.

Control of Bone Shape:

The periosteum covers the bone and controls how much and in what direction a bone grows.

If there was not this covering, then the bone could grow more and more in many directions.

If there is uncontrolled bone growth that escapes past the periosteum covering, it is called exostosis.

When a bone is broken, it is the periosteum that makes new bone and helps the two broken parts come together.

This coming together of parts is called CONSOLIDATION.

This periosteum will continue to make new bone until this consolidation is very strong.

More information about broken bones if given in FRACTURES CHAPTER.

<u>Question</u>:

After an "amputation" (the cutting and removal of part of the body), the bone that was cut may continue to grow. Where does this bone growth come from?

____

Normally it will grow in a downward fashion. Why in this direction?

____

____

____

____

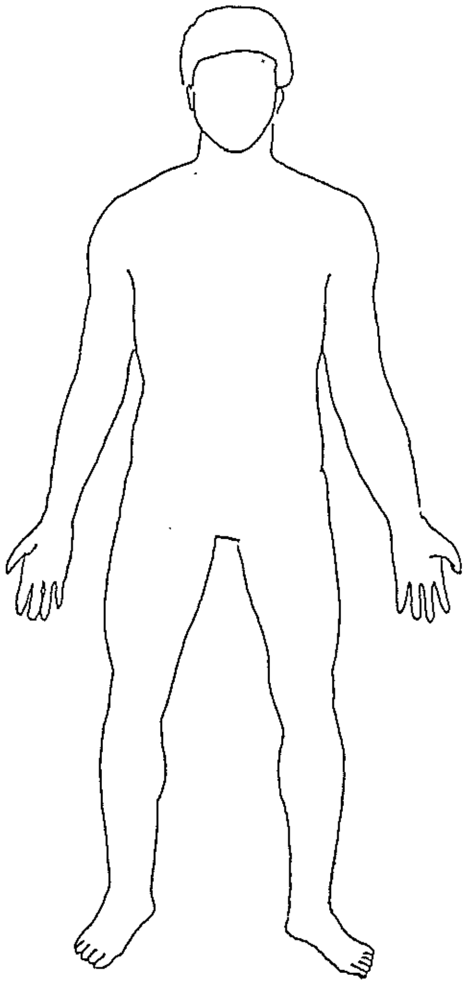
E. HUMAN SKELETON

In this section, we will discuss the specific bones of the body. This will include their name, their general shape, and their location.

Activity:

The PTA may have some knowledge about bones before studying this chapter.

In the picture given below, the PTA should draw and name as many bones as he/she knows.



The bones of the body can be learned by studying each one separately or by dividing the skeleton into main areas.

In this manaul we will divide the skeleton into the following parts:

I) Bones of the Head

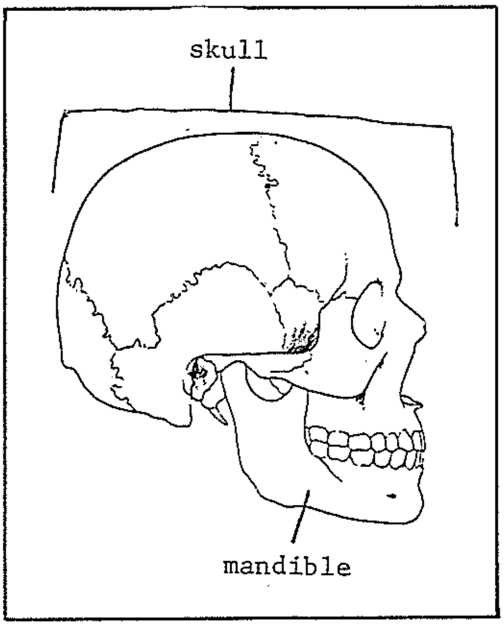
II) Bones of the Back

III) Bones of the Chest

IV) Bones of the Upper Limb

V) Bones of the Lower Limb

I) <u>Bones of the Head</u>



There are many bones of the head - all are flat or irregular in shape.

Together they are called the SKULL.

The <u>skull</u> forms a box that holds the brain (a special part of your body that controls everything) and keeps it safe. These bones do not move.

The only bone in the head that moves well is called the <u>mandible</u> (or jaw bone). Your lower teeth are attached to this bone and so it helps in chewing food. (This is the bone that moves when you open and close your mouth).

In addition to protecting the brain and holding the teeth, the skull is also responsible for the shape of a person's face.

<u>Activity</u>:

Feel your nose on your face. Is the whole nose made of bone?

Yes _______ No _______

Put your fingers on the place where the bone stops.

Feel your teeth. Find the place where your lower teeth attach to the mandible both in the anterior and posterior areas of your mouth.

Feel the area just superior and inferior to your eyes.

Can you feel the circle of bone that surrounds your eye? What is the function of this bony area?

____

II) <u>Bones of the Back</u>

Together all the bones of the back are called the <u>VERTEBRAL COLUMN</u>.

"Vertebra" is the name of the bone
"(Vertebr<u>ae</u>" is more than one)

ONE vertebr<u>a</u>

"Column" are objects put one on top of another straight up and down.

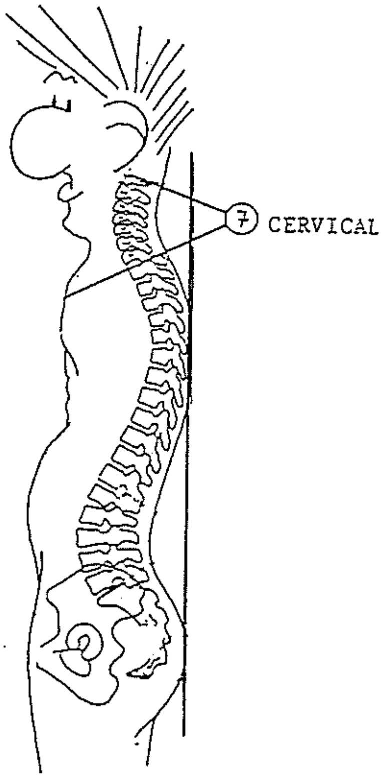
SEVERAL vertebr<u>ae</u>

The total number of bones in the vertebral column is 33.

Only the first 24 of these bones can move.

To better understand the organization of the vertebral column, it has been divided into five parts. (See diagram on next page).

CERVICAL VERTEBRAE



The bones that are in between the bottom of the head and the top of the shoulders are called the <u>cervical</u> vertebrae.

There are 7 cervical vertebrae.

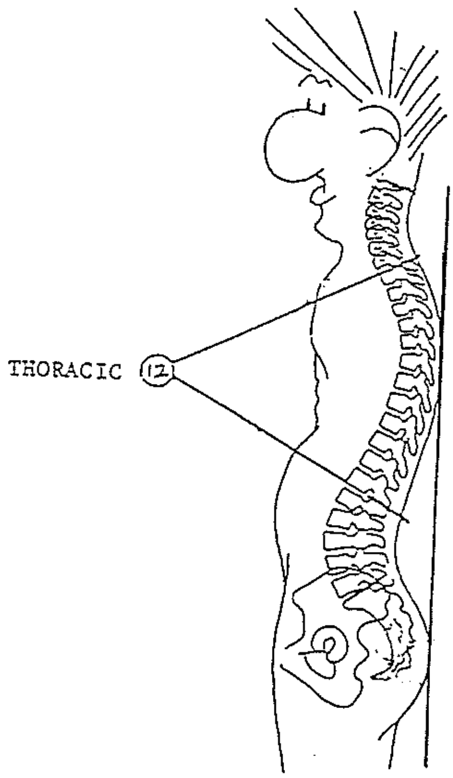
The first one is called C1, the second one is C2, the third is C3 and so on.

The cervical vertebrae are the bones responsible for allowing neck movement.

<u>Activity</u>:

If you flex your neck and touch the dorsal surface of your neck, you will feel one bone that seems bigger than the others. This bone is C7.

THORACIC VERTEBRAE



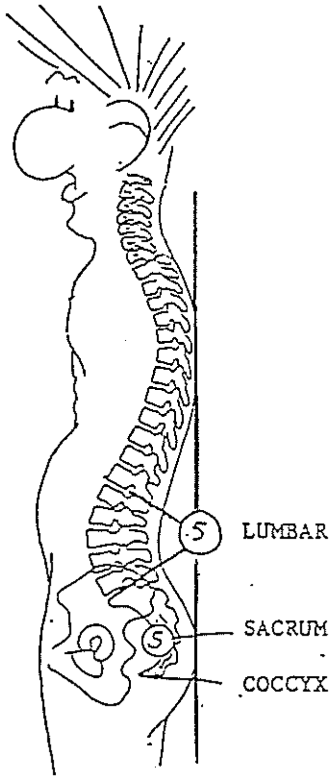
Just below the cervical vertebrae are the <u>thoracic</u> vertebrae.

There are 12 thoracic verebrae.

The bones of the chest (the ribs) are attached to the thoracic vertebrae.

The thoracic vertebrae are located from the level of the shoulders to the middle back.

The thoracic vertebrae help allow movement of the trunk.



LUMBAR VERTEBRAE

The bones of the lower back are called the <u>lumbar</u> vertebrae.

There are 5 lumbar vertebrae.

They are just inferior to the thoracic vertebrae.

The lumbar vertebrae are responsible for allowing movement of the trunk.

SACRUM

These 5 vertebrae are different because they have all grown together to form one big bone.

The <u>sacrum</u> is like a table that holds the other vertebrae on top of it.

The sacrum is located in the area just above the buttocks.

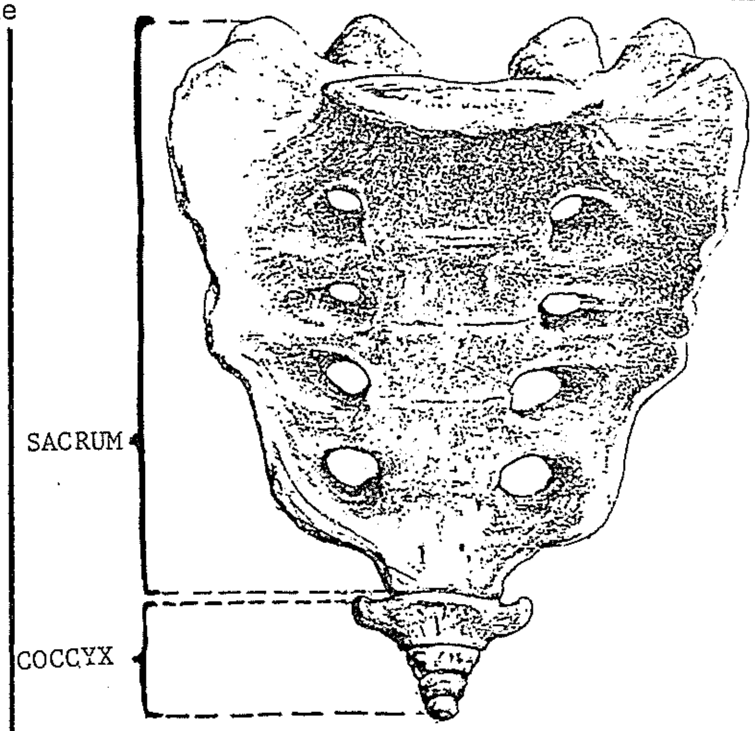
No bones in the sacrum can move apart from one another.

COCCYX

There are 3-4 very small vertebrae fused together called the <u>coccyx</u>.

They are attached to the end of the sacrum and have no real function.

They are sometimes called the "tail bone".



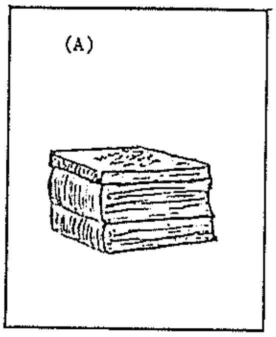
(anterior view of sacrum and coccyx)

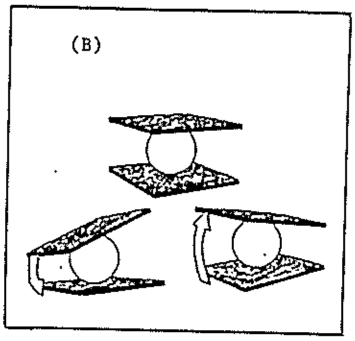
The DISC *****

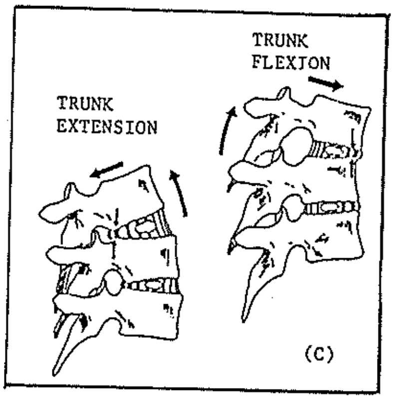
As we said, the vertebral column is made of many bones.

It is important to know that between each individual bone (from C2 to L5) is a more flexible part called the <u>disc</u>.

The disc allows the bones to move more freely upon one another.


(A)


(B)



(C)

<u>Example</u>:

<u>Picture A:</u>
There are a stack of books on a desk; if you try to bend them in any direction they will not move because they are hard and flat.

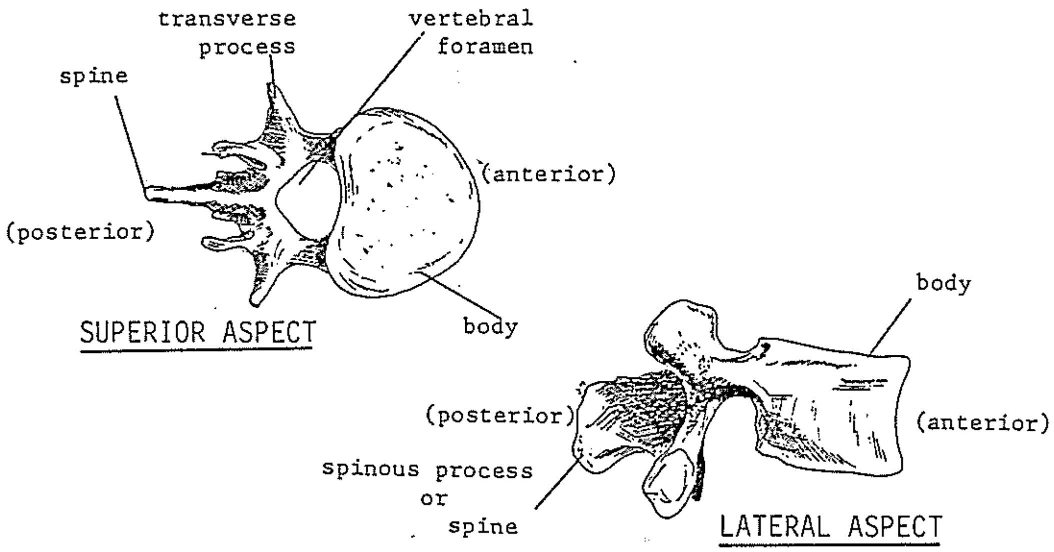
<u>Picture B:</u>
There is a balloon filled with water between each book; the books are now able to bend more freely in many directions.

<u>Picture C:</u>
It is the same principle with the bones and the disc (the books are the vertebral bones, and the balloon is the disc).

The <u>disc</u> will be discussed in more detail in future chapters, but for now it is important to remember that <u>the disc helps the vertebral column to bend more freely in many directions</u>.

Vertebral Bones

In general, most all cervical, thoracic and lumbar vertebrae look like this:



The vertebral body is the part that holds the weight of the vertebrae stacked on top of each other. (Between each vertebral body is a disc). The vertebral body is anterior.

The transverse process and the spine help keep the vertebrae attached togeher; they are also places where muscles attach to make movement of the vertebral column.

(The spine is the most posterior part of the vertebral column; the small bumps that you can feel or see on the midline of your back are individual spines of each vertebrae.)

The vertebral foramen is a hole found on each of the vertebrae.

The spinal cord (like a rope that carries all information to and from the brain) passes through these holes; the vertebral bones help to protect this important structure.

Each of the five areas of the vertebral column has its own special job (or function).

The bone shape in each area may be a little different because of the different functions.

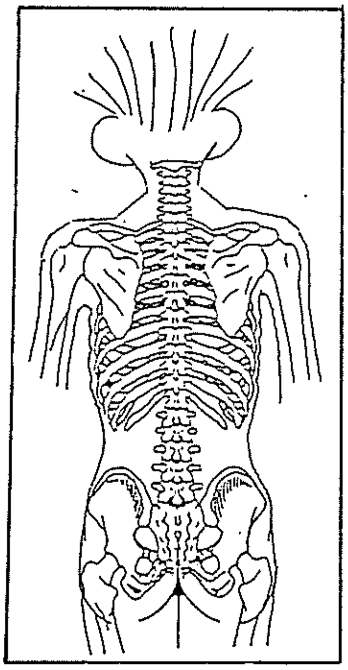
Vertebral Curves

The last important area to discuss about the vertebral column is its general shape when it is all together.

There are two directions that you can look at the vertebral column; posteriorly and laterally.

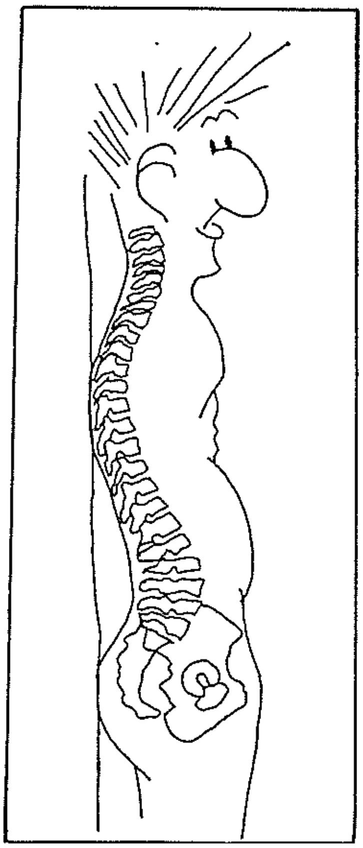
a. posterior view / anatomical position

In this view,
the vertebral column
should be straight.



2. lateral view / anatomical position

In this view, the
vertebral column will
have some curves that
are easy to see and feel.



These posterior and anterior curves are called KYPHOSIS and LORDOSIS.

KYPHOSIS

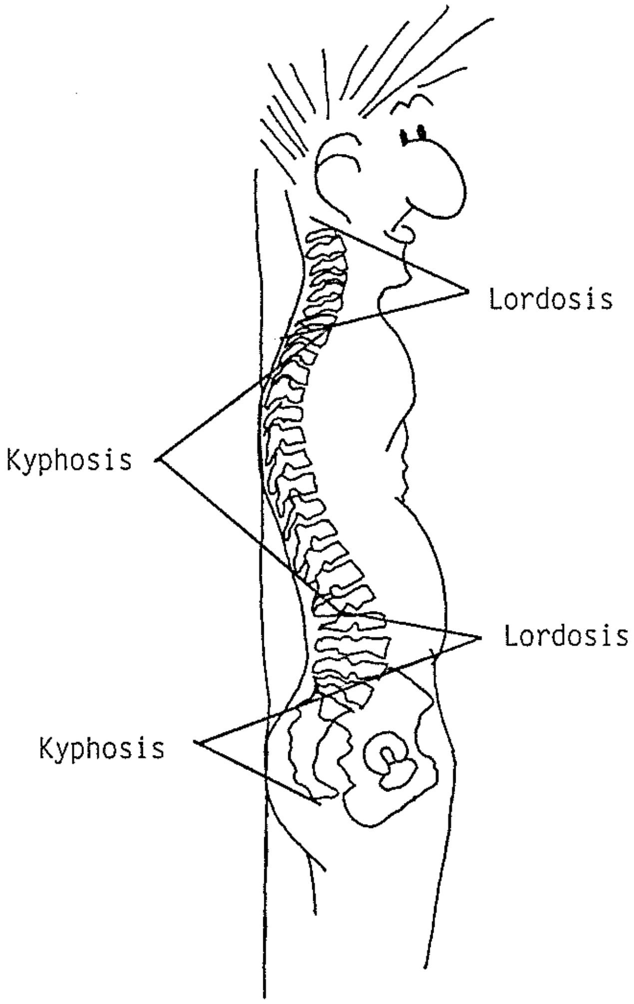
Kyphosis is the vertebral column curving in a posterior direction.

Examples of kyphosis can be seen in the thoracic and sacral areas.

LORDOSIS

Lordosis is the vertebral column curving in a anterior direction.

Examples of lordosis can be seen in the cervical and lumbar areas.



Activity:

To better see real kyphosis and lordosis, form groups of two people each.

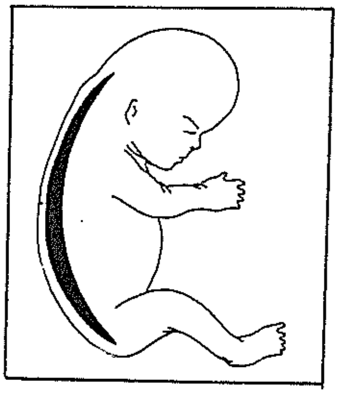
On one person draw or put tape over the kyphosis areas of the vertebral column.

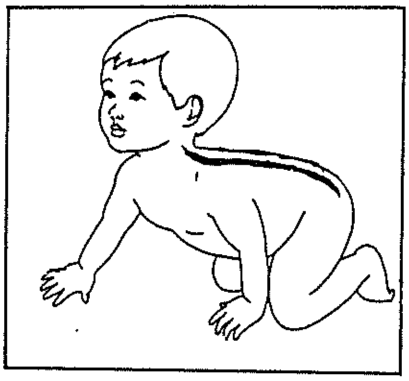
On the the other person draw or put tape over the lordosis areas of the vertebral column.

Development of Vertebral Curves

As a baby, we are shaped like this: our body is in a position of flexion.

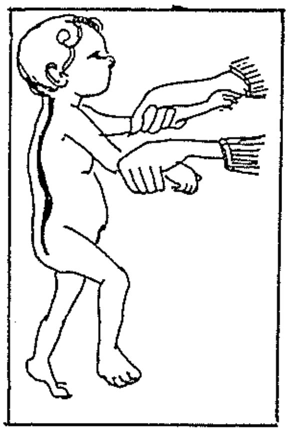
If we never moved, we would be in a position of flexion always.





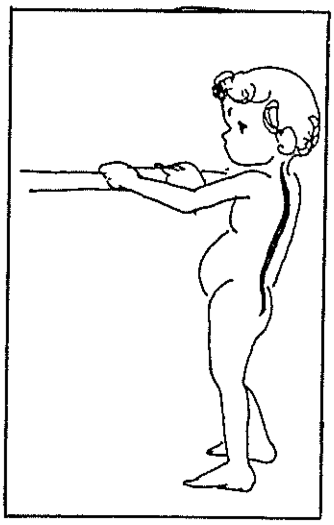
But, when we can, we begin to lift our head by ourself.

This will cause a change in the curve in the neck area (the cervical area).



As we later begin to stand and walk, there is another change in the curve of the vertebral column.

This change happens near the hips or low back area (lumbar area).



In summary, there are two changes that happen in our vertebrl column when we are young.

One is in the cervical region and one is in the lumbar region.

Questions :

1. Does neck flexion increase or decrease cervical lordosis?

   ____

2. What movement will decrease lumbar lordosis?

   ____

3. Primary means happening first. Secondary means happening second. Think about the curves in your spine. What curves are the primary curves?

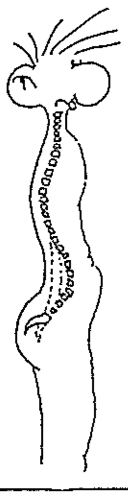
   ____

   What curves are the secondary curves?

   ____

Activity:

Below is a picture of the vertebral column.
Please write if the curve is normal, has increased lordosis or increased kyphosis.



CERVICAL: ______________________________

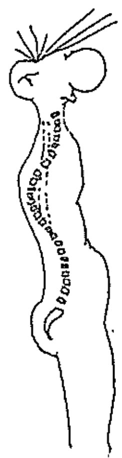
THORACIC: ______________________________

LUMBAR: ______________________________

SACRAL: ______________________________

Activity: (continued)

Below is a picture of the vertebral column.
Please write if the curve is normal, has increased lordosis or increased kyphosis.



CERVICAL: ______________________

THORACIC: ______________________

LUMBAR: ______________________

SACRAL: ______________________

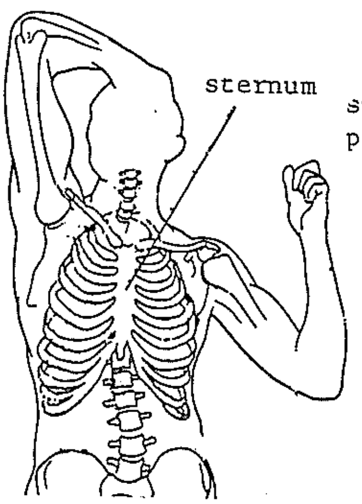
III) Bones of the Chest

The bones are the chest are the ribs and the sternum.

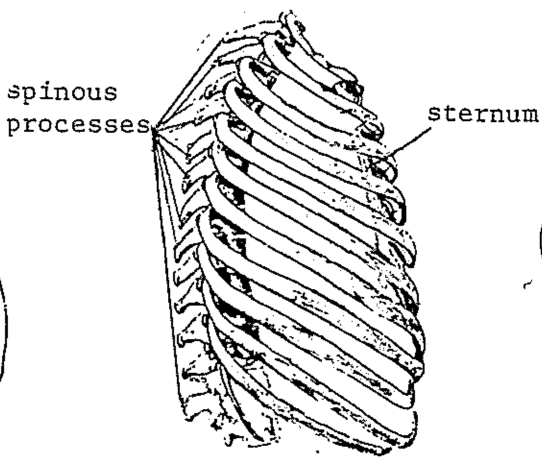
The ribs help to protect the heart and lungs from injury.

There are 12 pairs of ribs (12 on the left side of the chest and 12 on the right side of the chest).

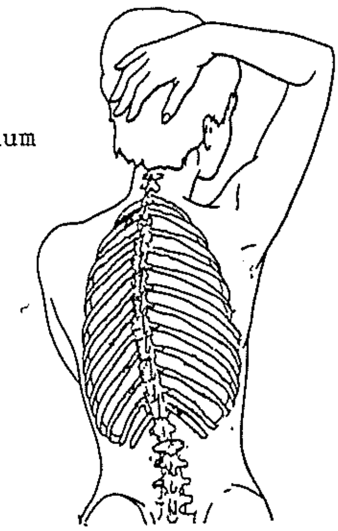
Together they are called the rib cage or thoracic cage.



ANTERIOR VIEW



LATERAL VIEW



POSTERIOR VIEW

Posteriorly, each rib attches to one thoracic vertebra.

Anteriorly, most of the ribs attach to a flat bone called the sternum.

The last two ribs do not attach to anything anteriorly.

Because the ribs attach both anteriorly and posteriorly, they limit anterior-posterior bending (trunk flexion) and also limit some side bending (lateral trunk flexion).

Movement of the ribs

Activity:

Inhale very deeply, and after, slowly let the air come out of your lungs. Bring the air in and out of your lungs again. Describe the movement you see and feel in your chest.

____

____

____

____

____

____

For details about rib movement in breathing, see RESPIRATORY CHAPTER.

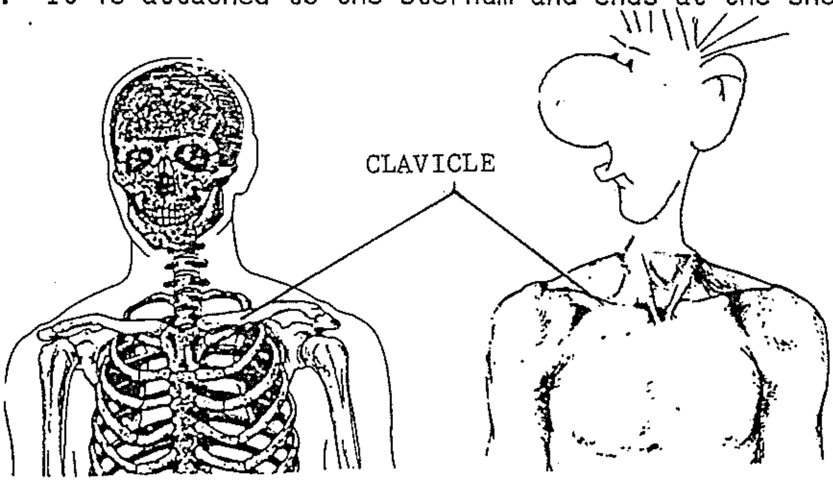
IV) Bones of the Upper Limb

When we think of the arm, we think of the area distal to the shoulder. This is true.

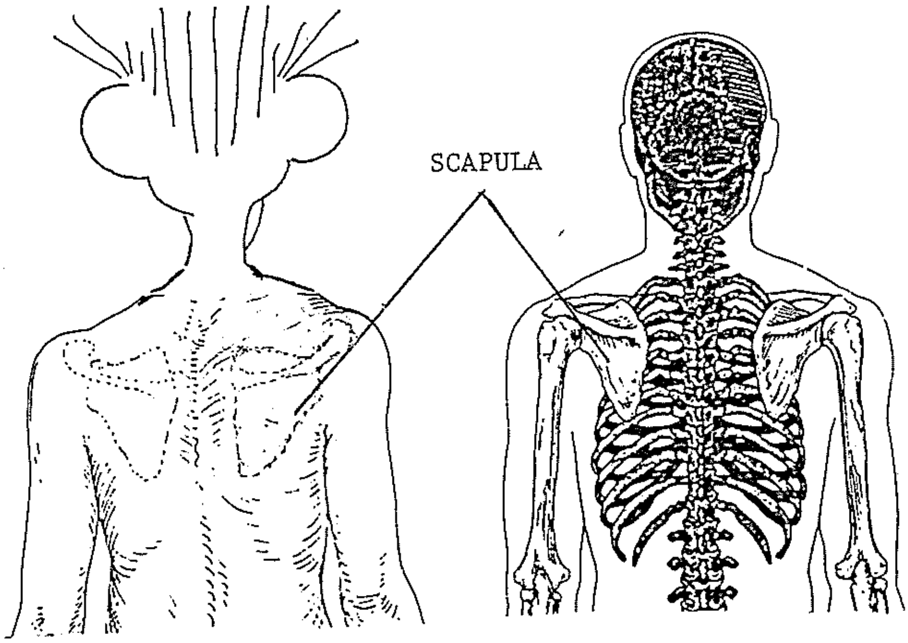
It is important to know that there are two other bones that help attach the arm to the trunk; these are the CLAVICLE and the SCAPULA.

On the anterior surface of the body is the clavicle.

There is one clavicle on the left side and one clavicle on the right side. It is attached to the sternum and ends at the shoulder.



On the posterior surface is a large triangular bone called the scapula. The scapula is very movable.



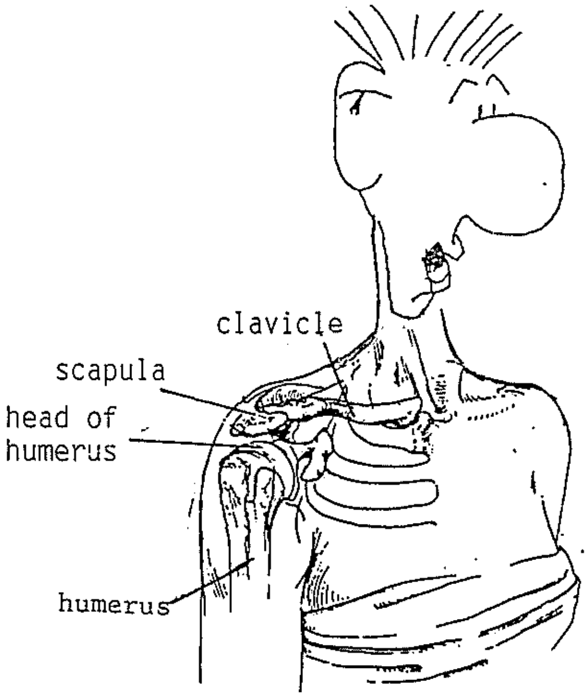
Activity:

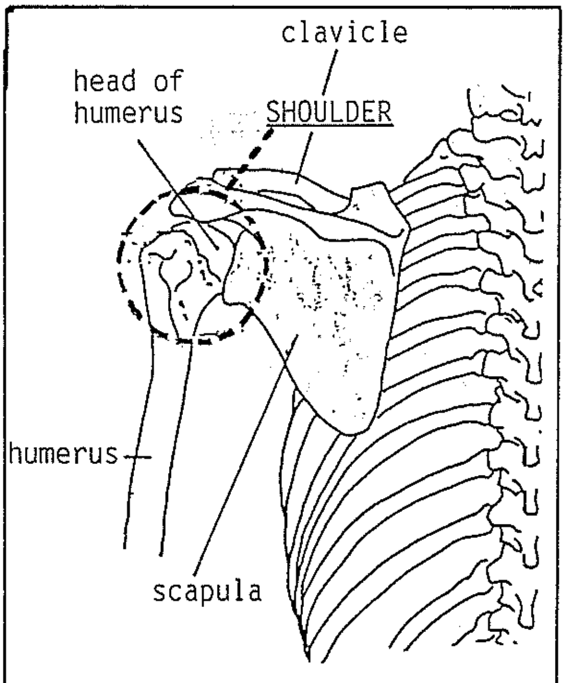
Both bones are very easy to see and feel on your body. Place your right hand over your left shoulder close to the neck. Under your wrist you will feel the clavicle; under under the ends of your fingers you will feel the scapula.

There are three bones between the shoulder and the wrist.

From the shoulder to the elbow is one bone called the HUMERUS. The proximal part is called the head, and it is shaped like a ball.

The shoulder is where the head of the humerus, the scapula, and the clavicle meet together.



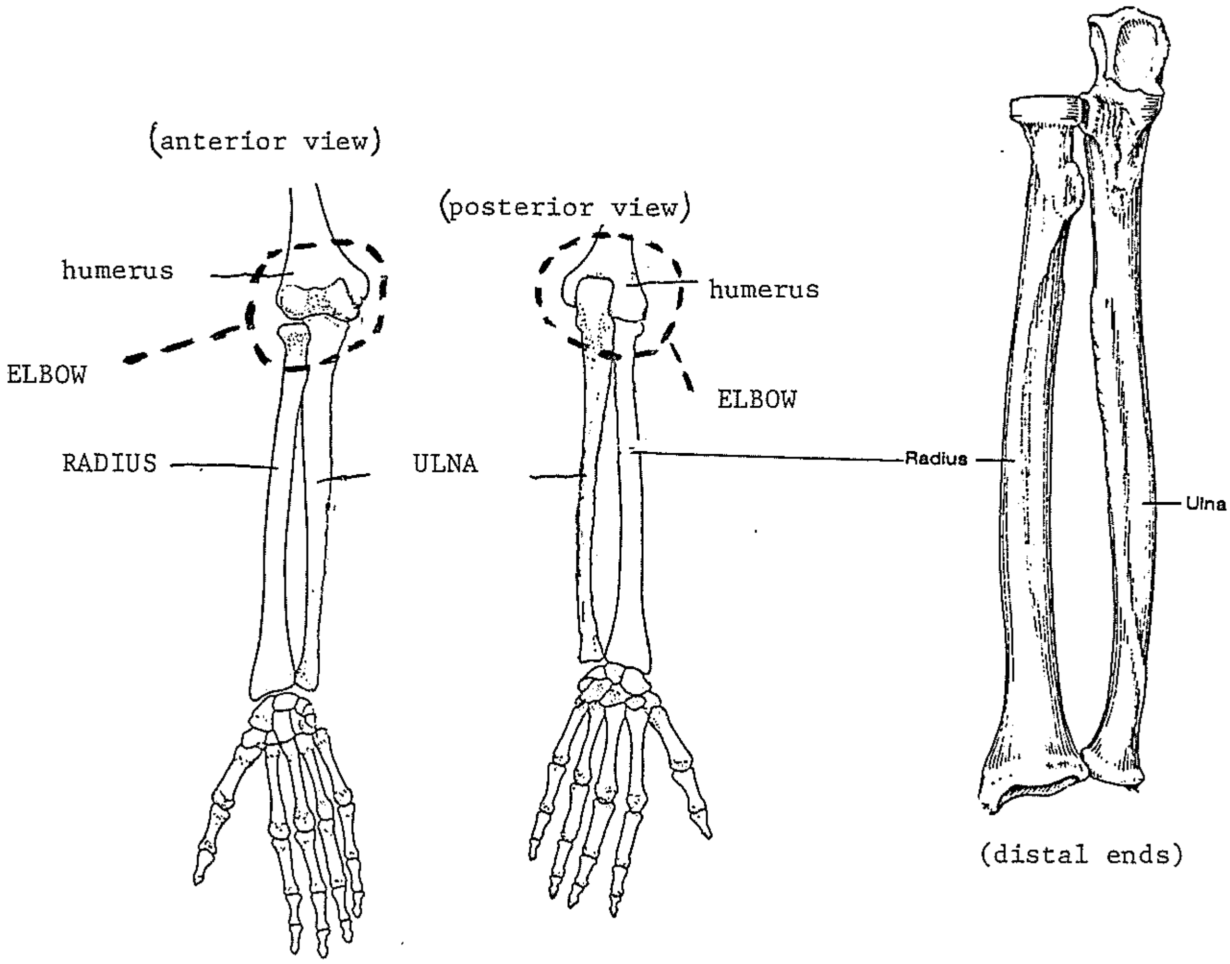


POSTERIOR VIEW

From the elbow to the wrist there are two bones: the RADIUS and the ULNA.

In anatomical position, the <u>ulna</u> is on the <u>internal side</u> (fifth finger side) and the <u>radius</u> is on the <u>external side</u> (thumb side).

The elbow is where the humerus, radius and ulna meet together.



The <u>radius</u>, <u>ulna</u>, and the CARPAL BONES together form the <u>wrist</u>.

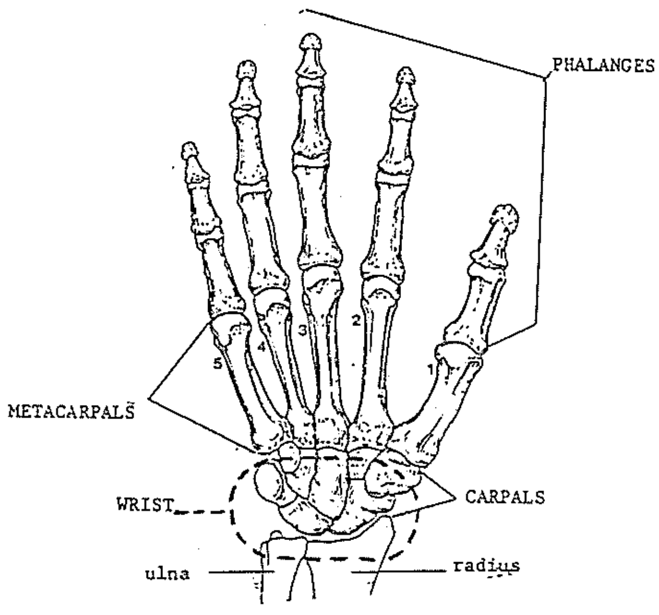
The HAND is made up of the CARPAL BONES, METACARPAL BONES, and PHALANAGES.

There are eight carpal bones.

Distal to the carpal bones are the 5 <u>metacarpal</u> bones; one for each finger and the thumb.

Distal to the metacarpal bones are the bones of the fingers and the thumb. These bones are called <u>phalanges</u>.

It is very good to have many small bones in the hand because this allows much more movement and flexibility.



(anterior view of right hand)

Activities:

1. Put your right hand on your left clavicle. Lift your left arm. Describe what happens to the clavicle.

   ____

   ____

2. Put your left hand behind your back and put your left fingers on the inferior end of the right scapula. Push forward with your right arm. Describe what you feel with your left fingers.

   ____

   ____

3. We have said that bones cannot bend. We can see that our fingers bend in many places. How many phalanges are in each hand?

   ____

In summary, the bones of the upper limb include:

SCAPULA, CLAVICLE, HUMERUS, ULNA, RADIUS, CARPAL BONES, METACARPAL BONES, and PHALANAGES.

These bones allow us to greet one another, to eat, to write, and to do many activities with the arms.

V) Bones of the Lower Limbs

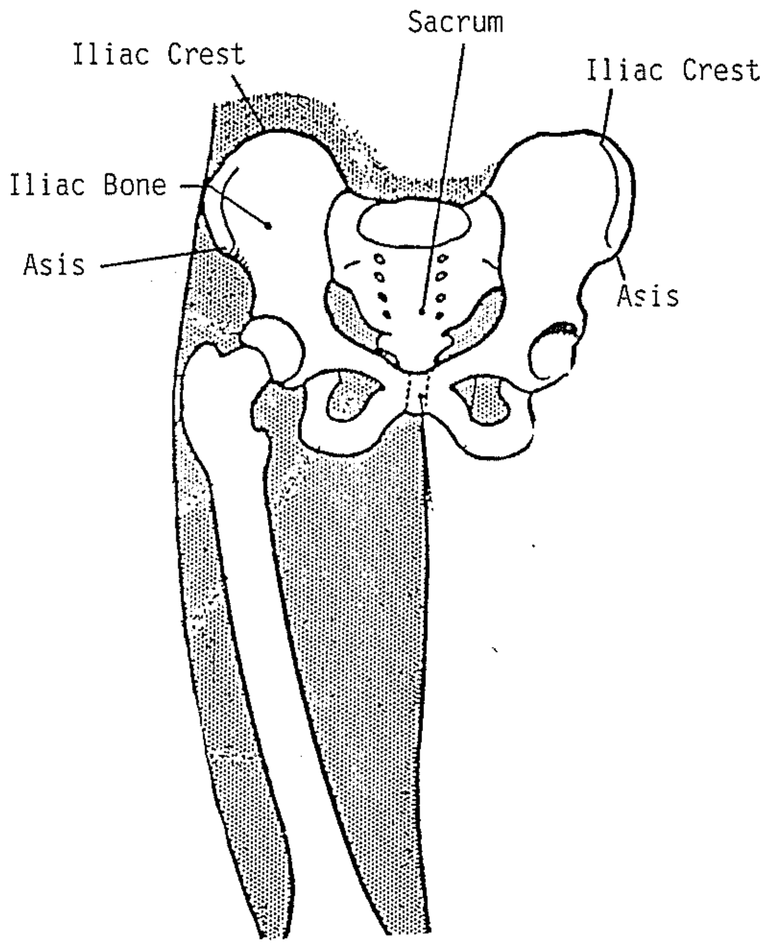
The body is very heavy, so the bones that support this weight must be very strong and very stable.

We had said that the sacrum supports the vertebral column and much body weight.

Activity:

Draw a picture of how you think the sacrum is attached to the two legs.

Between the sacrum and the thigh bone is a large and heavy bone on the left side and the right side.



These large flat bones are called the ILIAC BONES.

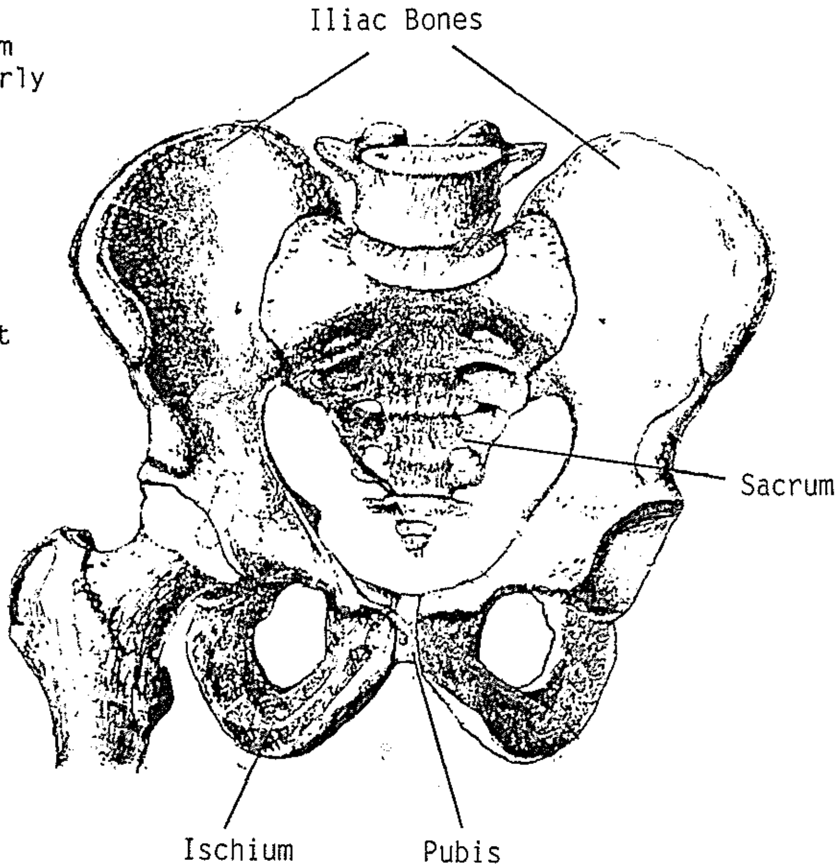
The top of the iliac bones is called the ILIAC CREST.

At the most anterior part of the iliac crest is the ANTERIOR SUPERIOR ILIAC SPINE (ASIS).

Activity:

To feel the iliac crests, get into a standing position. Place both hands on your hips the same as you would do in a relaxed position. The bones you feel just under your hands are the iliac bones. Move your hands to feel the superior part of them. These are the iliac crests.
Then move your hands to feel anteriorly along the iliac crests until you feel the ends of them. Here you may feel a larger bump; this is the ASIS.

The iliac bones are attached to the sacrum posteriorly. Anteriorly they atttach together in an area called the PUBIS.



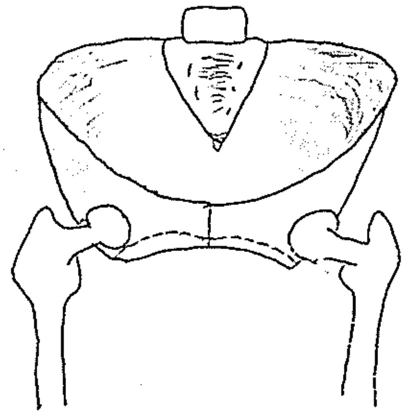
The most inferior part of the iliac bone is called the ISHCIUM.

This is the bone that you can feel very well under your buttocks when you sit down.

Activity:

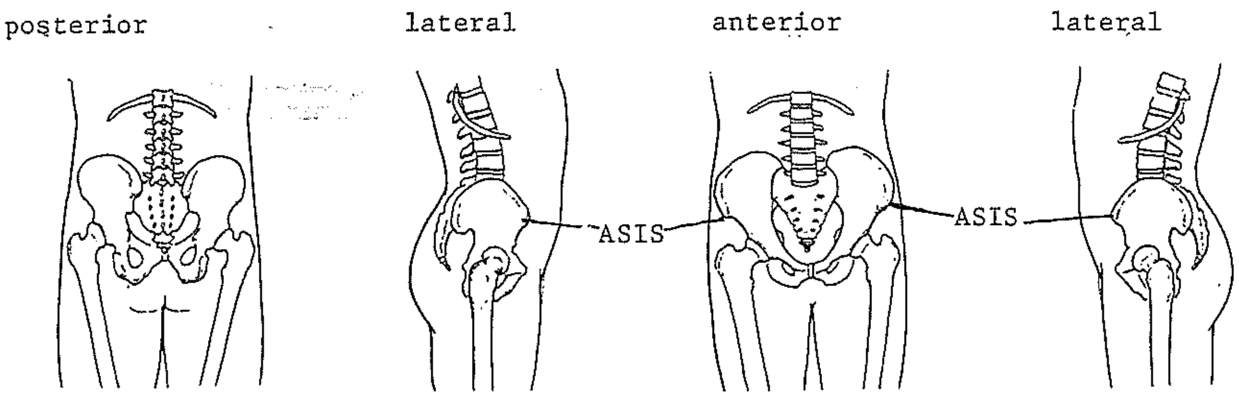
Take time to feel the ischium. It will be an important place to be able to find correctly when treating patients in the future.

In sitting position, put your left hand underneath your left buttock. Place your hand on the ischium. Now come to standing position and try to find the ischium again.



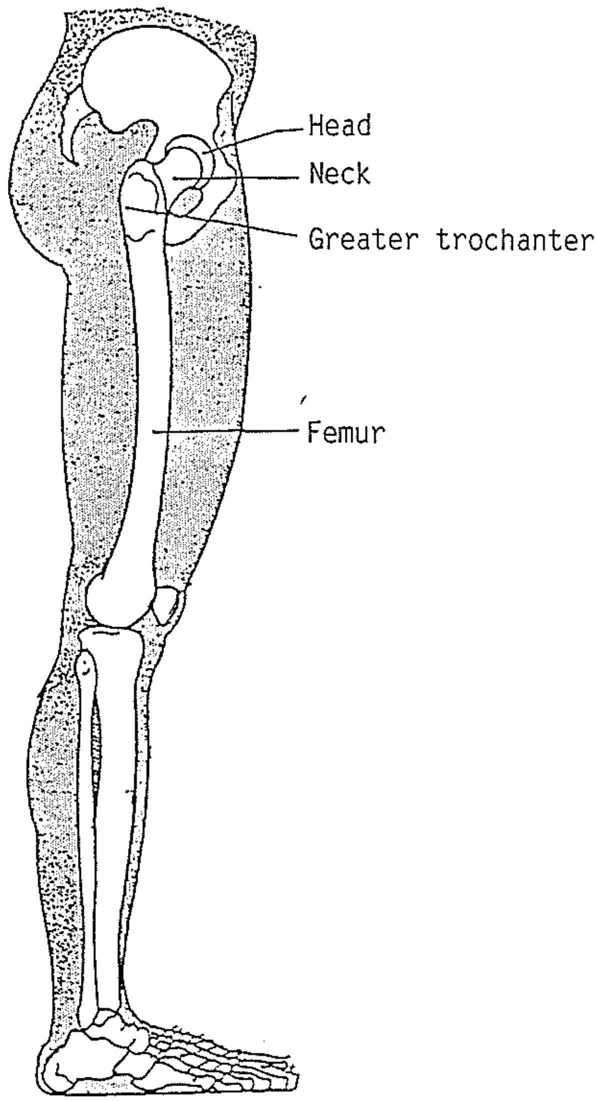
The PELVIS (the two iliac bones and the sacrum together) can be compared to a large bowl.

This bowl contains many important parts of the body (stomach, intestines, liver, etc), helps to hold the baby when a woman is pregnant, and connects the vertebral column to the lower limbs.



Different views of the pelvis can be seen in the pictures (above).

Between the hip and the ankle are 3 long bones and one small round one.



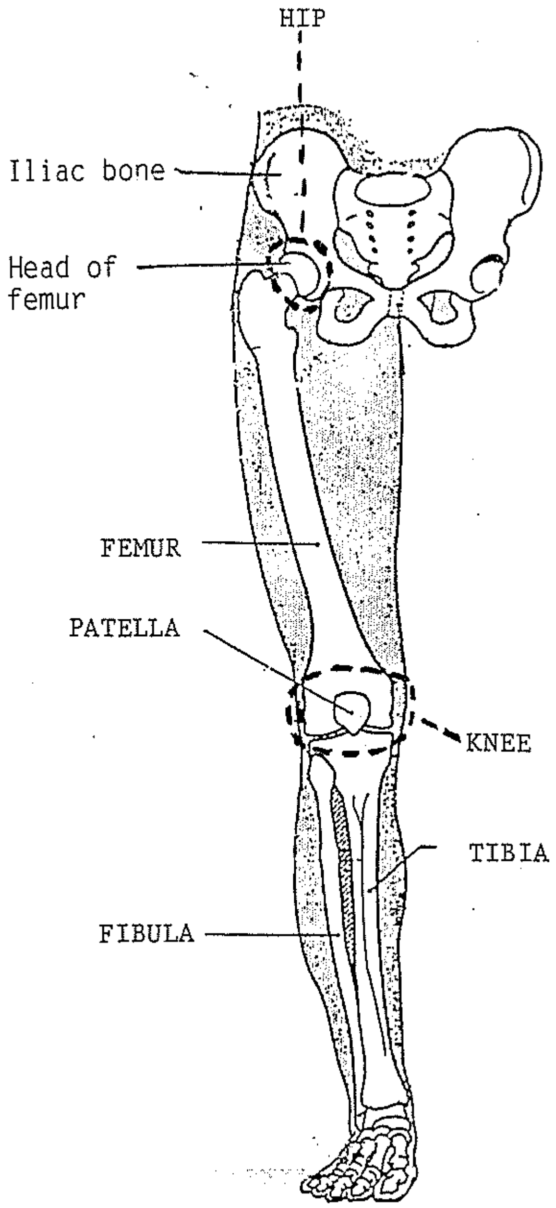
The bone between the hip and the kneee is called the FEMUR.

The proximal part is round like a ball and is called the <u>head</u>.

Distal to the head is the <u>neck</u>. Distal to the neck is the <u>greater trochanter</u>.

<u>Activity</u>:

To feel the greater trochanter, stand up, place your right hand on the external side of your leg just distal to the hip joint. With the knee extended, internally and externally rotate the leg. The bump you feel moving forward and backward is the greater trochanter.



The hip is the connection of the head of the femur and the iliac bone of that side.

Distally, the femur meets the TIBIA. This large bone of the lower leg holds <u>all</u> of the weight of the body.

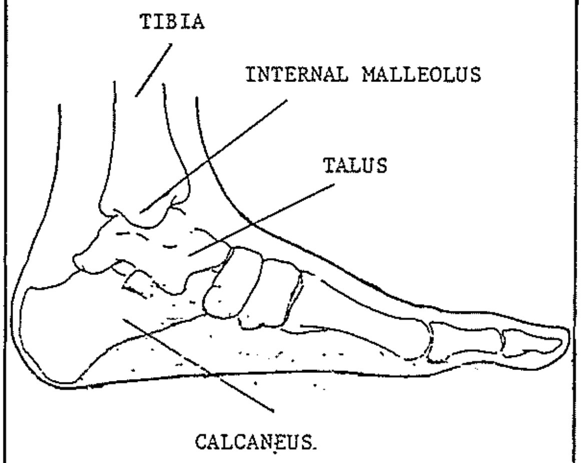
Parallel to the tibia in the FIBULA; it is <u>external</u> to the tibia.

Anterior to the connection of the tibia and the femur is a small round bone called the PATELLA.

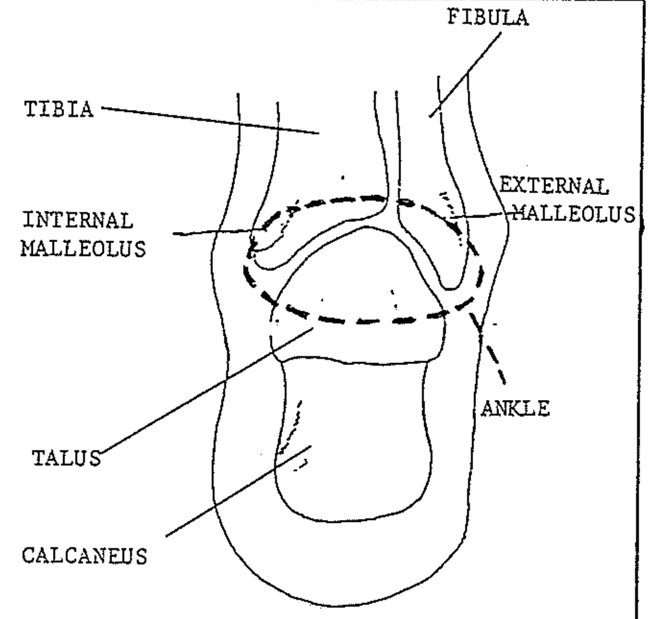
To feel the patella, sit with your left leg extended and relaxed. Take your left hand and feel the top of your knee joint --this is the patella. Try to move this small bone with your fingers.

The knee is made of the patella, distal femur, and proximal tibia.

The distal tibia and fibula together with the first bone of the foot make the ANKLE.



internal view of the foot



posterior view of the foot

Look at your ankle. You will see a bump on the internal and external side of the ankle.

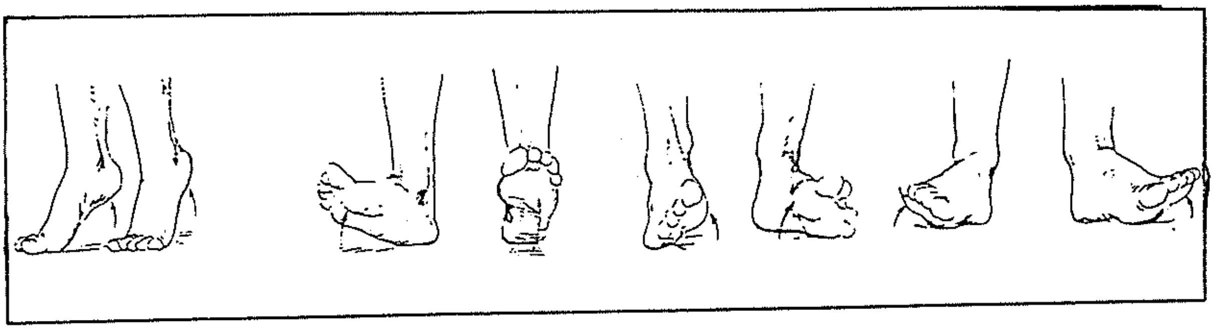
The one on the internal side is called the <u>internal malleolus</u>; (it is part of the tibia).

The one on the external side is called the <u>external malleolus</u>; (it is part of the fibula).

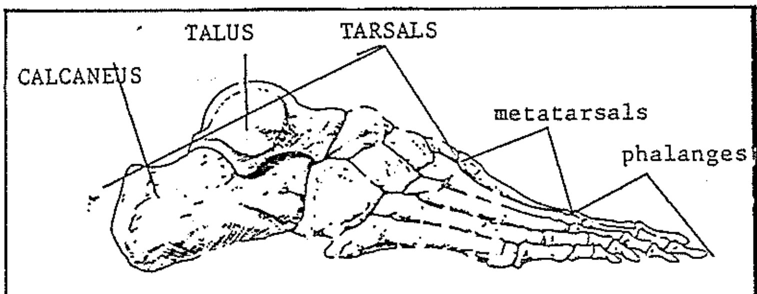
<u>Activity</u>:

With you pen, draw a circle around the internal and external malleolus so you can better see their location.

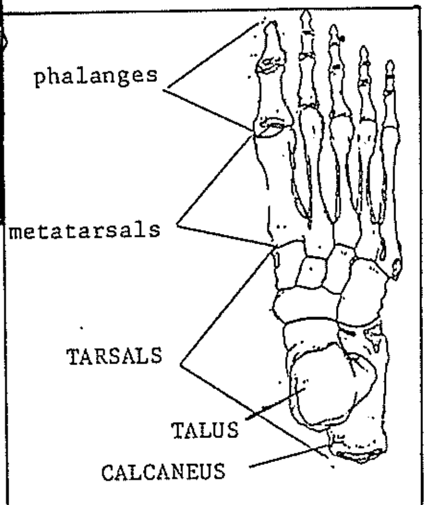
There are many bones in the foot to allow flexibility and movement.



There are 7 TARSAL bones.
The TALUS, CALCANEUS, and 5 smaller tarsal bones.



(lateral view)



(superior view)

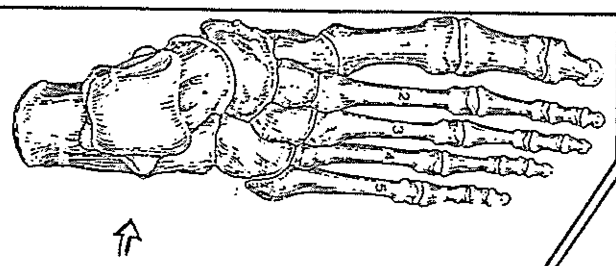
Just inferior to the tibia is the talus.

Just inferior to the talus is the calcaneus.

Anterior to the talus and calcaneus are the five smaller tarsal bones.

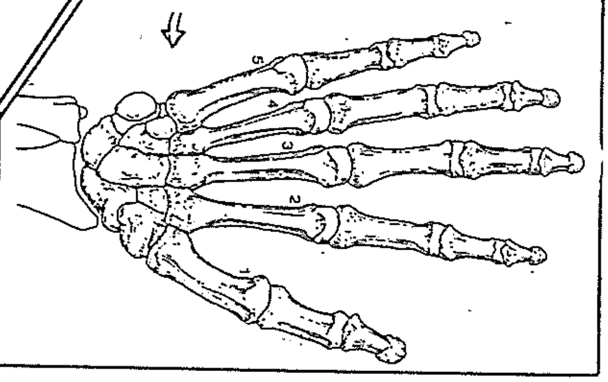
As in the hand, there are also many bones in the foot.

There are 5 METATARSAL BONES and the same number of PHALANGES as in the hand.



(superior view of right foot)

(anterior view of right hand)



Questions:

1. In sitting position bring your knee to your chest. What bone is touching your chest?

   ____

2. Put your right ankle on top of your left knee. What bone is touching your left femur?

   ____

3. In walking, what bone of the foot normally touches first?

   ____

In summary, the bones of the lower limb include the

ILIAC BONE, FEMUR, TIBIA, FIBULA, PATELLA, TARSALS, METATARSALS and PHALANGES.

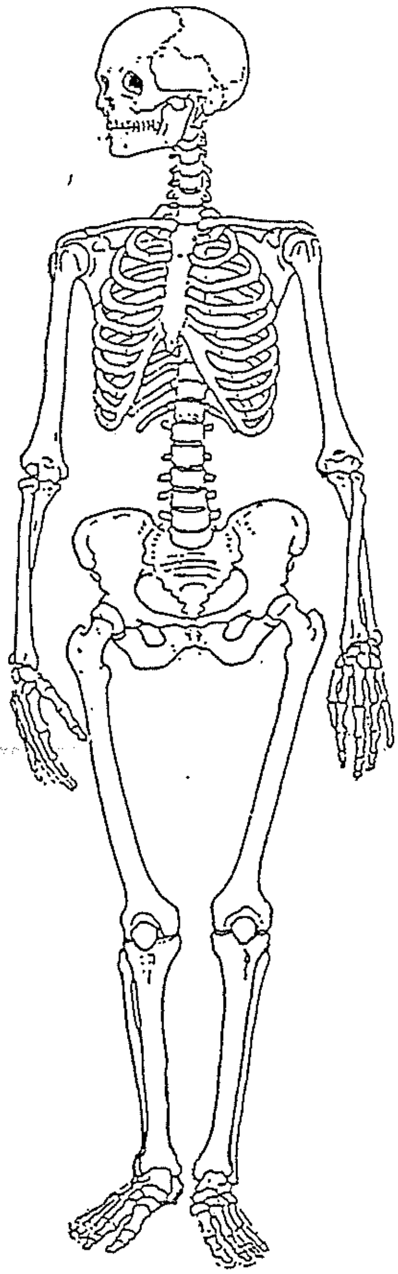
Activity:

From the individual lessons in this chapter, please name all the bones that you know.

** Is this skeleton in anatomical position? ____________

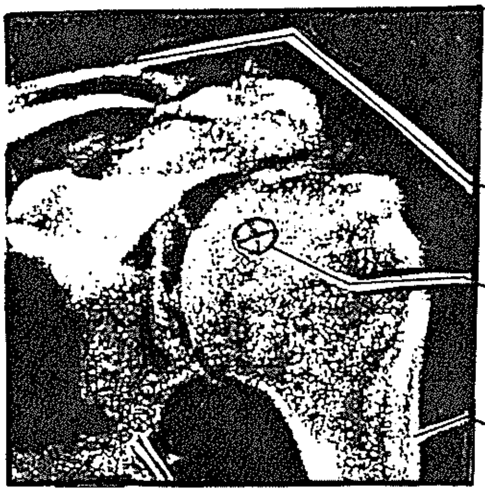
Why or why not? ______________________________

____



<u>Activity</u>:

Below are pictures of X-RAYS (pictures able to see the bones of the body) for different parts parts of the body. Please name the joint, bone, or area for each picture.



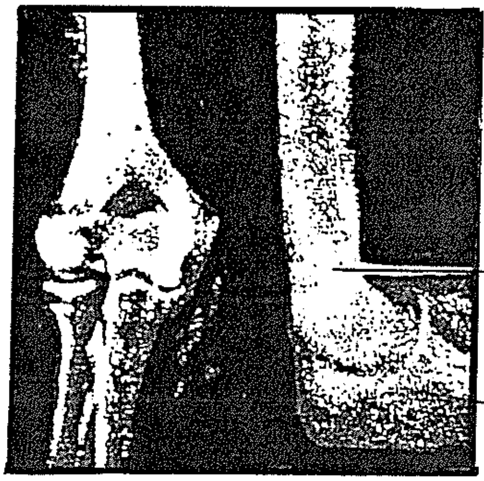
1. JOINT ______________

name of bone ______________

specific part of bone ______________

name of bone ______________

name of bone ______________

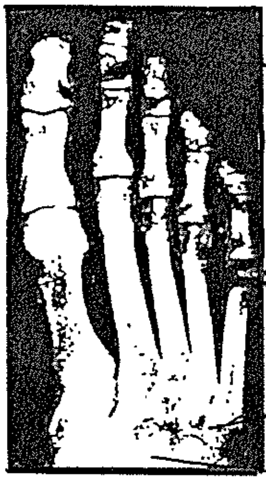


2. JOINT ______________

name of bone ______________

name of bone ______________

3. AREA OF BODY



name of bones

name of bones

name of bones

4. JOINT

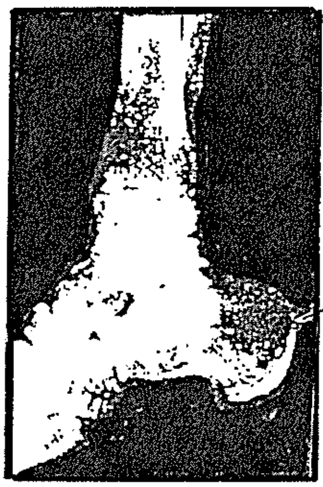
name of bone

specific part of bone

specific part of bone

name of bone

5. JOINT



name of bone

F. CHAPTER SUMMARY

OSTEOLOGY is the study of bones. All of the bones of the body together are called the skeleton.

Bone supports the body, protects special body parts, and allows us to make movement.

The bones of a baby are softer, smaller and more flexible than the bones of an adult.

Bone growth: The ends of bone are responsible for increasing the length of bone. The outer covering of bone (periosteum) is responsible for increasing the width of bone and for bone repair.

Main bones of the different body areas inclyde:

HEAD	Skull, Mandible
BACK	33 vertebrae (7 Cervical, 12 Thoracic, 5 Lumbar, 5 Sacral, 4 Coccyx)
CHEST	12 pairs of ribs, sternum
UPPER LIMB	Scapula, Clavicle, Humerus, Ulna, Radius, Carpals, Metacarpals, Phalanges
LOWER LIMB	Iliac bone, Femur, Tibia, Fibula, Patella, Tarsals, Metatarsals, Phalanges

The vertebral column curves anteriorly in the cervical and lumbar areas; this is called LORDOSIS. It curves posteriorly in the thoracic and sacral areas; this is called KYPHSOSIS.

Our vertebral column is in complete kyphosis when we are born. As we lift our head and stand, lordosis develops in the cervical and lumbar areas.

5.

ARTHROLOGY

ARTHROLOGY is the study of joints.

OBJECTIVES

At the time of the exam and with 80% proficiency, the students will be able to correctly:

1. describe the main supporting structures of a joint (ligament, tendon, capsule, cartilage).

2. identify major joints of the body and the movements available at each joint.

3. state the amount of degrees for different angle measurements.

4. when shown a joint in a specific position, state the approximate (+/- 10) angle the joint is in.

5. given a patient problem, evaluate range of motion (ROM), identify the limitation, and give the approximate measurement of the joint (+/- 10).

6. given a patient problem, identify the area(s) of compensation for different movements.

CHAPTER CONTENTS

A. INTRODUCTION

ARTHROLOGY is the study of joints. A joint is the place where two or more bones come together. There are many joints in the body.

B. FUNCTION OF JOINTS

Joints have two functions :

1) to hold the bony skeleton together

2) to permit movement of the bones in specific directions.

C. STABLE JOINTS AND MOBILE JOINTS

In OSTEOLOGY chapter we learned that there are many different shapes of bones.

In the same way, there are also many different shapes of joints.

The SHAPE of the joint is what most often decides how much and what kind of movement is available there.

Some joints of the body have a shape that does not allow much movement between the bones; they fit together very tightly.

These joints are for STABILITY. For example, the joints between the bones of the skull are very stable.

They do not have much movement; their shape holds the bones together well.

Question: Why is it important that the joints holding the skull bones together are stable?

____

____

In other joints, the bones can move very well in many directions.

More movement means more mobility.

An example of a joint that is very mobile is the shoulder. The bones of the shoulder are shaped in such a way that their ends do not attach together closely and so can move more freely.

Not many joints have complete stability or complete mobility in them -- most joints have a little of both.

The bones of the joint will help decide how much stability or mobility there is.

Of most importance to the PTA are those joints that have a lot of movement (are the most mobile).

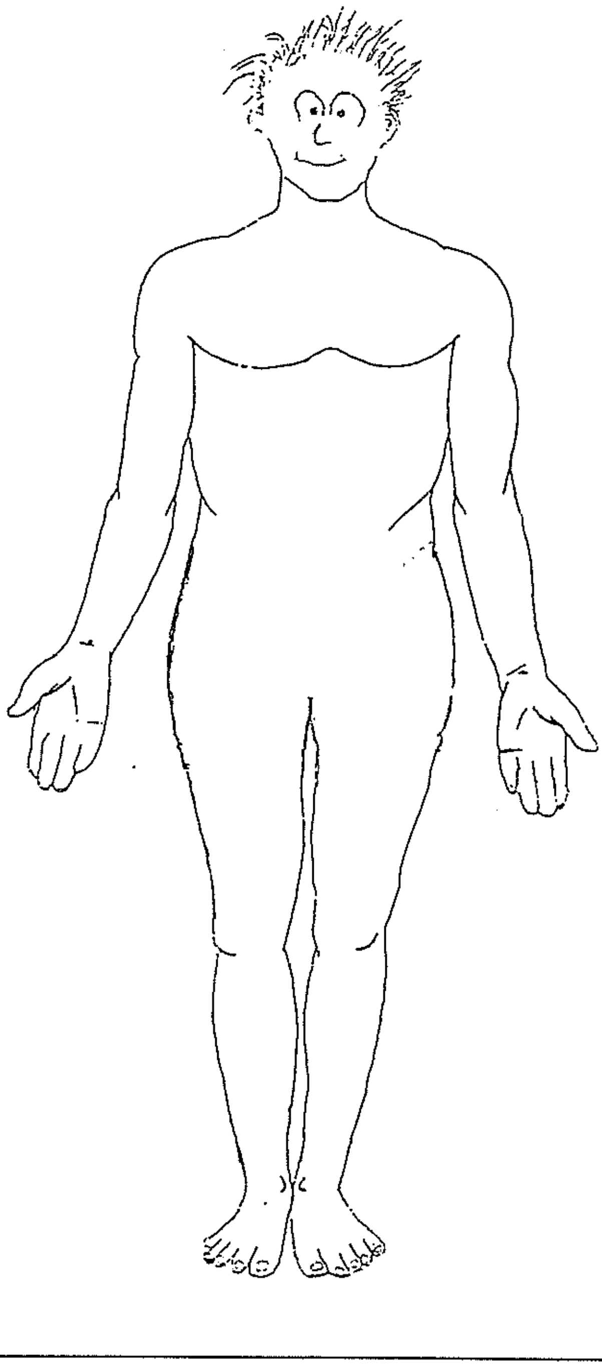
This is for two reasons.

1) the more movable joints are the ones that we most often use in our common daily activities

2) the more mobile joints are the joints most often injured.

Activity:

In the picture given below, please (a) draw all the bones that you know and (b) name of all of the body parts and bones that you see in the picture.



<u>Activity</u>: The shoulder, elbow, wrist, hip, knee and ankle are all joints that have some mobility. Please name the bones that help to make each of these joints.

SHOULDER ________________ ________________

HIP ________________ ________________

ELBOW ____________ ____________ ____________

KNEE ____________ ____________ ____________

WRIST ____________ ____________ ____________

ANKLE ____________ ____________ ____________

Because the bones are not tightly attached to each other, the more mobile joints have other parts that help to keep the bones together.

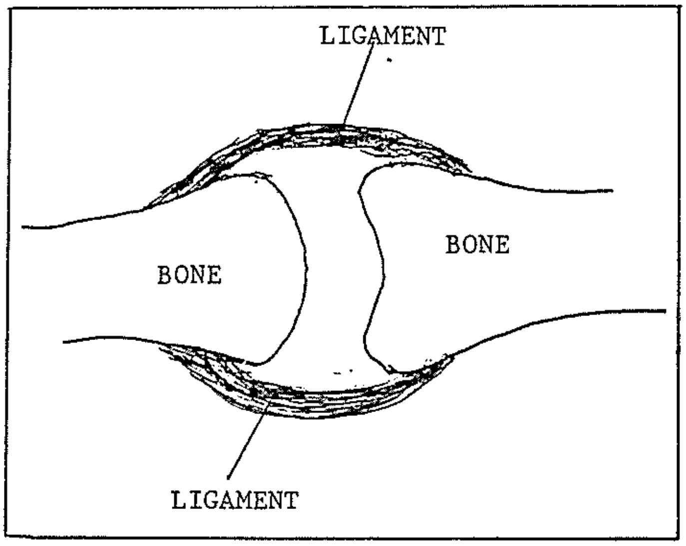
D. DIFFERENT PARTS OF A MOBILE JOINT

We have said that bones are alive. The other parts of a joint are also alive! They need food, can become sick or damaged, and will grow and change with time and activity.

There are many different parts that help to keep the bones together. The parts that the PTA should know are:

1. ligament
2. tendon
3. cartilage
4. capsule

1. LIGAMENT



The ligament directly connects bone to bone.

The main function is to limit joint movement. It is very strong and is like the plastic (rope) that is used to hold packages together.

It helps to give the joint more stability.

Activity: Draw a picture of the right femur, tibia and fibula in anatomical position.

Draw a ligament attaching the external side of the femur with the external side of the fibula.

Draw a ligament attaching the internal side of the femur with the internal side of the tibia.

What are the functions of these ligaments?

____

____

____

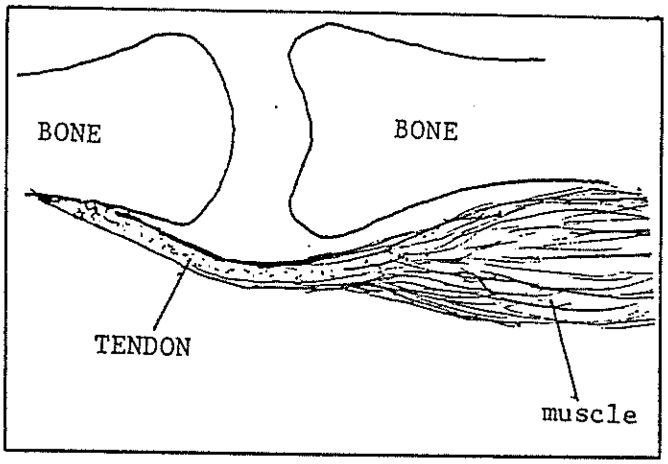
What direction of movement do they limit?

____

____

2. TENDON

<u>The tendon connects muscle to bone</u>.



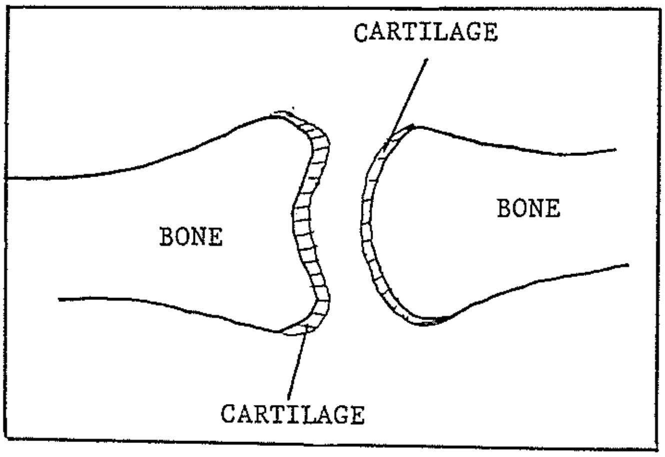
(Muscle is a very elastic part of the body that helps to make the bones move -- it will be discussed in the next chapter.)

A tendon is strong like a ligament and also gives stability to the joint .

Question: What area of the body do you find the patellar tendon (upper limb or lower limb)?

____

3. CARTILAGE



Cartilage is like very hard rubber; it covers the ends of bones to make movement easier.

It makes the surfaces smoother so the bones can move against each other without trouble.

Activity:

Cartilage is alive. Normally there is a special fluid that surrounds the cartilage that gives it food and keeps it wet.

Explain the problem at a joint is this fluid did not exist.

____

____

____

____

____

The disc in the vertebral column is also made of cartilage.

As we said earlier, it helps for more movement in the vertebral column.

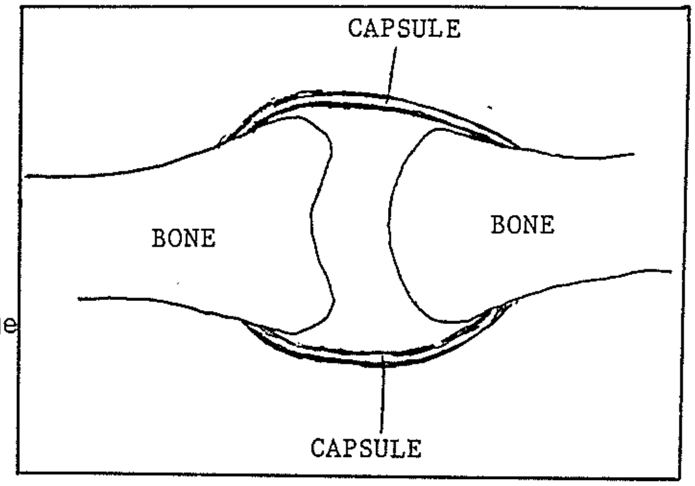
It also works to prevent damage to our vertebral bones as we walk, run or jump.

It does this by acting as a cushion placed between each of the hard bones.

This cushion decreases the hitting of hard bones together and so protects them from damaging each other.

4. CAPSULE

The capsule is like a plastic sac that surrounds the joint.



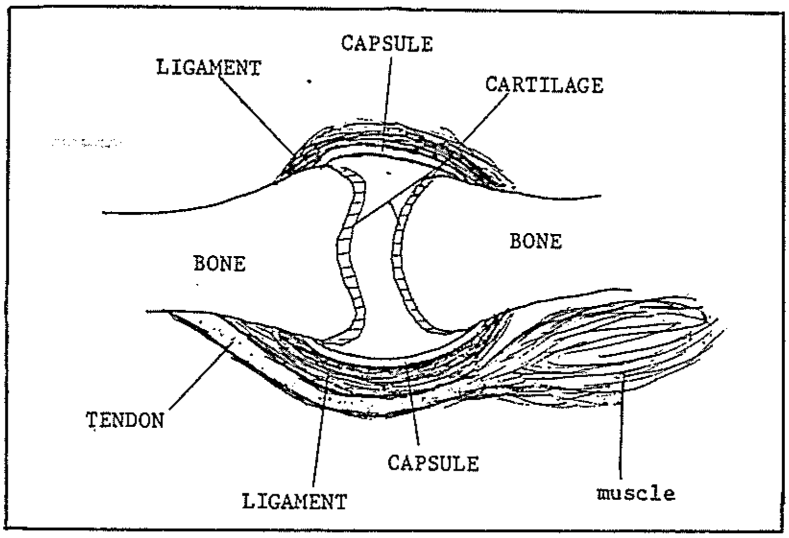
Inside of this sac is a water-like fluid that helps the bones to move on each other more easily.

This fluid keeps the cartilage healthy, wet and smooth.

The functions of the capsule are to keep this fluid in the joint and also provide some joint stability.

In summary, the five main parts of a movable joints are:

BONE, LIGAMENT, TENDON, CARTILAGE and CAPSULE.



Questions:

What three parts help to make a joint more stable? (Do not include bone).

____

____

What two things help to make the bones move more easily on one another? (Do not include bone.)

____

____

E. DIRECTIONS OF JOINT MOVEMENT

Bone shape can limit what direction a joint can move.

A tight muscle/tendon, tight ligament, or tight capsule could also decrease joint mobility.

Normally, each joint of the body has specific movements that it can do.

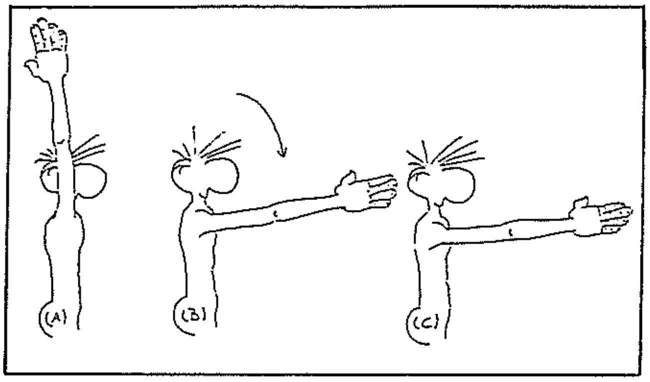
It is important for the PTA to know in what direction most normal joints move.

NOTE To be very clear, it must be well understood that you can say the direction that you move the limb AND the position the limb is in when it stops moving.

For example:

Start with your right shoulder in complete flexion (arm next to your head).

Next, slowly lower your arm until it is straight out in front of you.



You have started in a position of flexion (A)

You have moved in a direction of extension (B)

You have stopped in a position of flexion (C)

Anatomical position (BODY PARTS AND MEDICAL VOCABULARY CHAPTER) is the neutral position for all joints. *

This means that in anatomical position the joint has 0° flexion, 0° extension, 0° IR, 0° ER, 0° adduction, and 0° abduction.

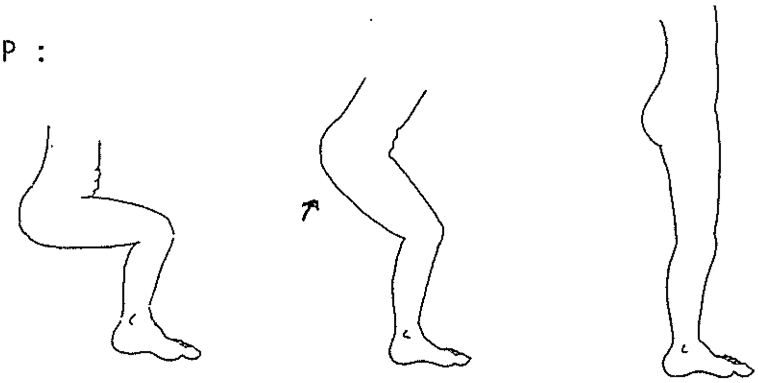
* The area that is not in neutral position is the forearm which is in complete supination.

Naming joint positions and directions of movement is in reference to anatomical position.

<u>Activity</u>:

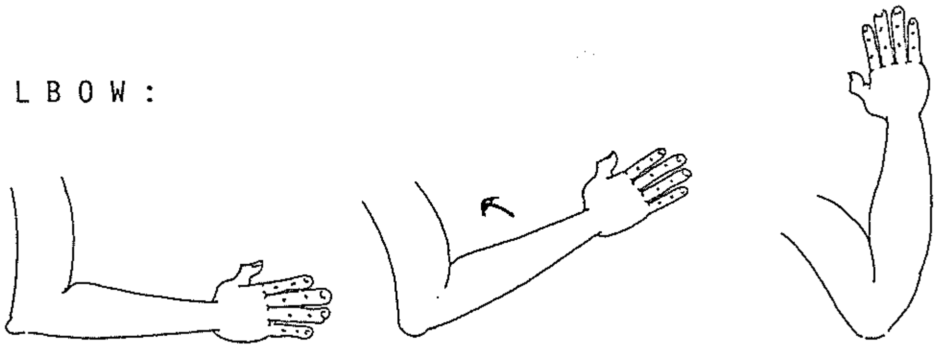
For each of the joints shown below, please write the name of the Starting Position (SP), Direction of Movement (DOM), and Ending Position (EP).

H I P :



SP ____________ DOM ____________ EP ____________

E L B O W :



SP ____________ DOM ____________ EP ________________

<u>Questions</u>:

In anatomical position, the forearm is in <u>supination</u>; why?

____

____

With the elbow extended and the forearm in neutral position, would the thumb be external, anterior, or posterior to the hand?

____

In Chapter 2 (pages 15 - 20) we discussed directions of movement. Review the different directions of movement and then apply them in the following activity.

<u>Activity</u>: For the joints listed below, write the types (directions) of movement that you can do at each joint.

SHOULDER ____________ ____________ ____________

____________ ____________ ____________

ELBOW ____________ ____________

Forearm * ____________ ____________

WRIST ____________ ____________ ____________

____

FINGERS ____________ ____________ ____________

____

THUMB ____________ ____________ ____________

____________ ____________

HIP ____________ ____________ ____________

____________ ____________ ____________

KNEE ____________ ____________

ANKLE ____________ ____________

Foot * ____________ ____________

TOES ____________ ____________ ____________

____

* Please note that the <u>forearm</u> and <u>foot</u> are NOT joints. They are areas where a movement can be seen most simply.

Question:

You can see that the types of movements you can do at different joints is not the same. Why?

____

____

F. AMOUNT OF JOINT MOVEMENT

The amount of movement at each joint is called the RANGE OF MOTION (ROM) of that joint.

Normally, each joint of the body has a specific amount of movement that it can do.

Bone shape can limit the amount of movement of a joint.

A tight muscle/tendon, tight ligament, or tight capsule could also decrease joint mobility.

If the amount of movement is not normal, then we must be able to write or say clearly how much movement there is at a joint.

To draw a picture of the joint position is one way to show how much a joint moves.

Another way to describe joint range of motion (ROM) is by using numbers.

Because numbers are the common method used in hospitals, it will be the method discussed in this manual.

To understand measurement of joint movement, we must first understand some basic mathematical words.

The words that are important to understand are angle, degree, perpendicular, and parallel.

ANGLE:

The picture shows two lines that join together. The space that is between the two lines is called an angle.

An ANGLE is the <u>amount of space that is between two lines that are joined together.</u>

The word used to describe how much space is between the two joined lines (angle) is <u>degree</u>.

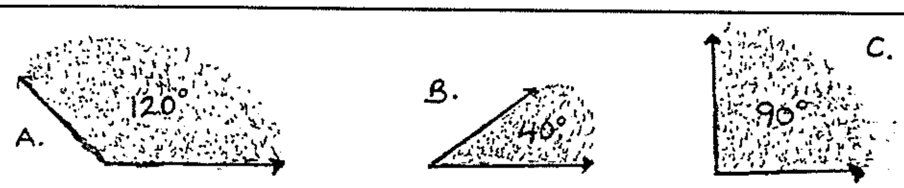
Normally, the word "degree" is represented by a small circle (°).

For example: 10 degrees is written as 10°
73 degrees is written as 73°
24° means 24 degrees.

A DEGREE is a word used to <u>describe how much space there is in an angle</u>.

<u>Activity</u>:

Below are pictures of three angles.

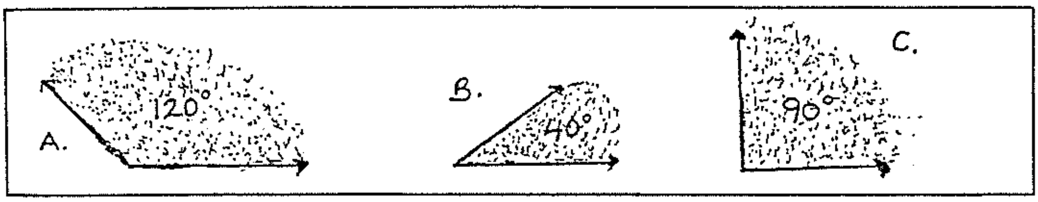


1. What picture has the most <u>space</u> between the two joined lines? ________________

2. What picture has the biggest <u>angle</u>? ________________

3. What picture has the smallest <u>angle</u>? ________________

Activity: (continued)



4. 40° is the measure of what? ____________________

5. What is the number of degrees of the angle in picture (C)? ____________________

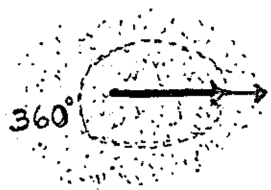
The PTA should be able to say approximately how big an angle is just by looking at it with her eyes.

Three angles that are very easy to see are 360°, 180°, and 90°.

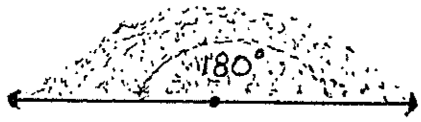
These are very important angles to remember; you can more easily identify other angles if you use these angles as your reference.

360°: If a line joins another line and is going in exactly the same direction, the space between them is 360°.

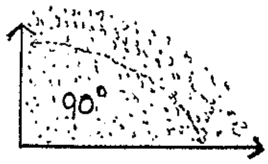
(Note that at the end point there is also no space between the two joined lines, so this angle can also be 0°.)



<u>180°:</u> If two lines join together in <u>exactly opposite</u> directions, then the space between them is 180°.



<u>90°:</u> If two lines join together and the space between them is 90°, (exactly one half of 180°), then the lines are PERPENDICULAR.



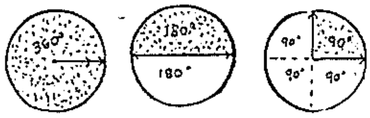
<u>Activity</u>: 90° angles are very common when building houses, chairs, and equipment. Give three examples of PERPENDICULAR lines (90° angles) that you can see in your classroom.

1. ______________________________

2. ______________________________

3. ______________________________

In summary, three angles that are easy to see are 360°, 180°, and 90°.



The last general word to know is PARALLEL.

<u>Parallel lines do not join together</u>.

For example:

With one line "A", there can be many, many lines that are parallel to "A".

These lines can be above "A"

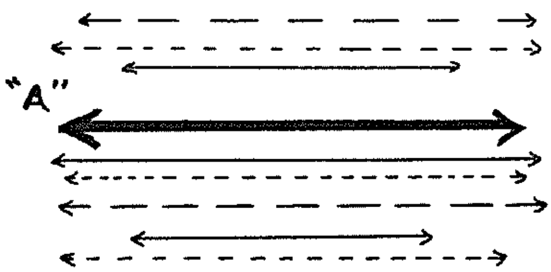
below "A"

beside "A"

on top of "A"

close to "A"

far from "A"



The one rule they must all follow is that to be parallel to "A", they must be placed in exactly the same direction as "A".

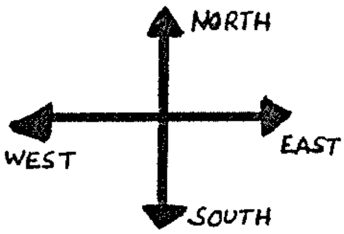
If you have two lines that are parallel, their ends will never meet (never join together)

Question: What does parallel bars mean?

____

____

Activity: On many maps you need to have the directions of North, South, East and West so you can find your way. Most often the directions look like the picture on the left.



1. How many degrees are between North and East? ____________

2. What direction(s) is (are) perpendicular to West?

   ____

3. How many degrees between North and South? ____________

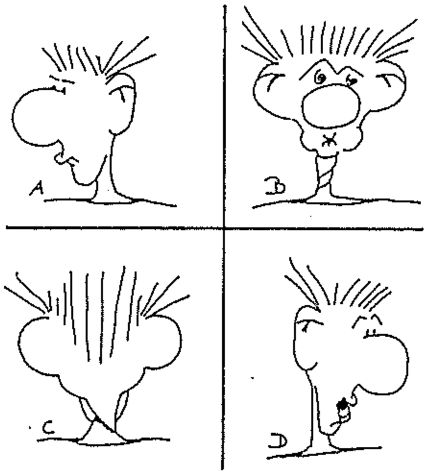
<u>Activity</u>:

This is a picture of a head. Choose the correct head position (between A, B, C, D) to answer the following questions.

1. If head (x) turns 180°, what will be the end position(s)? ____________

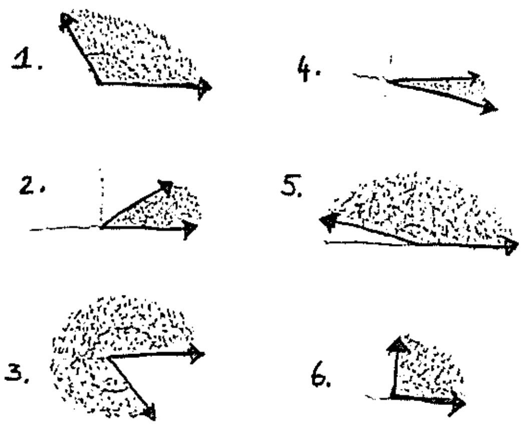
2. If head (x) turns 90°, what will be the end position(s)? ____________

3. If head (x) turns 360°, what will be the end position(s)? ____________



<u>Activity</u>: Match the picture with the number of degrees it describes correctly.

1. 45° ____________
2. 100° ____________
3. 300° ____________
4. 90° ____________
5. 160° ____________
6. 20° ____________



Draw an angle of 75° ______________________

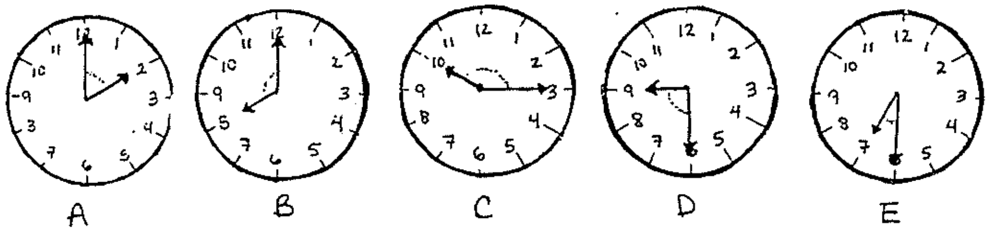
Draw an angle of 90° ______________________

Draw an angle of 10° ______________________

Draw an angle of 270° ______________________

Activity: Below are pictures of five clocks. Please give the number of degrees (the amount of space) that is between the two hands on each clock.

A. ________ B. ________ C. ________ D. ________ E. ________



Now that you are familiar with angles and measurements, we will apply them to the human joints.

We had said that each joint of the body can move in specific directions.

The PTA should know that for every direction, the joint only moves in a specific space (number of degrees).

This amount of movement is called range of motion (ROM).

The Range of Motion (amount of movement) at each joint can be measured.

It is important to know if the range of motion is normal, or if the movement is limited (amount of movement is less than normal).

The guidelines, hand positions, and movements made to evaluate range of motion will be presented at the end of this chapter.

G. SPECIFIC JOINTS OF THE BODY

In the following joints, more complete anatomy, specific movements and range of motion will be discussed.

I. Shoulder *

II. Elbow

III. Forearm *

IV. Wrist *

V. Hand/Fingers *

VI. Hip

VII. Knee

VIII. Ankle

IX. Foot/Toes *

X. Vertebral column *

** Note that these areas may be a combination of many joints (hand, foot, shoulder, vertebral column); or may be an area and not a joint (forearm).

For each of the areas shown above, the following information will be given.

a. bones

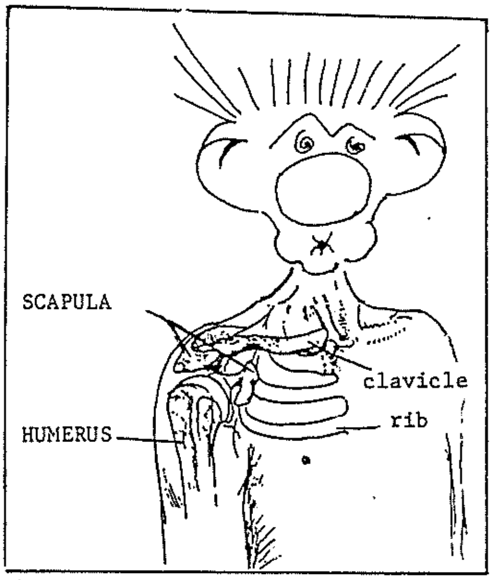
b. function

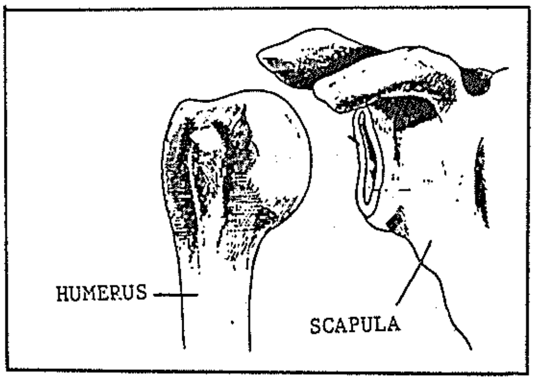
c. other structures

d. movement

e. range of motion

I. THE SHOULDER



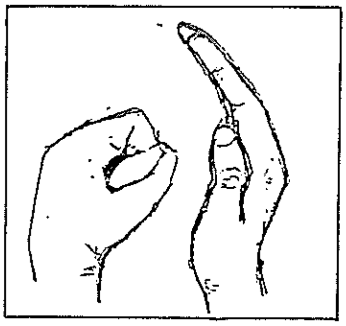


a) Bones of the shoulder

There is more than one joint in the shoulder area, but the joint most commonly identified as the "shoulder joint" is the one made by the joining of the HUMERUS with the SCAPULA.

The humerus is like a stick with a ball on its proximal end. The part of the scapula where the humerus attaches is shaped like a shallow half-circle.

Activity: With your left hand, flex the fingers tightly so the hand is in a fist. Flex the wrist slightly. Keep it in this position. With the right hand, adduct all fingers so that they are touching together. Now bend the palm and the fingers a small amount. Keep it in this position. Now put the left hand in the palm of your right hand. Your left hand is the head of the humerus and your right palm is a part of the scapula where the head of the humerus attaches.



b) Function of the shoulder

The function of the shoulder is to attach the upper limb to the trunk.

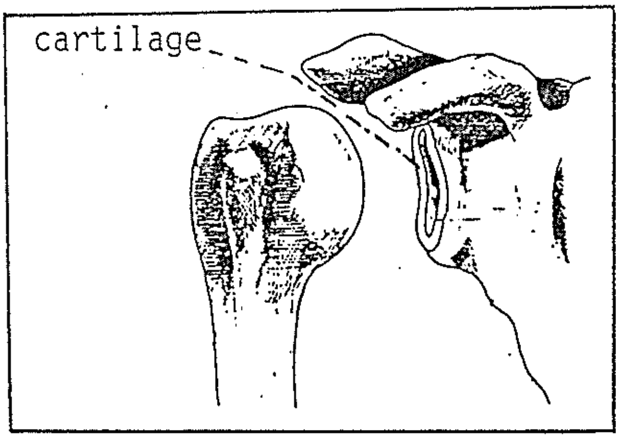
Because it is a very mobile joint, it allows the hand to be functional is many different positions around the body.

c) Other Structures of the shoulder

Because of the shape of the bones, the shoulder is not a very stable joint.

The capsule, muscles, and tendons provide the stability for this joint.

Observe that the cartilage helps to make the cup shape on the scapula a bit more deep.



d) Movement of the shoulder

It is important to know that to move the upper limb, the scapula and clavicle will move also.

Question: If the scapula could not move, would you expect the Range of Motion (ROM) at the shoulder to be increased or decreased?

____

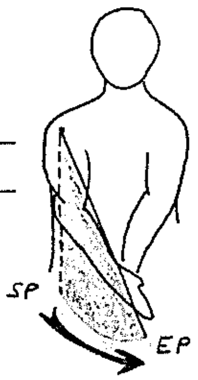
Why ? ___________________________________

____

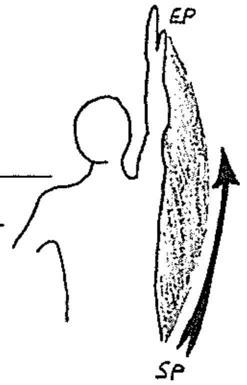
____

e) Range of Motion of the shoulder

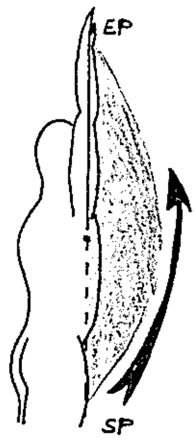
<u>Activity</u>: For the pictures given below, please write the <u>name of the position</u> and the <u>number of degrees</u> between starting and ending positions. The amount of space between them is a darker area.



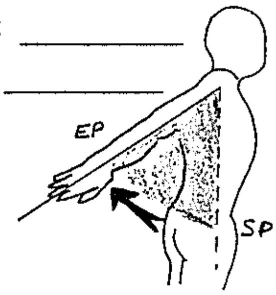
Position : ______
Degrees : ______



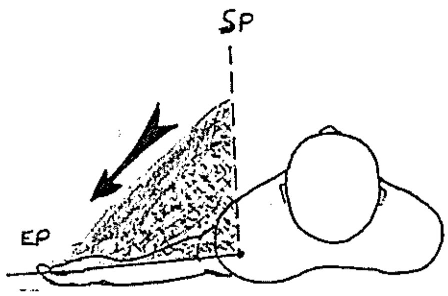
Position : ______
Degrees : ______



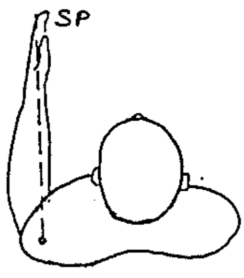
Position : ______
Degrees : ______



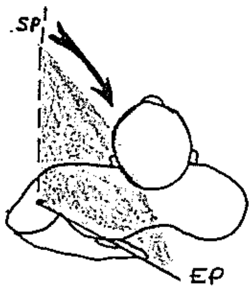
Position : ______
Degrees : ______



Position : ______
Degrees : ______

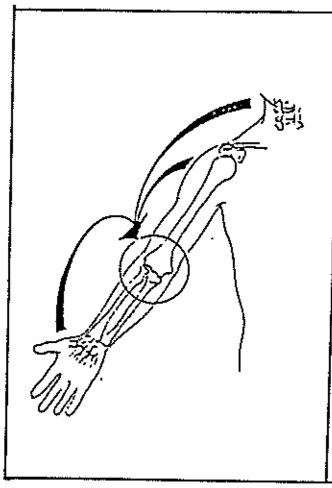


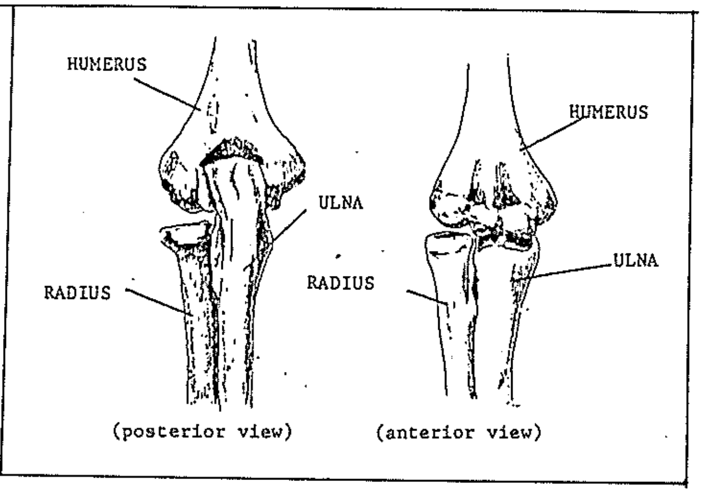
Position : <u>neutral</u>
Degrees : <u>0°</u>



Position : ______
Degrees : ______

II. THE ELBOW





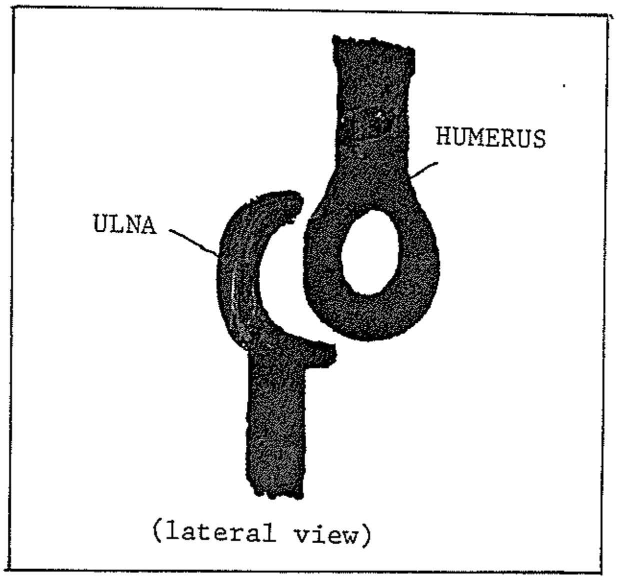
(posterior view) (anterior view)

a) Bones of the elbow

The elbow is the attachment of the distal part of the HUMERUS with the proximal parts of the RADIUS and ULNA.

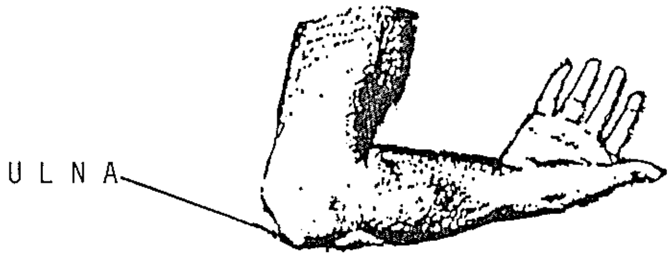
Note that the ulna has the most contact with the humerus and has a very special shape.

The proximal part of the ulna is shaped like the letter "c" and the distal humerus is shaped like the letter "o".



(lateral view)

<u>Activity</u>: Feel the posterior elblow area; the bone that makes the point of the elbow is the proximal part of the ulna. This part is called the OLECRANON.



b) Functionof the elbow

<u>Activity</u>: Normally you have three bones between the shoulder and the wrist. Your body has changed and now you have only <u>one long bone</u> in the upper limb; the length of your upper limb remains the same.

With this new upper limb, try to scratch the top of your head. Try to put something in your mouth. Try to write words in your book.

Describe what happened with these activities:

____

Did you have difficulty? ____________________

If yes, what?

____

In your own words, write the function of the elbow joint:

____

____

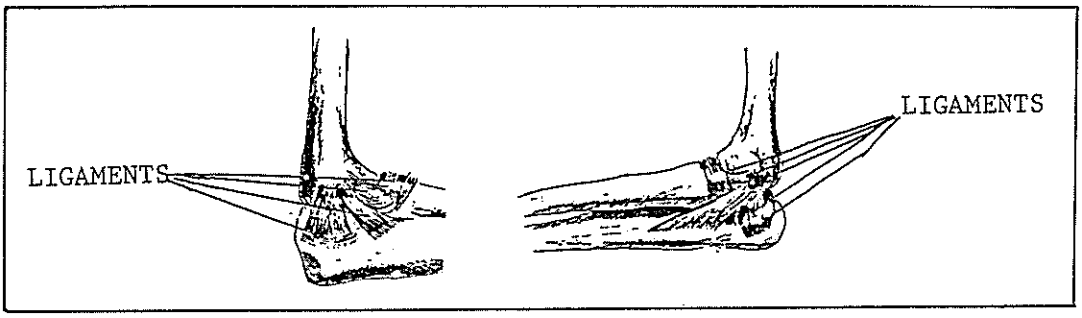
____

c) Other Structures of the elbow

Because the ulna fits closely with the humerus, the elbow is a very secure joint.

There are, however, many ligaments that connect the radius to the ulna, and the ulna and radius to the humerus.

The joint capsule surrounds the distal end of the humerus and the proximal parts of the radius and ulna.

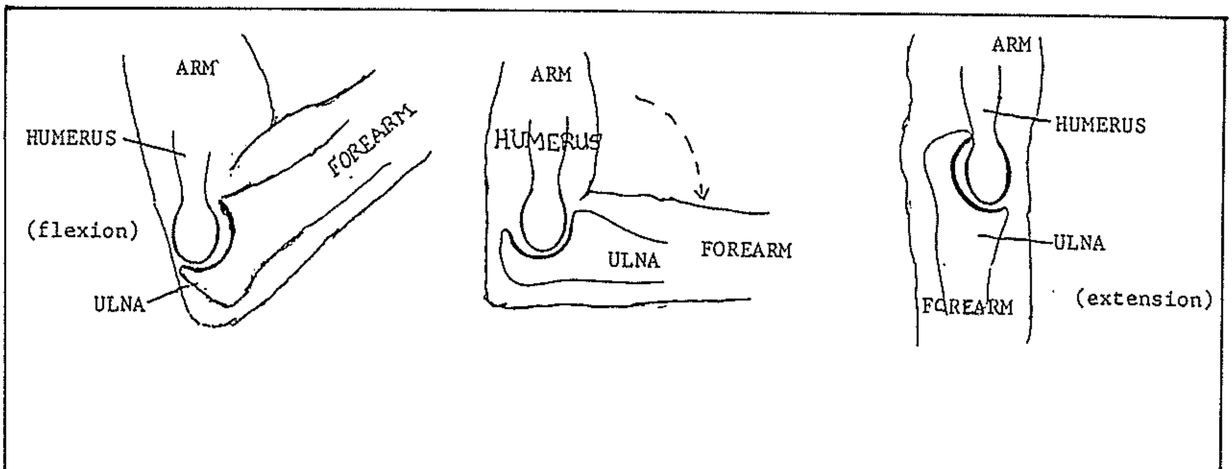


d) Movement of the elbow

Observe that with elbow movement, the "c" (ulna) moves on the "o" (humerus).

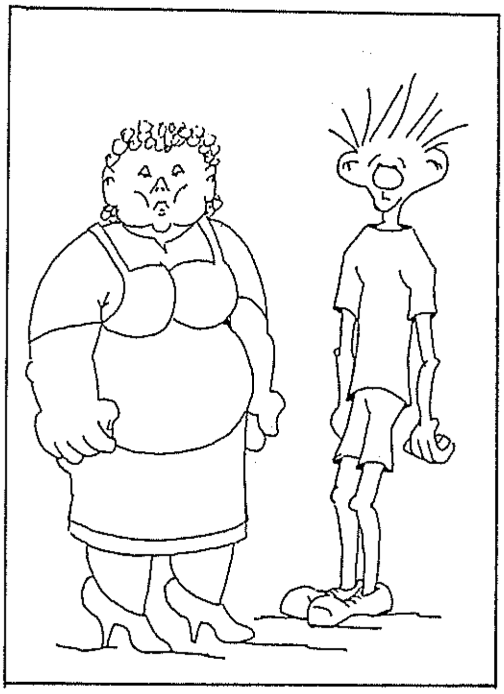
The movement of <u>extension</u> stops when the top of the "c" contacts the humerus.

In flexion, it is more the skin and muscles that will stop the movement.



INTERNAL VIEW OF RIGHT ARM

Activity: You are measuring the elbow ROM on two patients. One is a huge obese woman and the other is a very malnourished man.



Will elbow flexion be the same for these two patients?

____

Why or why not?

____

____

____

____

If not the same, who will have more ROM for elbow flexion (the woman or the man)?

____

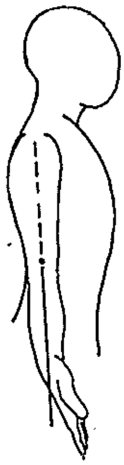
* Note that the joints of each patient are normal.

e) Range of Motion of the elbow

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between then is a darker area.

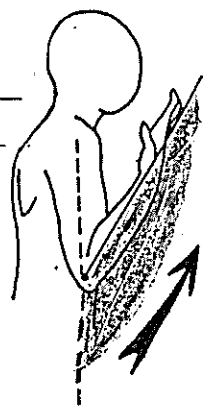
Position : __________

Degrees : ___0°____

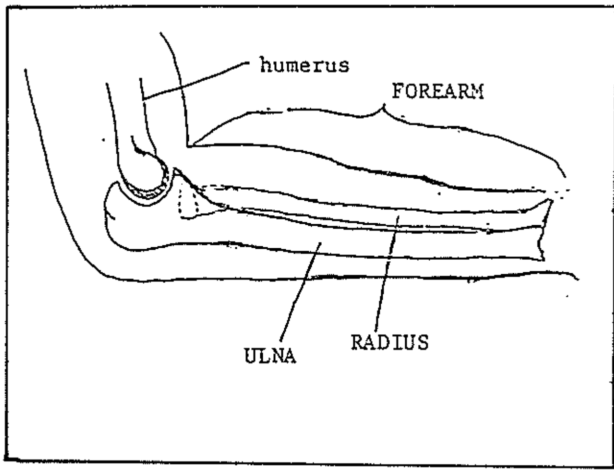


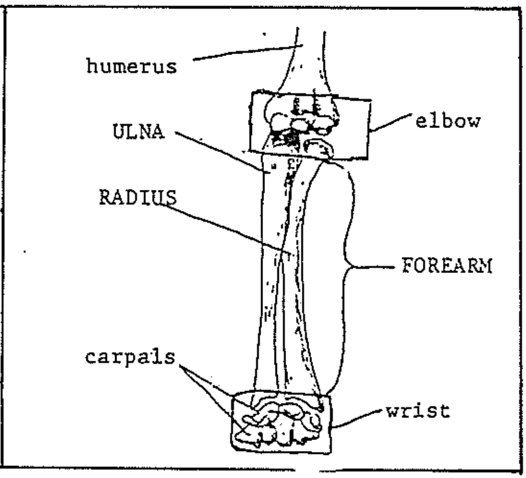
Position : ___

Degrees : ______



III. THE FOREARM (Note that this is an area and not a joint.)





a) Bones of the forearm

The bones of the forearm are the RADIUS and the ULNA.

b) Function of the forearm

The function of this area is to make the hand more functional in allowing <u>pronation</u> and <u>supination</u>.

<u>Activity</u>: Please list four activities that you could not do if you were unable to pronate and supinate the forearm.

1. ______________________________

2. ______________________________

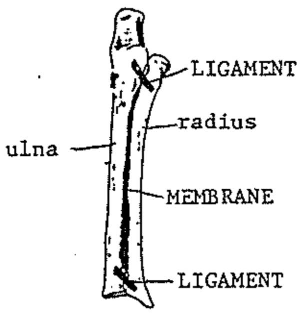
3. ______________________________

4. ______________________________

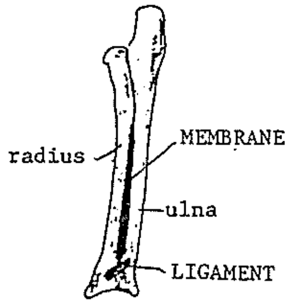
c) Other Structures of the forearm

There are ligaments at the proximal and distal ends of these bones to help to provide stability.

There is also a strong membrane that helps to attach the two bones along the middle.



(anterior view)



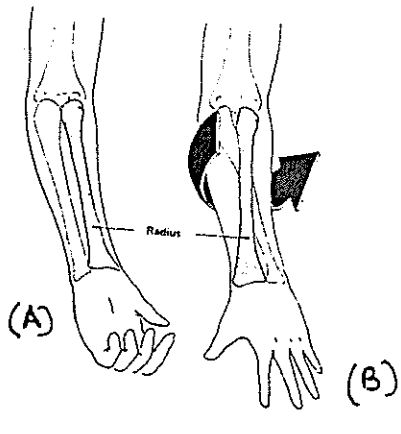
(posterior view)

d) Movement of the forearm

In supination, the raduis and ulna are parallel to each other (A).

In pronation the radius crosses over the ulna (B).

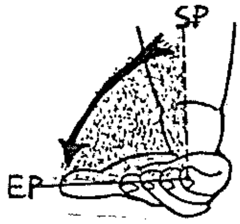
The actual crossing of bones occurs in the forearm; thus we have decided to describe supination and pronation as happening in the forearm.



(anterior view
left forearm and
hand)

e) Range of Motion of the forearm

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

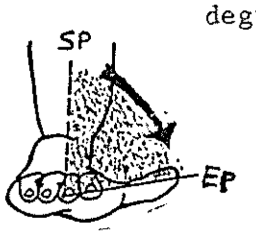


position: ______________

degrees: __________

position: neutral

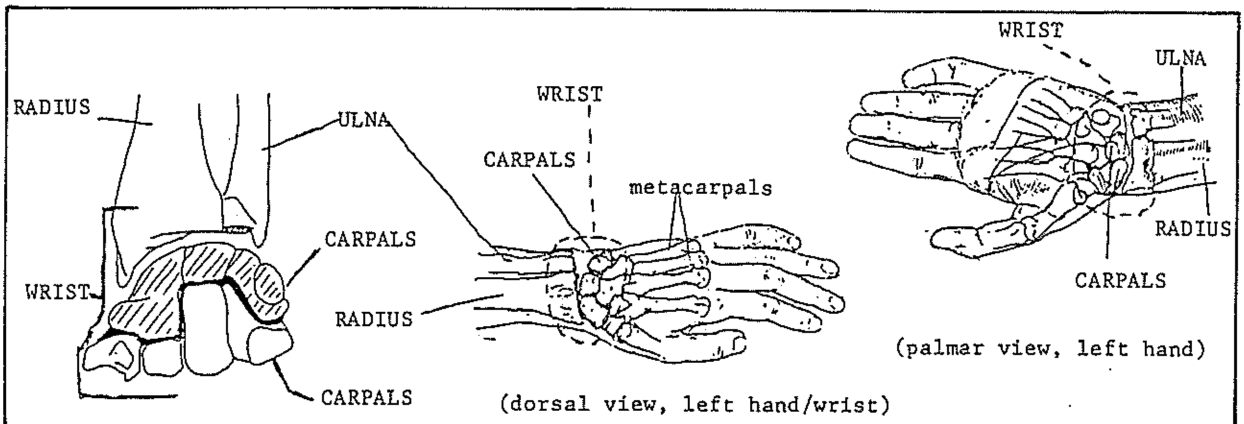
degrees: 0°



position: ____________________

degrees: ___________

IV. THE WRIST



(dorsal view, left hand/wrist)

(palmar view, left hand)

a) Bones of the wrist

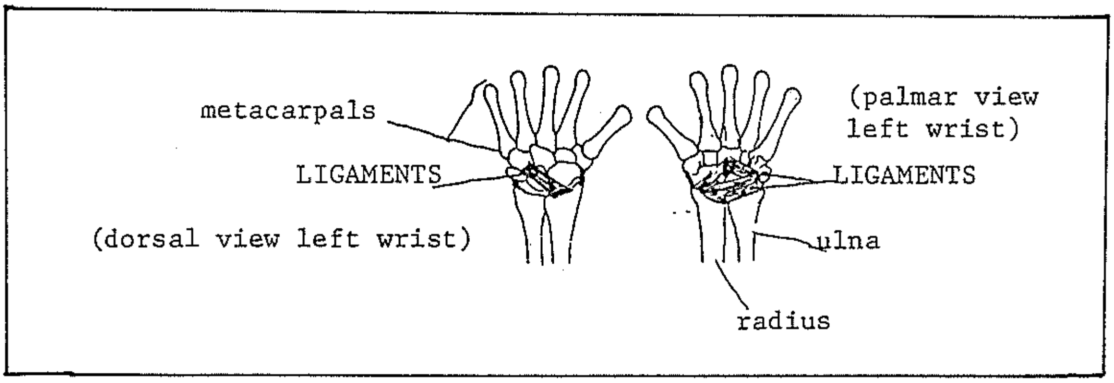
The wrist is made of the joining of the distal RADIUS/ULNA and the CARPAL BONES.

b) Function of the wrist

Like the other joints in the upper limb, the wrist joint helps to make the hand more mobile and functional in everyday activities.

c) Other Structures of the wrist

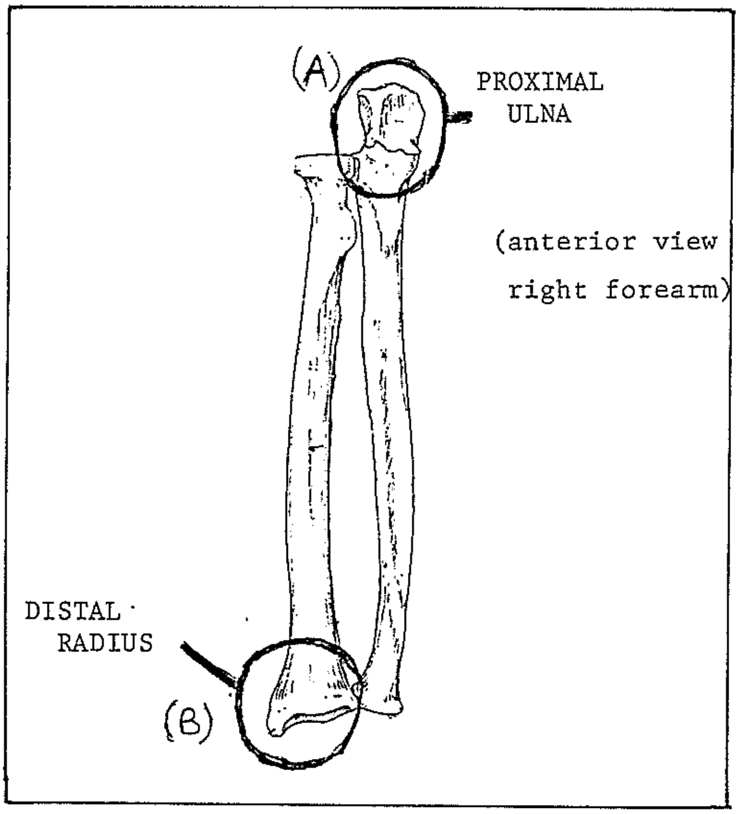
There are many small ligaments that attach the bones of the forearm and the carpal bones together.



d) Movement of the wrist

Note that in the elbow, the proximal part of the ulna has the most contact and importance in movement. (A)

In the wrist, it is the distal part of the radius that plays the major role in contact and movement. (B)

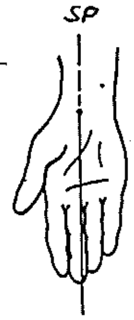


e) Range of Motion

<u>Activity</u>: For the pictures given below, please write the <u>name of the position</u> and the <u>number of degrees</u> between starting and ending positions. The amount of space between then is a darker area.

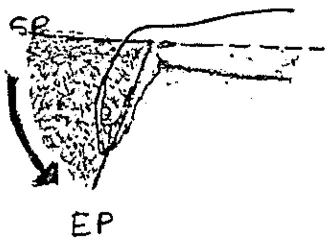
position: neutral

degrees: 0°



position: neutral

degrees: 0°

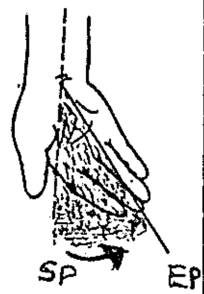


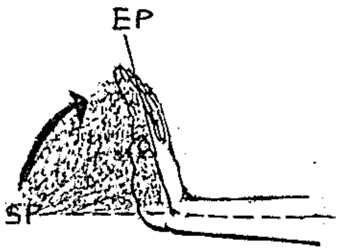
position: ______

degrees: ______

position: ______

degrees: ______





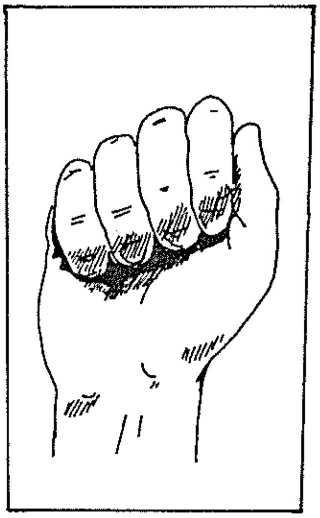
position: ______

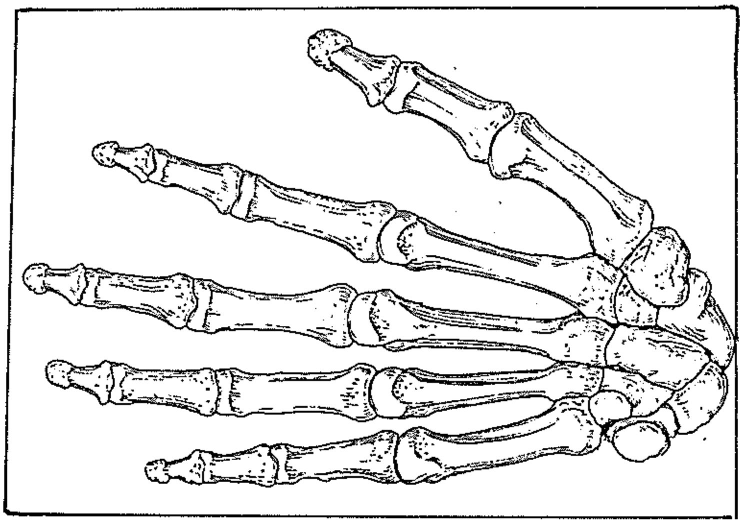
degrees: ______

position: ______

degrees: ______

V. THE HAND/FINGERS





a) Bones of the hand/fingers

Question: There are many bones and many joints in the hand. What are the names of the bones in the hand?

________________ _________________ _________________

Activity: Look at the fingers and thumb; how many joints (total) are in these parts?

Fingers: ____________ Thumb: ______________

b) Function of the hand/fingers

<u>Activity</u>: Think about all the times you use your hands in one day. Please list five activities that you do with your hands.

1. ____

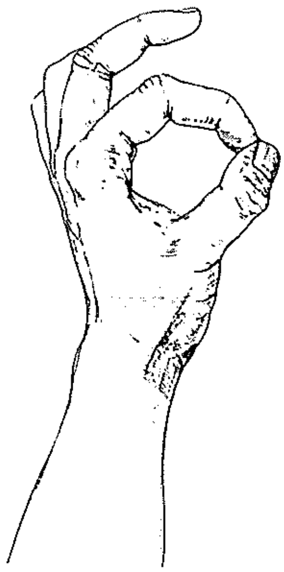
2. ____

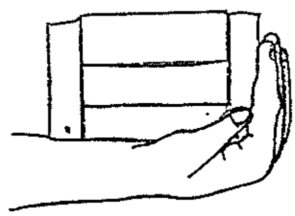
3. ____

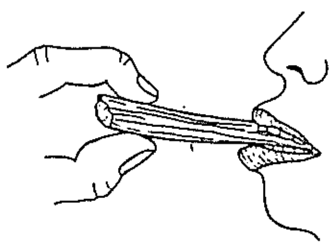
4. ____

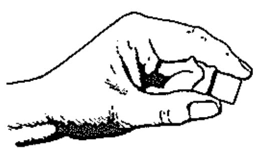
5. ____

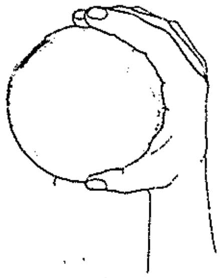
Your hands are the tools that you have to grab and move all things (light, heavy, big, or small) in any way that you wish.

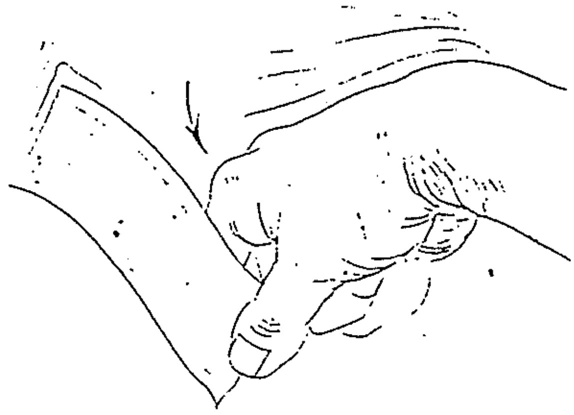


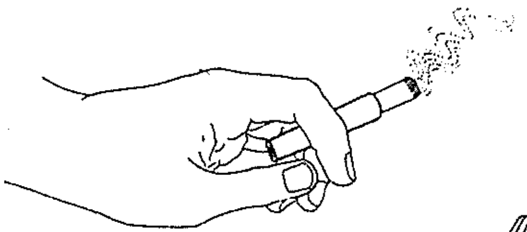


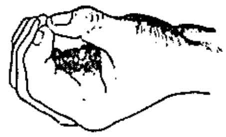












c) Other Structures of the hand/fingers

In the hand and fingers there are many, many ligaments that hold all of these small bones together.

Look at the shape of the palm; you can see that it is not flat, but looks more like the shape of a spoon. 

This helps to make objects easier to hold. It is made by bone shape, ligaments, and small muscles of the hand.

There are also many tendons that attach to different bones in the hand.

These tendons are from muscles that work to extend or flex the hand; they can be seen on the dorsal and palmar side of the hand or wrist.

<u>Activity</u>:

Supinate your forearm and put your thumb and last finger together. Slightly flex your wrist. When you look at your wrist you should see one long tendon that comes from your forearm and passes your wrist.

Pronate your forearm. Flex all of your fingers together making a fist. In this position, gently move your index finger in abduction and adduction. You can see the tendon moving across the knuckle.

d) Movement of the hand/fingers

Because the hand has many small bones, it can easily change its shape to fit many different sizes and shapes of objects.

A special movement found only in humans in the movement made by the thumb.

This movement is called <u>opposition</u>. Opposition is the thumb's ability to touch the other fingers in the hand.

We use opposition every time we write (holding a pen between fingers and thumb), eat (holding a spoon or food between the fingers and thumb), in dressing, and many other activities during the day.

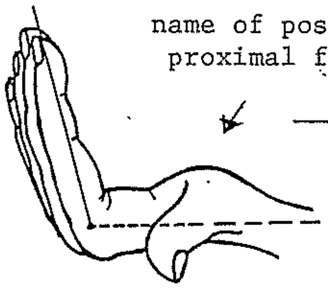
Opposition is very important!

e) Range of Motion of the hands/fingers

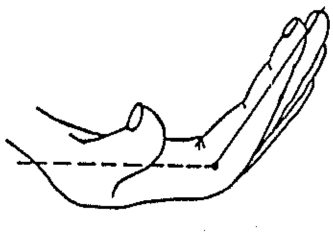
Because the movements of the hand are difficult to measure, sometimes it is better to <u>describe the position</u> of the fingers and thumb and say <u>what they can do functionally</u>.

Activity:

For each of the pictures below, write the name of the position only.



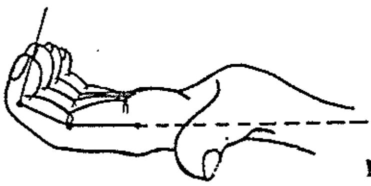
name of position of
proximal finger joint: ____________



name of position: ____________

name of position of the thumb:

____

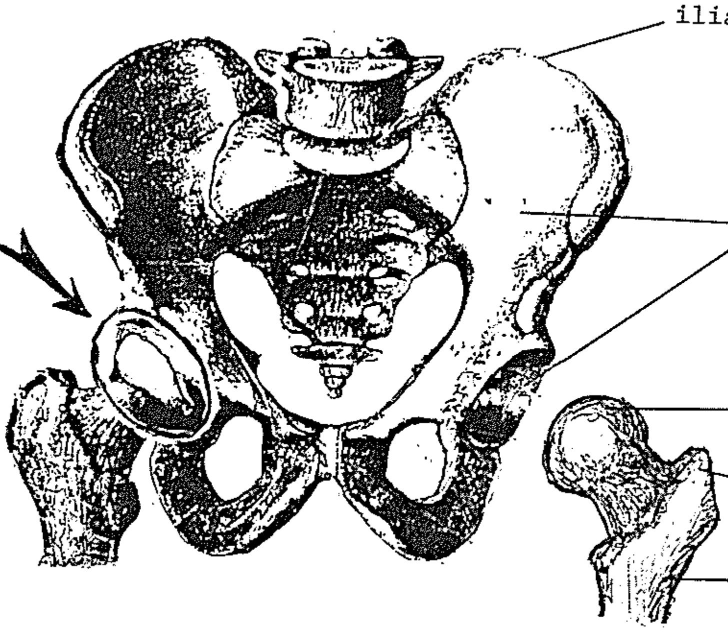


name of position of
distal finger joint:

____

name of position: ____________

VI. THE HIP



a) Bones of the hip

The hip is the joining of the FEMUR with the ILIAC BONE.

The way the two bones come together is similar to the shape of the place where the humerus and scapula meet in the shoulder.

Activity:

In your own words, describe the shape of the hip joint where the surfaces of the femur and iliac bone come together.

____

____

____

Although the hip joint and the shoulder joint are similar in their shape, there are some differences between the two joints:

* The place on the iliac bone where the femur attaches is <u>deeper</u> than the place where the humerus attaches to the scapula.

* Ligaments and tendons in the shoulder are very important for stability.

* The ligaments and tendons in the hip are not as important because the bone shape helps to make the hip joint more stable.

* The hip is a bigger and stronger joint made for weight bearing; the shoulder is not.

b) Function of the hip

The function of the hip is <u>weight bearing</u> and <u>mobility</u>.

It allows the leg and foot to be placed in many different positions; it also holds the weight of the upper body during standing and walking activities.

<u>Activity</u>:

Normally your hip joint can move in many directions. Imagine this has changed. Your hip joint is now fused and no movement can happen here. Your lower limbs are in a straight position only, and cannot move.

Desribe how your put your pants on in the morning.

____

____

____

____

Activity: (continued)

Desribe how you walk.

____

____

____

____

Describe how you sit.

____

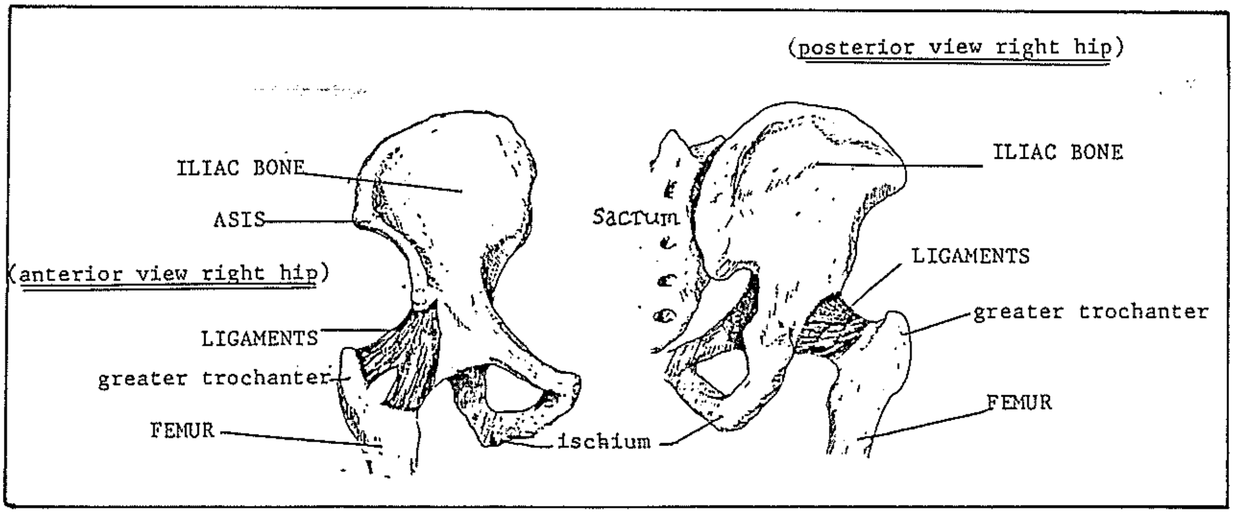
____

____

____

c) Other Structures of the hip

There are many strong ligaments that help support the hip on all sides.



d) Movement of the hip

It is important to know that the hip joint is indirectly attached to the sacrum (i.e. the femur attaches to the iliac bone and the iliac bone attaches to the sacrum).

This means that movement at the hip can affect the vertebral column.

This is because of the many ligaments and tendons that are in these areas.

Activity:

Put your body in supine position with the lower limbs straight. straight. Feel the lumbar area of your vertebral column.

In supine position, flex your hips and knees, and put your feet flat on the floor. Again feel the lumbar area of your spine.

In what position do you feel more lumbar lordosis?

____

____

What position decreases lumbar lordosis?

____

____

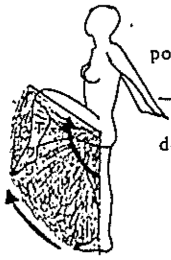
e) Range of Motion of the hip

Activity:

For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

position: ____________

degrees: ________



position: ____________

degrees: ____

position: ____________

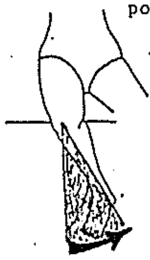
degrees: ________

position: ____________

degrees: ________

position: ____________

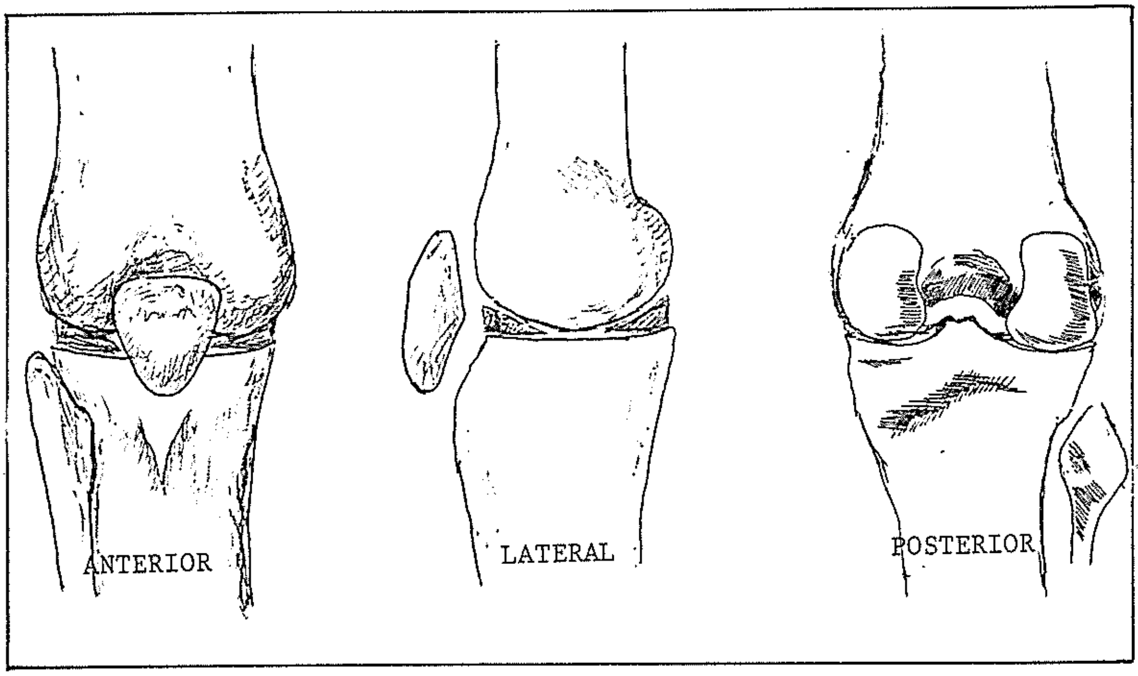
degrees: ________



position: ____________

degrees: ____

VII. THE KNEE



a) Bones of the knee

The bones that make the knee joint are the distal part of FEMUR, proximal part of TIBIA, and the PATELLA.

Although the fibula is <u>near</u> the joint, it is not a part of the knee joint.

b) Function of the knee

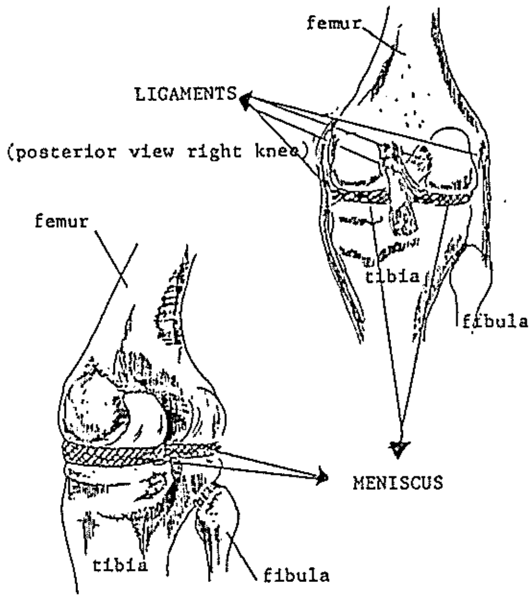
The knee helps to <u>support the weight</u> of the body in standing and walking and helps in <u>mobility</u> (walking, sitting and squatting activities).

Knee flexion and extension also provide a functional shortening and lengthening of the lower limb.

c) Other Structures of the knee

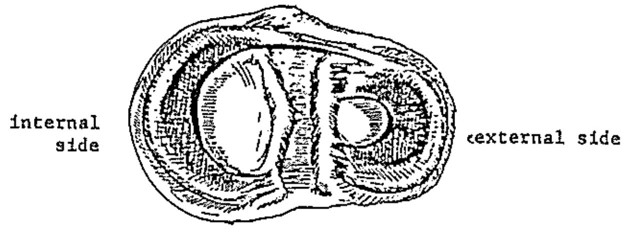
The bones of the knee do not give it much stability; <u>but</u> the <u>many</u> strong <u>ligaments</u> that connect the bones, and the tendons that cross the joint help to make it a stable joint.

It is more stable in extension than in flexion because the ligaments are more tight in extension.



(postero-medial view right knee)

There is also special cartilage (called MENISCUS) that is between the femur and the tibia. Its function is for increased stability and to decrease hitting of the femur and tibia together.



(superior view of both meniscus on tibia)

The knee joint is one of the most complex because of the many tendons and many ligaments that attach in this area.

The joint capsule is also very big and is important in holding the fluid that helps the three bones easily move upon one another.

d) Movement of the knee

The patella changes its position with knee flexion and extension. In flexion it moves down, in extension it moves up.

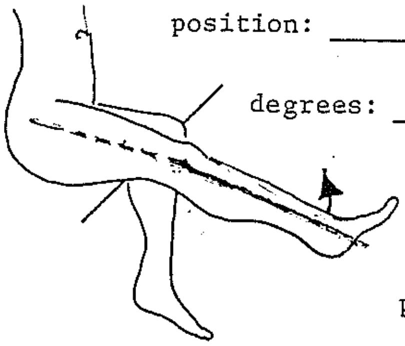
A small amount of internal and external rotation can happen at the knee. These movements happen only when the knee is flexed at 90 .

It is not important for the PTA to measure this movement; just know that <u>some rotation</u> of the knee can occur when the knee is in a flexed position.

e) Range of Motion of the knee

Activity:

For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

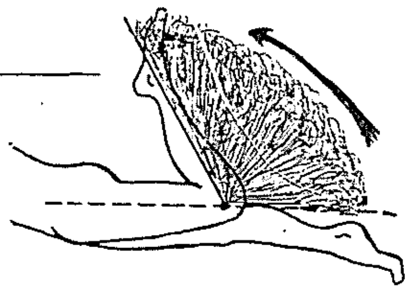


position: ______________________

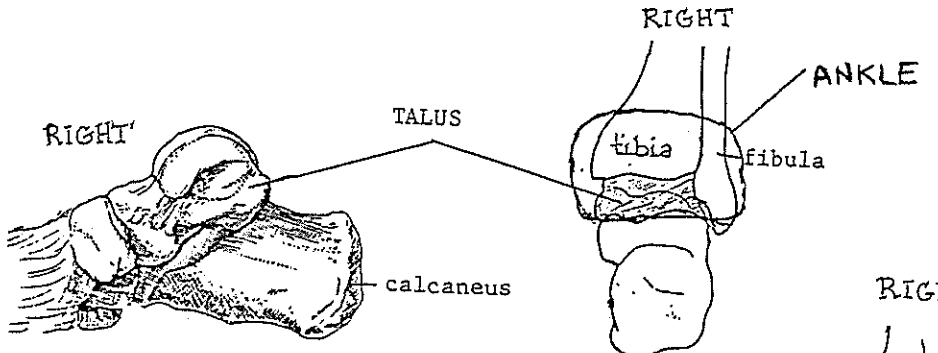
degrees: ________

position: ______________________

degrees: ________

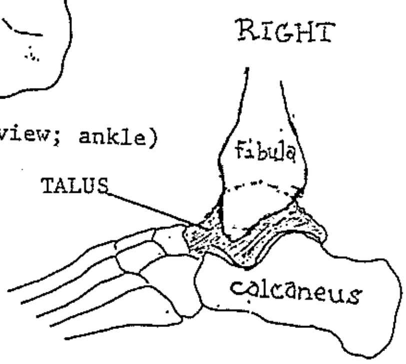


VIII. THE ANKLE



(internal view; talus and calcaneus)

(posterior view; ankle)



(external view of the ankle)

a) Bones of the ankle

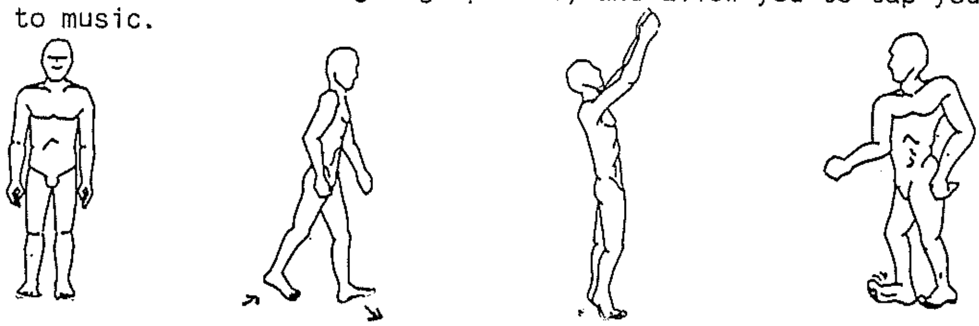
Many people will call the area where the foot and the leg meet the "ankle"; generally, this is true.

More specifically, the ankle joint is the connection between the TALUS, the distal part of TIBIA, and the distal part of FIBULA.

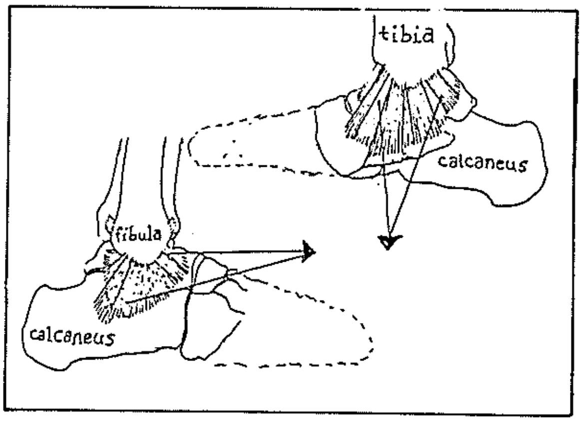
b) Function of the ankle

The ankle attaches the foot to the leg.

It works closely with the foot to support the body in standing, helps in contacting and leaving the ground when walking, can help make you taller in reaching high places, and allow you to tap your feet to music.



c) Other Structures of the ankle



Again, as in all of the joints, there are ligaments to help keep the bones together. The ligaments of the ankle joint help to give stability to the area.

Question:

Sometimes when you walk or run you turn your ankle and fall on the external side of the joint. The area below the distal fibula may have pain and swelling. What could be damaged?

___

e) Range of Motion of the ankle

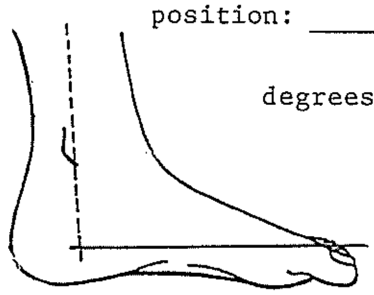
Activity:

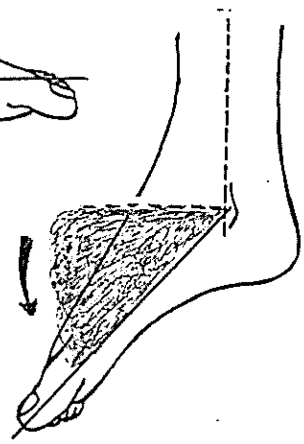
For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

position: ____________________

degrees: ______________

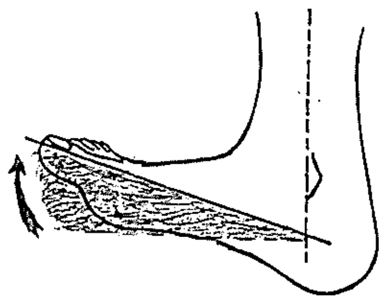
position: NEUTRAL





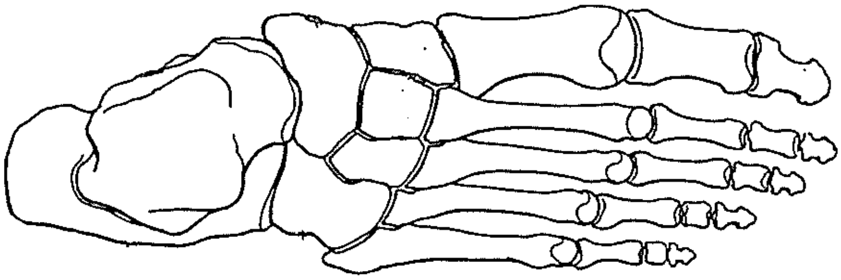
position: ____________________

degrees: __________________



IX. THE FOOT/TOES

superior view of right foot



a) Bones of the foot/toes

Activity:

As in the hand, there are many bones and joints in the foot and toes. Please write all of the bones that you know in the foot.

________________ ________________ ________________

________________ ________________

b) Function of the foot/toes

The foot functions as our only contact with the ground when walking.

It carries all of the weight of our body and adapts it shape to adjust to the surfaces we walk on.

Think about this as you walk on rocks, over uneven surfaces, and up and down hills.

The foot will always try to have complete contact with the surface it is walking on.

<u>Question</u>:

One boy (A) walks with very hard bottoms (soles) on his shoes; they cannot bend much. One boy (B) walks with thin rubber on the bottom of his shoes. On uneven surfaces, which boy will have the most movement between the bones in his feet?

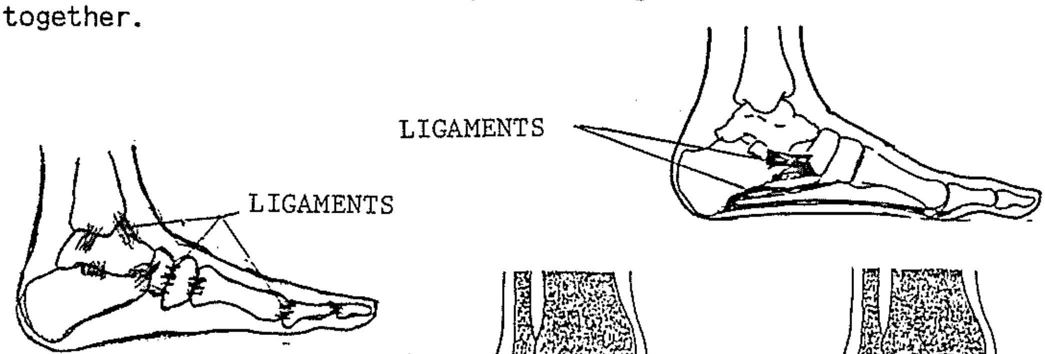
____

Why? ____

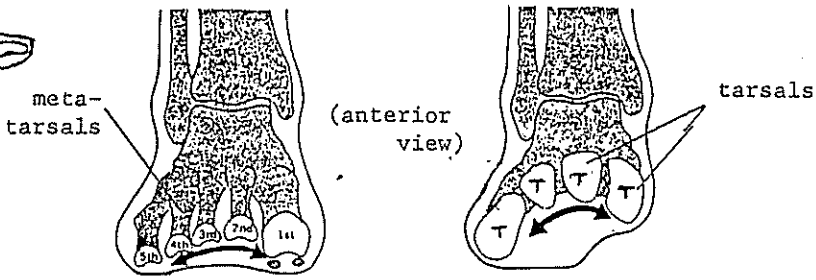
____

c) Other Structures of the foot/toes

As in the hand, there are many small ligaments that attach the bones together.

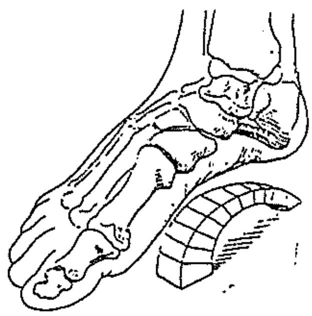


Just as the hand has a special shape, so does the sole (bottom of the foot).



(transverse arches of the foot)

The rounded part is called an <u>arch</u>. The arches help the foot adjust to the different surfaces that it moves on.



(long arch of the foot)

There are also many tendons that attach to the bones of the foot and toes.

These tendons are from muscles that will dorsiflex or plantarflex the foot.

<u>Activity</u>:

You can see many tendons on the dorsal side of the foot if you extend the toes.

Posteriorly, you can see and feel a big tendon just superior to the calcaneus.

There are also many small muscles located in the foot/toe area.

d) Movement of the foot/toes

<u>Inversion</u> and <u>eversion</u> are important movements that happen in the foot.

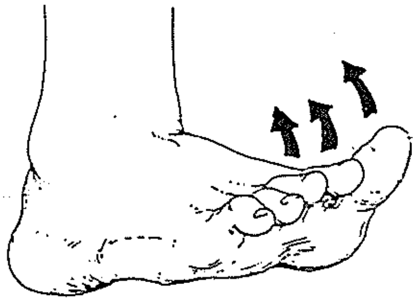
They are combinations of many movements.

Generally the result of these movements is:

Inversion -- when the bottom of the foot turns to the inside.

Eversion -- when the bottom of the foot turns to the outside.

Movement of the toes are flexion/extension and a little abduction and adduction.

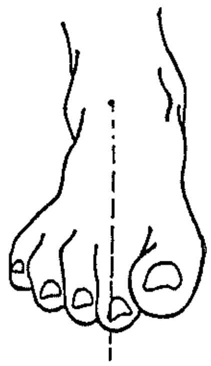


e) Range of Motion of the foot/toes

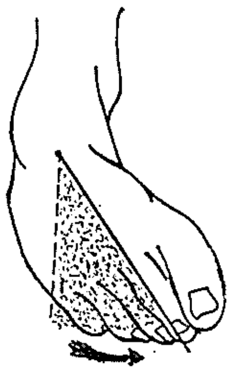
<u>Activity</u>:

Because movement of the foot and toes is difficult to measure, sometimes it is better to <u>describe the position</u> of the foot and toes and what they can do functionally.

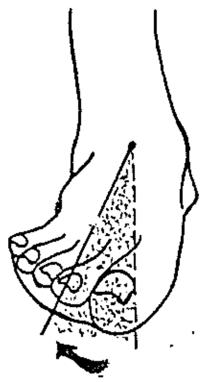
For each of the pictures below, write the <u>name of the position</u> only.



position: <u>neutral</u>



position: ______________



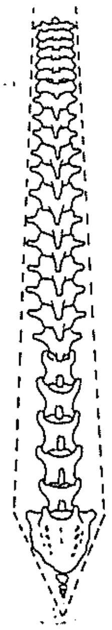
position: ______________

X. THE VERTEBRAL COLUMN

a) Bones of the vertebral column

Activity:

From your study in Osteology, please give the names of the areas of the vertebral column and the number of vertebrae in each area.



Posterior view

Lateral view

Area ____________________ Number of vertebrae __________

Area ____________________ Number of vertebrae __________

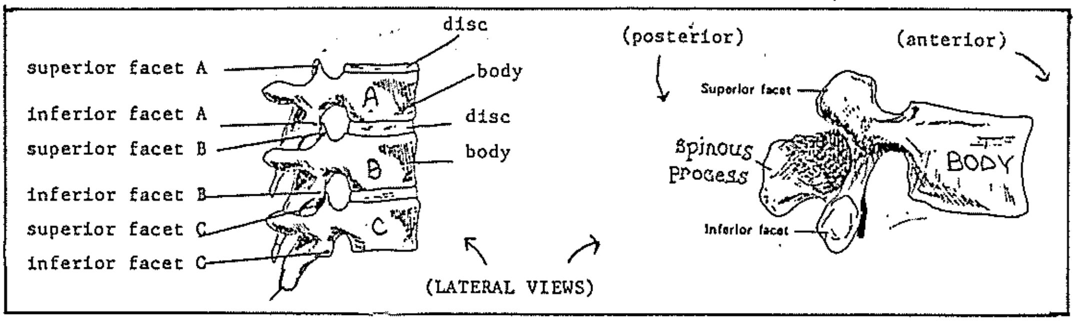
Area ____________________ Number of vertebrae __________

Area ____________________ Number of vertebrae __________

Area ____________________ Number of vertebrae __________

Generally, each vertebra joins together in two places.

One place is between the bodies of the vertebrae (with the discs between each one), and one place is posterior between the small parts of the vertebrae called articulating processes or facets.



b) Function of the vertebral column

Activity:

Again from your study in Osteology, what are the functions of the vertebral column?

1. ______________________________

2. ______________________________

3. ______________________________

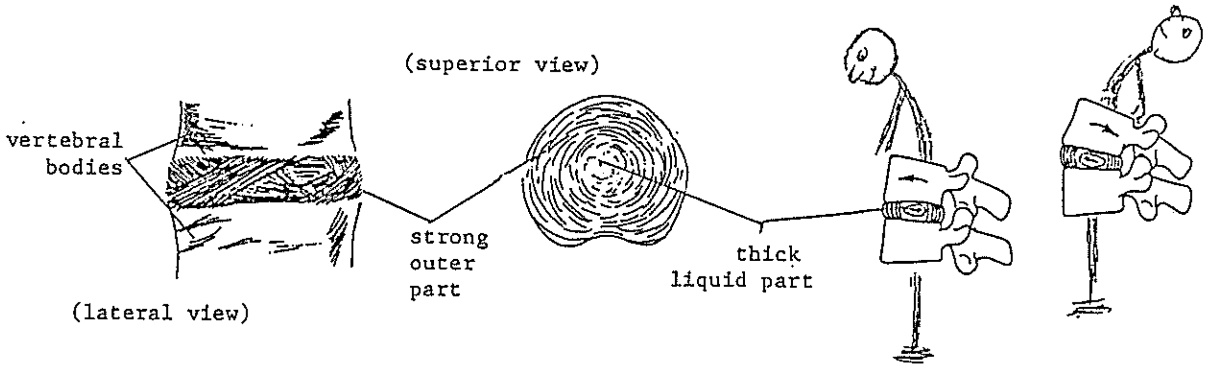
c) Other Structures of the vertebral column

The disc, ligaments and muscles help control each vertebral joint.

We have said that the disc helps the vertebral bones to move on each other for bending actions.

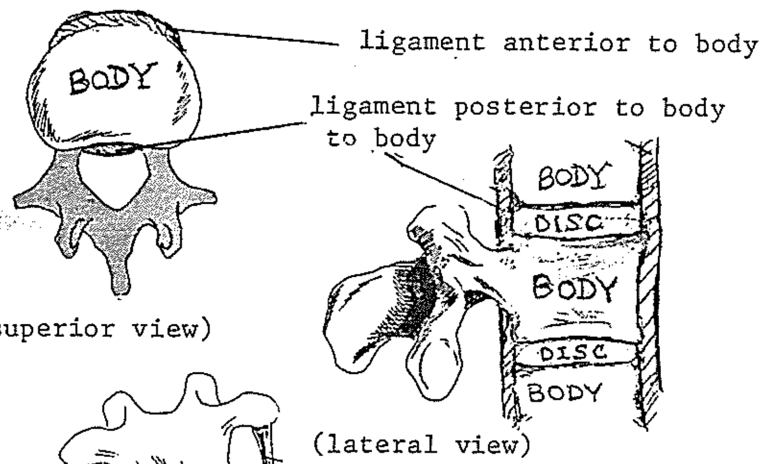
The outer part of the disc is strong and firmly attached to the vertebral bodies.

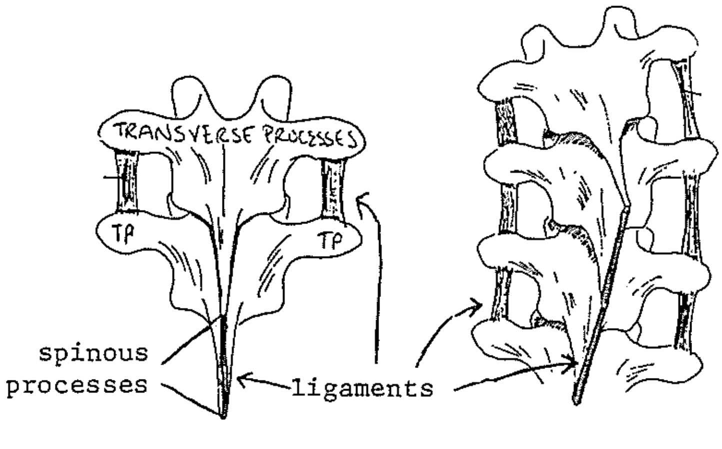
The inner part is like a thick liquid that moves as the vertebrae bend on each other.



Ligaments are found anterior to the vertebral body, posterior to the vertebral body, between spinous processes, and between transverse processes.

Each ligament gives the vertebral column more stability by limiting movement in specific directions.



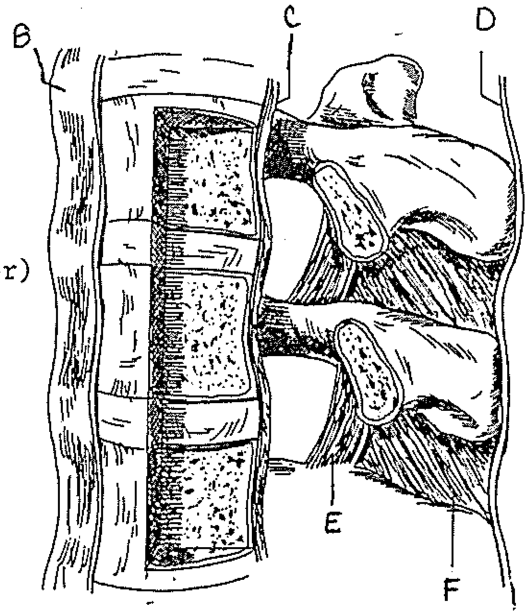


(posterior views)

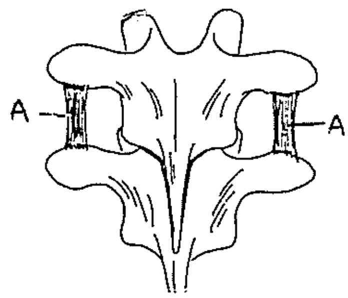
Activity:

For the pictures below, please write what direction of movement each ligament (A,B,C,D,E,F) will limit.

(anterior)



(lateral view of vertebral column)



(posterior view of vertebral column)

Ligament A limits ____________________

Ligament B limits ____________________

Ligament C limits ____________________

Ligament D limits ____________________

Ligament E limits ____________________

Ligament F limits ____________________

What movement is most limited by ligaments?

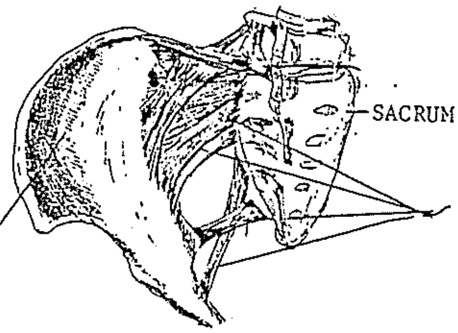
____

Vertebral bone shape does not limit flexion movements. Extension movements <u>are</u> limited by the shape of the vertebral bones (think of spinous processes).

This is the main reason why there are many ligaments that help to limit flexion, and few ligaments that limit extension.

There are also <u>ligaments</u> that help attach the <u>sacrum</u> to the <u>iliac bone</u>.

Muscles attach to each of the vertebrae to give them stability <u>and</u> help them move.



d) Movement of the vertebral column

<u>Each</u> vertebra does not move much by itself, but when all of the bones move together you can see a big change in the position of the vertebral column.

<u>Activity</u>:

One student will stand in front of the class and slowly make different movements of the trunk.
The class should observe the movement of the vertebral column and discuss the following:

- The place(s) where you see the most <u>rotation</u>

____

- The places(s) where you see the most <u>lateral bending</u>

____

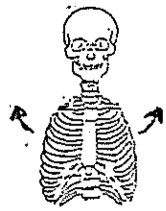
- The places(s) where you see the most <u>flexion/extension</u>

____

Discuss your observations with the entire class.

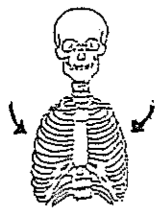
Remember that the ribs attach to each thoracic vertebrae.

In <u>inspiration</u> (taking air in) the ribs move <u>up and out</u>.



(INSPIRATION)

In <u>expiration</u> (pushing air out) the ribs move <u>down and in</u>.



(EXPIRATION)

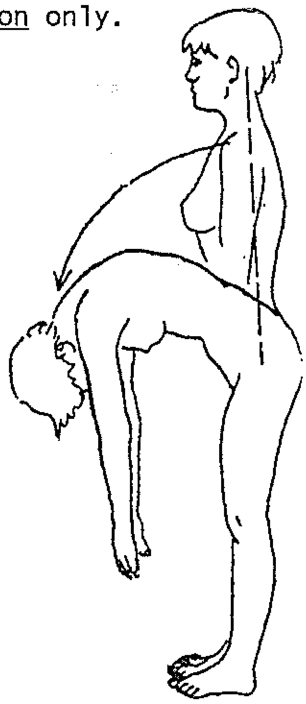
e) Range of Motion of the vertebral column

As in the other areas that have many bones (hand, foot), the movements in the vertebral column are difficult to measure.

It is important that you can <u>identify</u> the different movements and positions so that you can <u>describe</u> them if they are not normal.

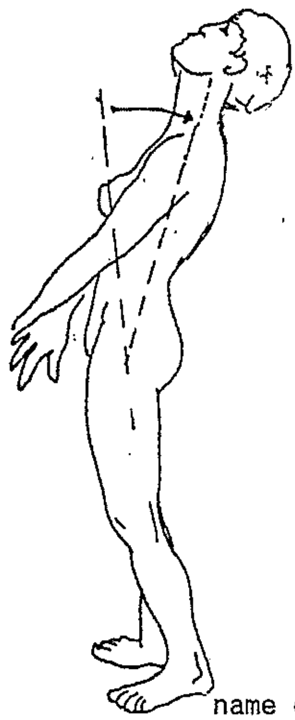
<u>Activity</u>:

For each of the pictures below, please write the <u>name of the position</u> only.



name of position

____



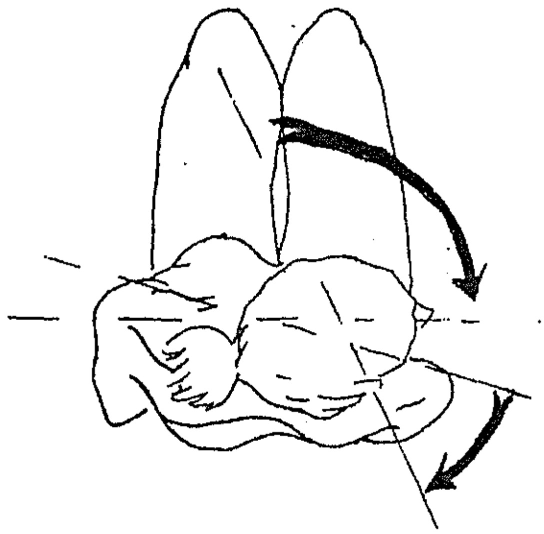
name of position

____

Activity: (continued)

For each of the pictures below, please write the name of the position only.

(posterior view)



(superior view)

name of position

____

name of position

____

Activity:

Below are pictures of different joints of the body.

For each picture, you must:

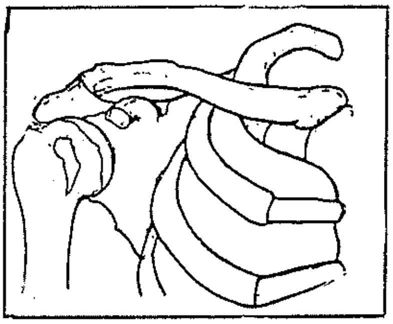
a) Put a circle around the joint.

b) Name the joint.

c) Write the view (what direction you are looking at the joint — anterior, posterior, lateral).

d) Name the bones that make the joint.

e) Label these bones on the picture.

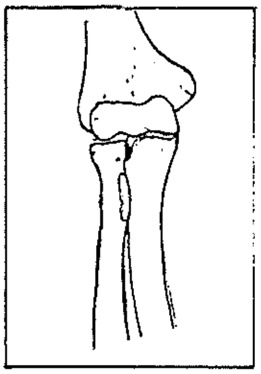


Joint ____________________

View ____________________

Bones ____________________

____

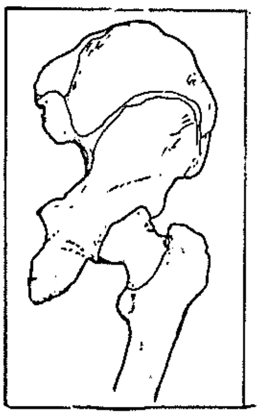


Joint ____________________

View ____________________

Bones ____________________

____



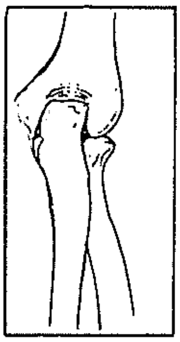
Joint ____________________

View ____________________

Bones ____________________

____

Activity: (continued)

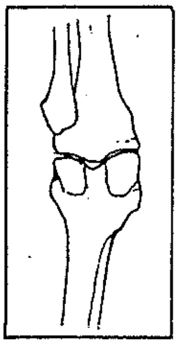


Joint ____________________

View ____________________

Bones ____________________

____

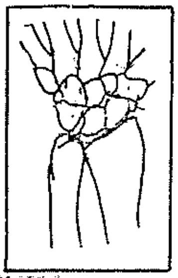


Joint ____________________

View ____________________

Bones ____________________

____

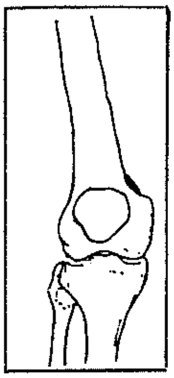


Joint ____________________

View ____________________

Bones ____________________

____



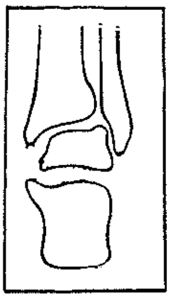
Joint ____________________

View ____________________

Bones ____________________

____

Activity: (continued)

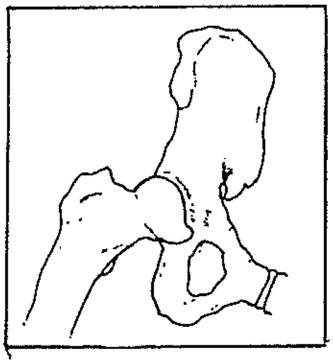


Joint ____________________

View ____________________

Bones ____________________

____



Joint ____________________

View ____________________

Bones ____________________

____

XI. SPECIAL VOCABULARY

In the beginning of this chapter we discussed major joints of the body, their general shape and the movements they can do.

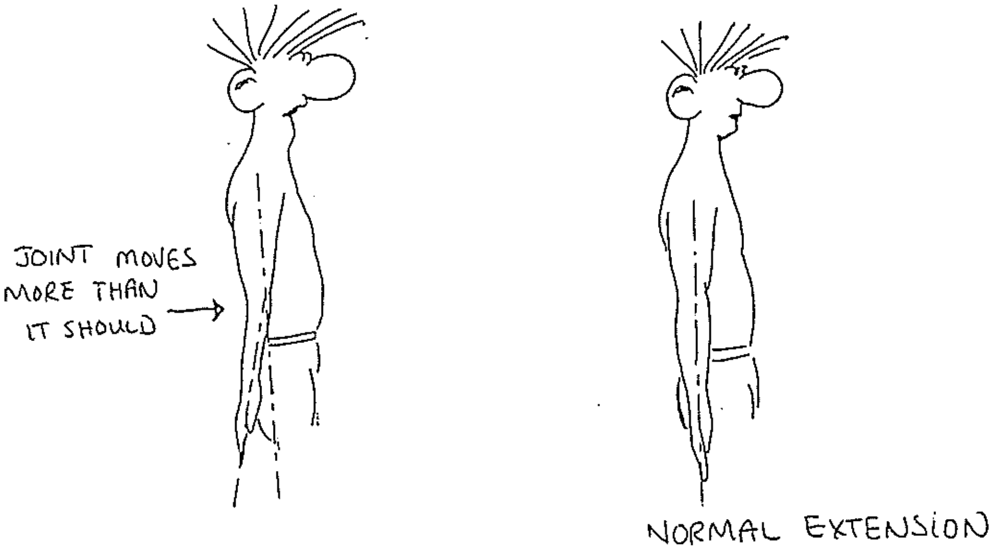
Now that you are familiar with these, it is important to present some of the problems that can occur with a joint.

There are four medical words that you should be familiar with.

These are: hypermobile, hypomobile, dislocation, and sprain.

HYPERMOBILE

The joint moves <u>more</u> that it normally should (more than complete ROM). An example is that in some people the elbow can bend more than 0°.



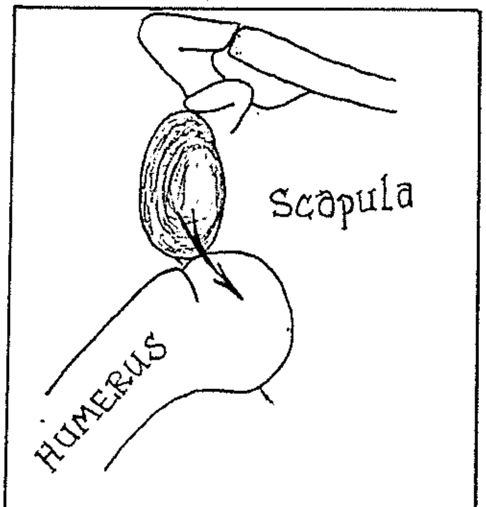
HYPOMOBILE (stiff)

The joint moves <u>less</u> than it normally should (less than complete ROM). An example is if a knee has not moved for 3 months, it will probably be stiff or hypomobile.

DISLOCATION

Normally two bones come together and move on each other in a specific way.

When one of these bones is pushed in a position where there is no longer normal contact between the bones, the joint is said to be dislocated.

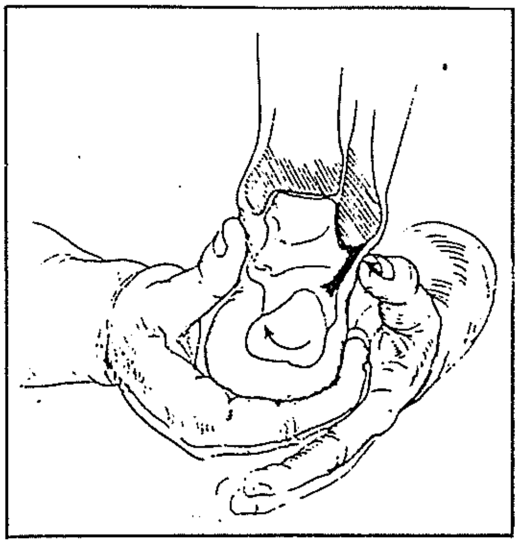


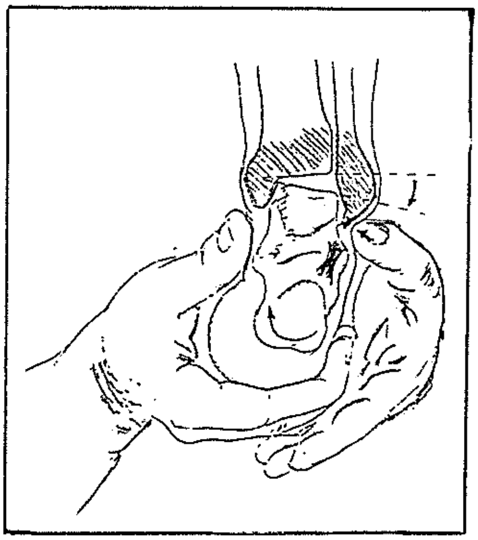
Shoulder Joint Dislocation

SPRAIN

When the ligament holding the two bones together become overstretched or torn.

Posterior view of right ankle





A. Hands are feeling a NORMAL ligament that connects the fibula to the talus and calcaneus.

B. Hands are feeling the same ligament that connects the fibula to the talus and calcaneus. This picture shows a torn ligament; this is one type of ankle SPRAIN. A torn ligament results in more joint mobility and less joint stability.

RANGE OF MOTION EVALUATION GUIDELINES

To know how much movement (range of motion) a patient has at a joint, the PTA can observe the active movement, or can move the limb passively.

In this manual we will discuss methods for PASSIVE RANGE OF MOTION EVALUATION.

General guidelines for all passive range of motion evaluation techniques.

1. Put the patient in a comfortable position so that the indivdual joint can be easily moved through its range of motion. (Position similar to anatomical position.)

2. Instruct the patient as to what you are going to do and why (moving the limb to find the areas that may be stiff or painful).

3. For PASSIVE measurement, ask the patient to relax and the PTA will do all the work.

4. Hold the limb around the joints to support these parts and have better control of the movement.

5. Move the limb slowly through the range of motion; observe at what angle the patient has pain and at what angle you feel stiffness. *

* Note that when one area is staff and cannot move, other parts of the body will try to help make this movement; this is called COMPENSATION.

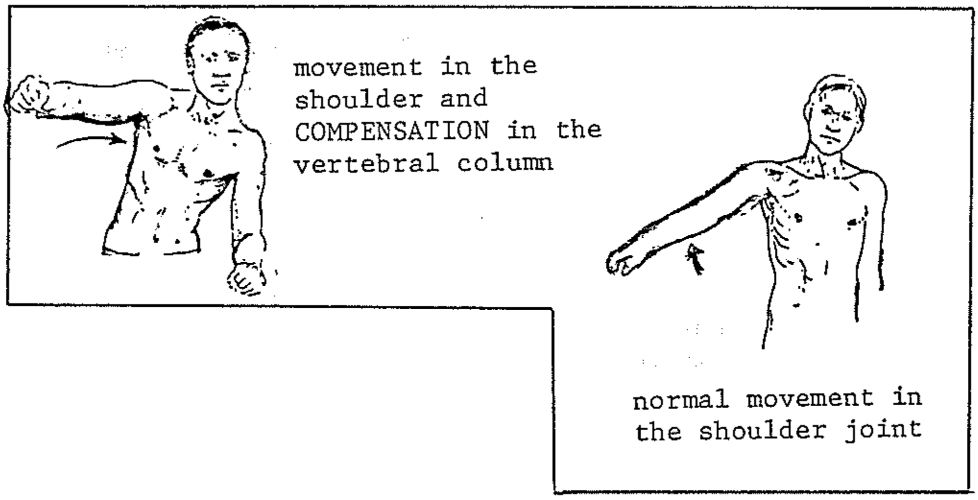
It is important that during the evaluation, the PTA observes the patient carefully to be able to identify what movements are happening at the specific joint, and what movements are being held by other parts of the body.

Example:

When you are testing right shoulder abduction, the movement should be at the joint.

If the joint is stiff, the patient may begin to bend their body to the left so it would look like an abduction movement, but actually the joint angle would not change.

This would be compensation seen in the vertebral column.



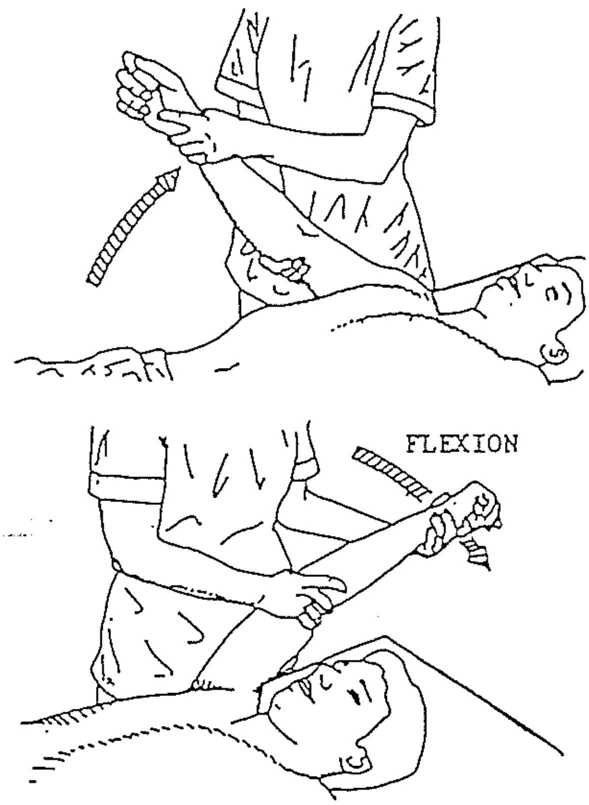
6. The PTA should write what compensatory movement he observes in his evaluation.

7. After the PTA completes the evaluation of one joint, he should write the results down on paper in order to remember the details.

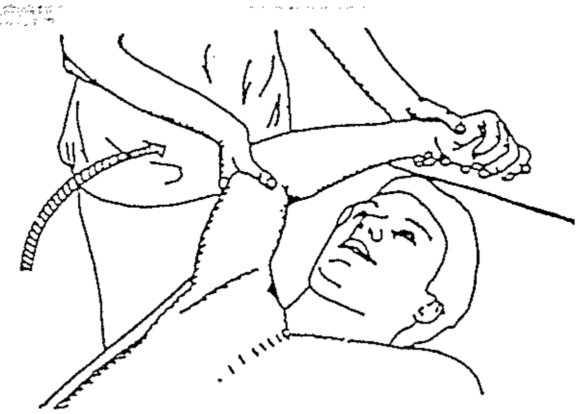
8. The PTA must always compare the two sides of the body. Often this will help the PTA identify the "normal" movement for the patient and what movement is limited.

The pictures on the following pages are to be used as <u>general guidelines</u> for hand positioning and patient positions.

THE SHOULDER

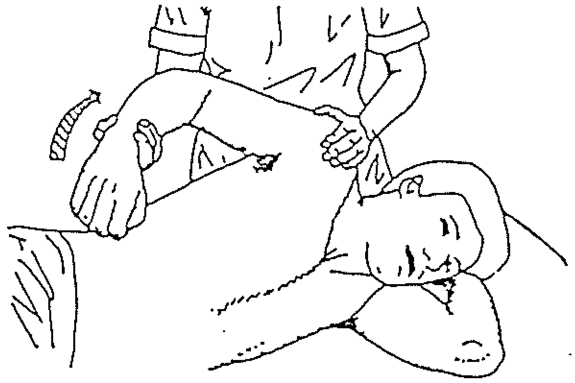


FLEXION



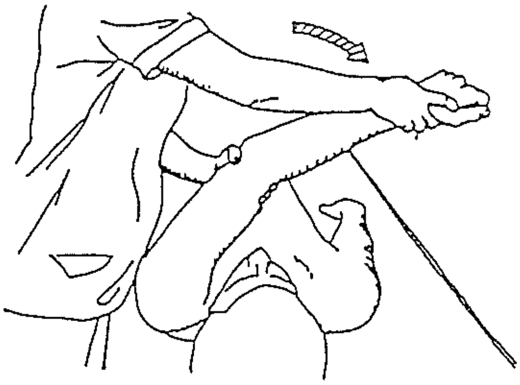
ABDUCTION

THE SHOULDER

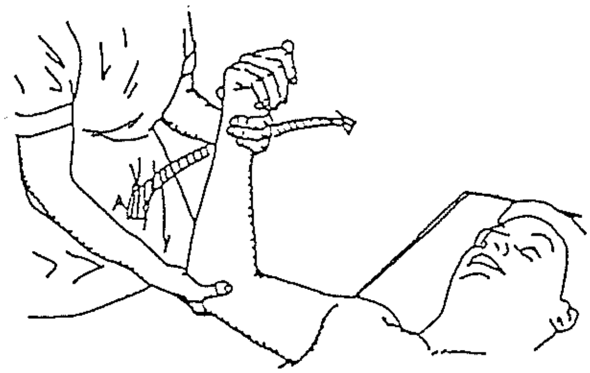


EXTENSION*

(* May modify this position to see the patient.)

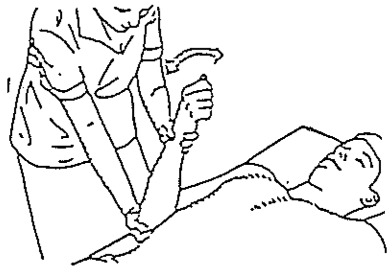


ADDUCTION



INTERNAL AND EXTERNAL ROTATION

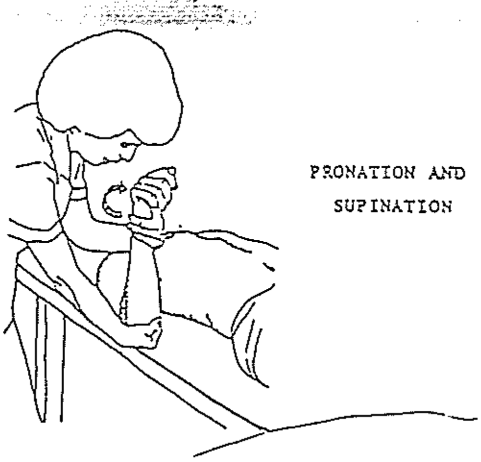
ELBOW



FLEXION AND EXTENSION

WRIST

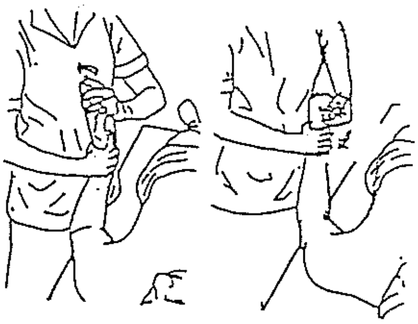
FLEXION
EXTENSION
ABDUCTION
ADDUCTION



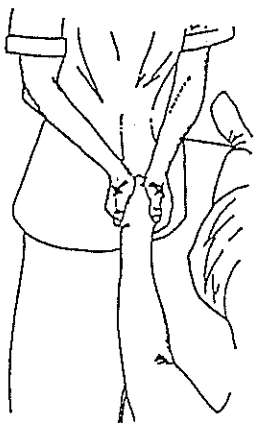
PRONATION AND
SUPINATION

FOREARM

THE HAND

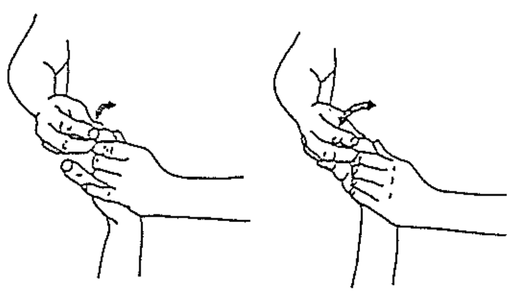


FINGER FLEXION

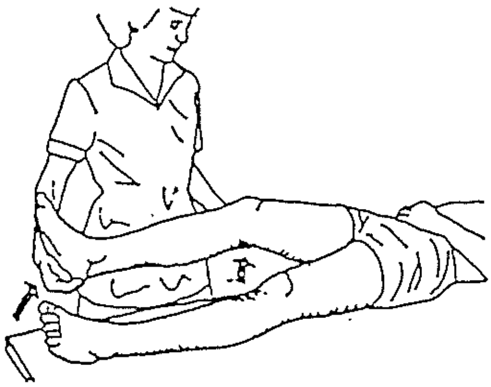


STRETCHING THE ARCH

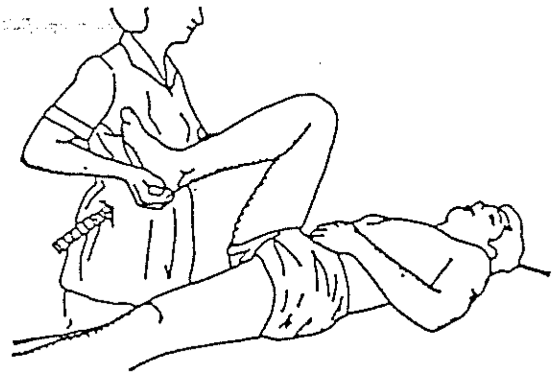
FINGER FLEXION AND EXTENSION



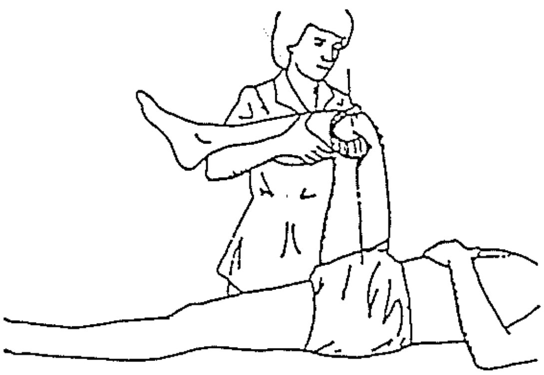
THE HIP



FLEXION*

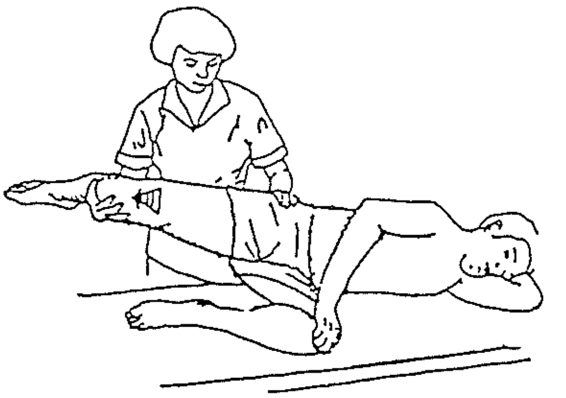


(* May modify this position to prevent the opposite leg from lifting.)

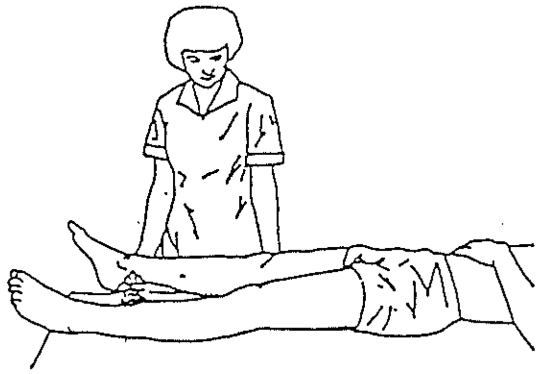


INTERNAL AND EXTERNAL ROTATION

THE HIP



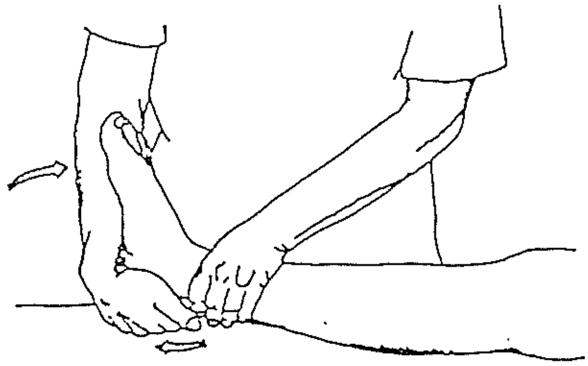
EXTENSION



ABDUCTION AND ADDUCTION *

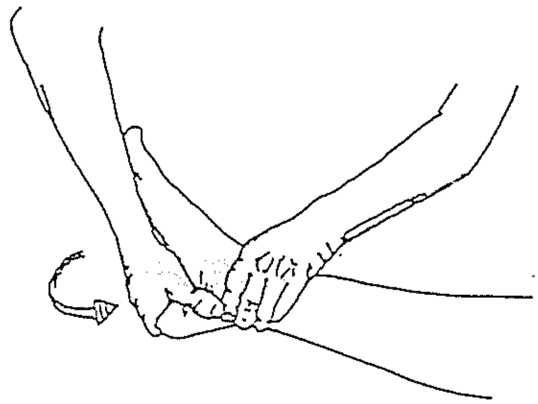
(* May modify this position to prevent the opposite leg from moving inward.)

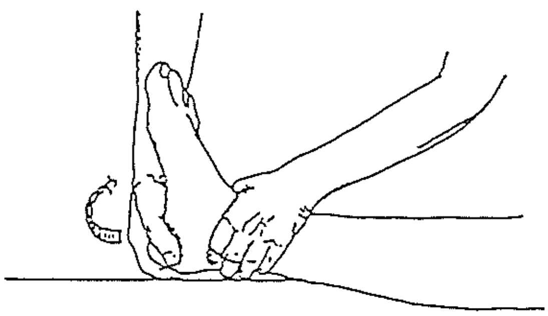
ANKLE



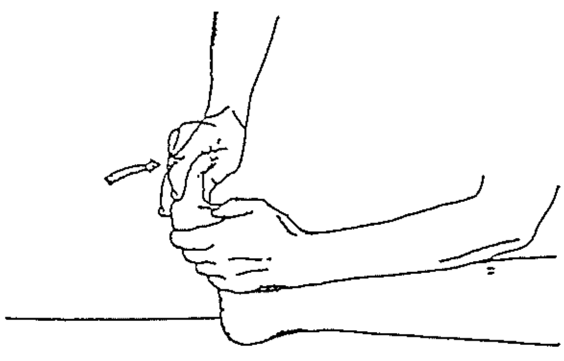
DORSIFLEXION AND PLANTARFLEXION

THE FOOT





FOOT INVERSION AND EVERSION



TOE FLEXION AND EXTENSION

H. CHAPTER SUMMARY

ARTHROLOGY is the study of joints. A joint is where two or more bones come together.

Joints help to hold the bony skeleton together and allow movement of bones in specific directions.

Bone shape helps to decide what movement can happen at a joint.

The main parts of a movable joint are:

LIGAMENT	connects bone to bone
TENDON	connects muscle to bone
CARTILAGE	smooth covering on the ends of bone
CAPSULE	sac that surrounds a joint and holds fluid that helps keep cartilage wet and smooth

Range of motion is the amount of movement at a joint.

The movement is measured in degrees ( ).

A summary of the general anatomy, types of movement, and amount of movement for main joints/body areas is given in the table on the following page.

JOINT / BODY AREAS	BONES	TYPES OF MOVEMENTS	AMOUNT OF MOVEMENT
SHOULDER	humerus/ scapula (clavicle)	Flexion Extension ABDuction ADDuction Int. Rotation Ext. Rotation	0 - 180 0 - 50 0 - 180 0 - 40 0 - 90 0 - 90
ELBOW	humerus/ radius ulna	Flexion Extension	0 - 135 0
FOREARM *	radius/ ulna	Supination Pronation	0 - 90 0 - 80
WRIST	radius/ulna carpal bones	Flexion Extension ABDuction ADDuction	0 - 80 0 - 80 0 - 45 0 - 30
HAND/FINGERS *	carpals metacarpals phalanges	Flexion Extension ABDuction ADDuction Thumb Opposition	Describe functional movement
HIP	femur/ iliac bone (clavicle)	Flexion Extension ABDuction ADDuction Int. Rotation Ext. Rotation	0 - 135 0 - 20 0 - 45 0 - 20 0 - 30 0 - 45
KNEE	femur patella tibia	Flexion Extension Int. Rotation Ext. Rotation	0 - 135 0 very small

JOINT / BODY AREAS	BONES	TYPES OF MOVEMENTS	AMOUNT OF MOVEMENT
ANKLE	tibia fibula talus	Dorsiflexion Plantar Flexion	0 - 10 0 - 30
FOOT/TOES *	tarsals metatarsals phalanges	Inversion Eversion Flexion Extension ABDuction ADDuction	Describe functional movement
VERTEBRAL COLUMN *	vertebral bones	Flexion Extension Lateral Bending Rotation	Describe functional movement

A hypermobile joint is one that moves <u>more</u> than it normally should.

A hypomobile (stiff) joint is one that moves <u>less</u> than it normally should.

Dislocation is when the bones of a joint are pushed in an abnormal position where they lose contact with the other.

Sprain is when the ligament holding the 2 bones together becomes stretched or torn.

Guidelines for evaluating ROM at each joint are given in this chapter.

Compensation is the extra movement of a part of the body in trying to help another part move.

The PTA must practice ROM techniques !!

6.

MYOLOGY

MYOLOGY is the study of muscles.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe (in own words) how a muscle works; to include brain, nerve, muscle fiber.

2. write two reasons why you may have pain in a tired muscle.

3. identify if an action uses an isometric, eccentric, or concentric muscle contraction.

4. describe "gravity" and identify gravity and non-gravity position for different muscle groups.

5. identify specific muscle names, locations and actions.

6. demonstrate muscle testing techniques for specific areas and patient problems.

CHAPTER CONTENTS

A. INTRODUCTION

MYOLOGY is the study of muscles. MUSCLES MAKE MOVEMENT! If are no muscles, then there is no active movement.

Activity:

We have learned about bones and joints. Are bones and joints useful if we have no muscles? ______________________

Why or why not? ______________________

____

____

B. TYPES OF MUSCLES

There are three different types of muscles in the body; cardiac muscle, smooth muscle, and skeletal muscle.

Each type is responsible to move different parts of our body.

* Cardiac muscle: This is a special muscle that is found only in the heart. (GENERAL BODY SYSTEMS, pages 17-19).

* Smooth muscle: This type of muscle is found in the walls of blood vessels, stomach/intestines/bladder, and in the colored part of the eye (see activity #2).

Smooth muscle and cardiac muscle work even when we don't tell them to.

They work while we talk, eat, study, and sleep. Even if we try to tell them to stop, these muscles will continue to work!

Activity:

Imagine your body has changed. You must now tell your heart to beat, tell the blood vessels to move blood, and tell the intestines and stomach to push and move food through them.

If you do not tell them, they will not work.

Try to direct all of these muscles and parts for one minute; do this now.

Is it difficult to remember to do everything? ____________

Could you play volleyball and, at the same time, continue to tell of these muscles to work? ____________

What happens when you go to sleep?

____

Activity #2

Form groups of two people each. Each student close their right eye and also cover it with their right hand. Stay in this position for 30 seconds.

When you remove the hand and open the eye, the student should quickly look at the colored part of the right eye of the other.

What movement did you see in the colored area?

____

____

Explanation

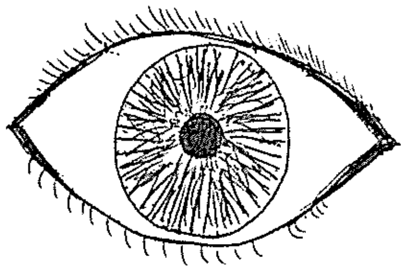
The colored part of your eye are muscles that control the amount of light that you need to be able to see.

If it is dark, they allow the hole (the black circle) to become bigger.

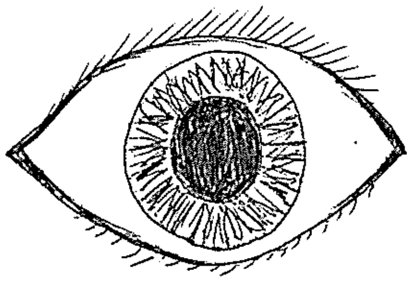
If it is too bright, they try to make the hole smaller.

They do this automatically -- without you telling them to do it.

BRIGHT LIGHT (hole is smaller because you don't need too much light).



DARKNESS (hole is bigger because you need more light to be able to see).



Skeletal muscle: This is the muscle that is attached to the bones in our body.

Skeletal muscle moves our limbs, trunk, head, fingers and toes, and all movable joints.

These muscles move our body because we tell them to.

We decide to lift our arm .... the brain sends a message to the muscle, and then the muscle will work.

Normally, our arm will not lift unless we have asked it to.

<u>Activity</u>:

<u>Voluntary</u> means something happens because we want it to.

<u>Involuntary</u> means something happens even if we don't want it to.

Apply these works to the three types of muscles.

1. What muscle type(s) are <u>voluntary</u> muscles?

____

2. What muscle type(s) are <u>involuntary</u> muscles?

____

Think of the <u>tongue</u> and the ability to move the eye in many directions.

Are these parts moved by <u>voluntary</u> or <u>involuntary</u> muscles?

____

Because skeletal muscle is the type that moves the limbs and body, it is the one that PTA's should study and know.

C. GENERAL INFORMATION ABOUT SKELETAL MUSCLES

There are many things to learn about the skeletal muscle; the following topics will be discussed in this section.

1. What a muscle is made of.
2. How a muscle becomes bigger and smaller.
3. How it works.
4. Nutrition/Wastes ... what happens when a muscle is tired.
5. How and when a muscle stops working.
6. Naming muscles.
7. Muscle opposites.

1. <u>What a muscle is made of</u>

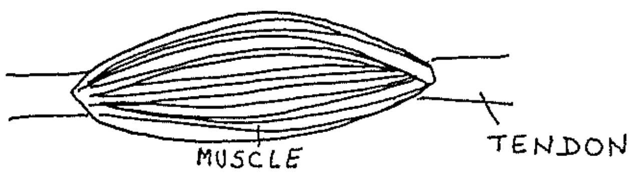
A complete muscle is made of:

a. tendon

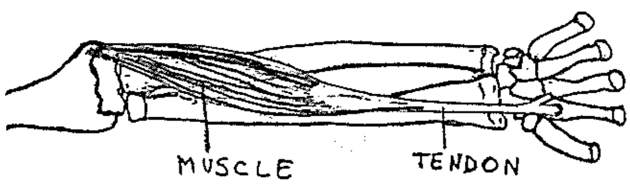
b. muscle fibers

a. <u>tendon</u>

The tendon is the non-contracting part of a muscle. It does not change its length.



The function of the tendon is to attach the muscle to bone (see page 30).



b. <u>muscle fibers</u>

The muscle fibers are the <u>working</u> parts of the muscle. (The fibres are often called the muscle belly. In this manual, the word <u>muscle</u> most often refers to the muscle belly.)

Muscle fibers can become shorter or longer - muscle fibers would always like to become shorter (like an elastic band).

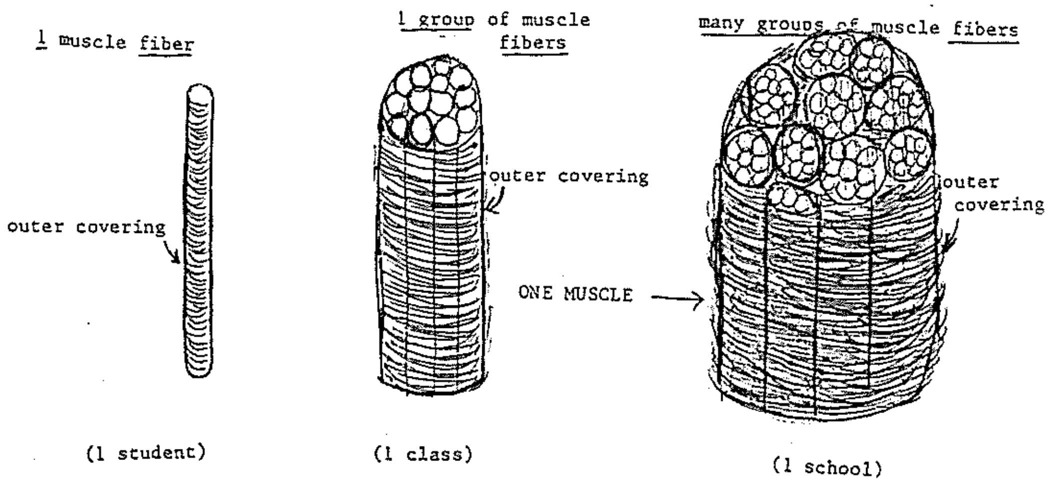
Each muscle has thousands and thousands of muscle fibers.

The number of muscle fibers that we have in our body rarely changes.

We have a specific number when we are a baby. When we are an adult, we generally have that same number.

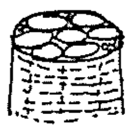
The fibers in a muscle are well organized. A simple comparison is with the organization of a school.

Below is a diagram to help show how individual parts (fibers) of a muscle are organized.

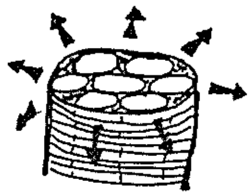


2. How muscles become bigger and smaller

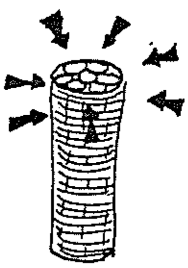
As was said earlier, the number of muscle fibers generally does not change.



With training and exercise, the muscle fibers become more thick and thus more strong.



With no exercise or movement, the muscle fibers become more thin and weak.



A decrease in the size of muscle fibers is called ATROPHY.

Atrophy can be caused by decreased movement of a muscle, or decreased nerves telling the muscle to work (nerve injury).

3. How muscles work

Muscles can make only one movement -- CONTRACT!

When a muscle contracts, it tries to become shorter.

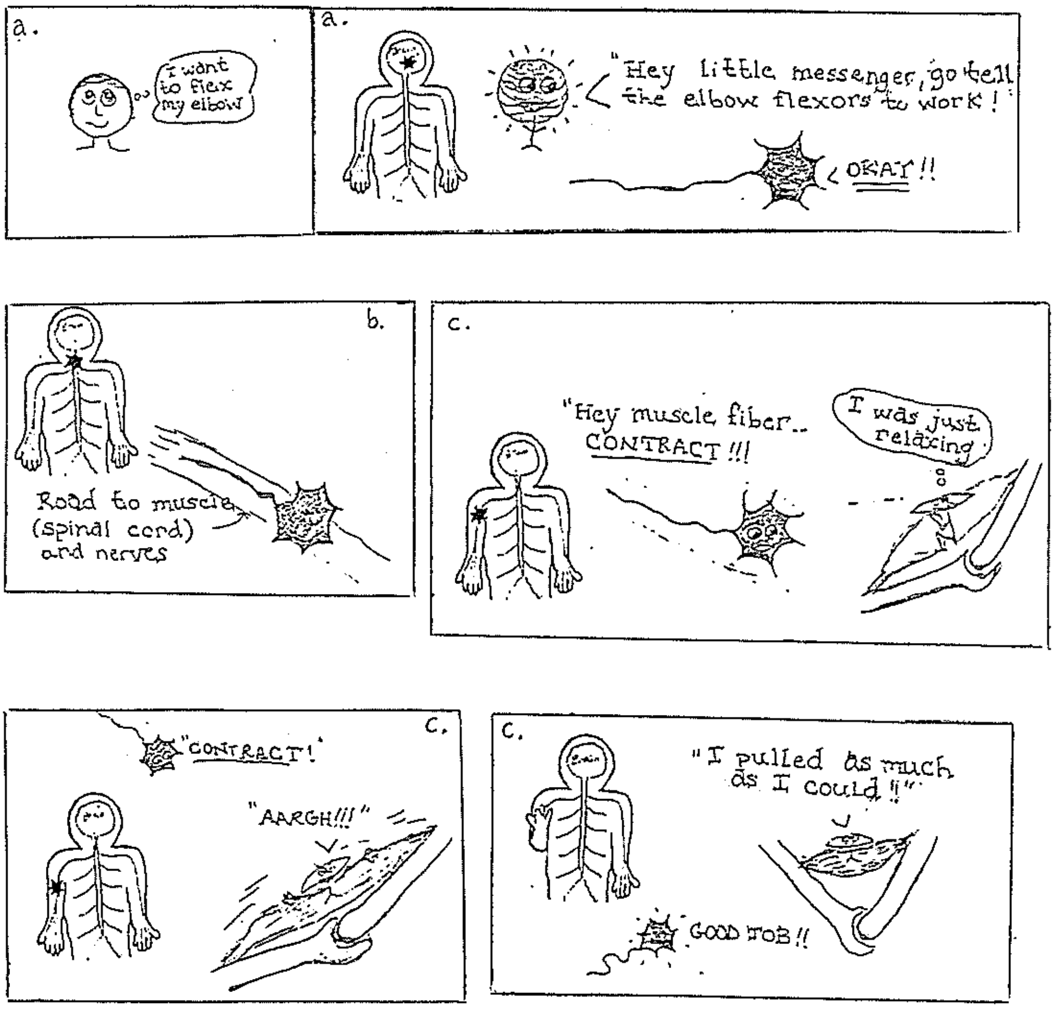
There are three basic steps for voluntary muscles to work.

a) The brain sends a messenger to tell the muscles to work.

b) The messenger travels along the NERVES (special roads that go from the brain to the muscle).

c) When it arrives at the muscle, the messenger orders the muscle fibers to contract!

THREE BASIC STEPS FOR A VOLUNTARY MUSCLE TO WORK



We had said before that the muscle is made of many individual parts called fibers.

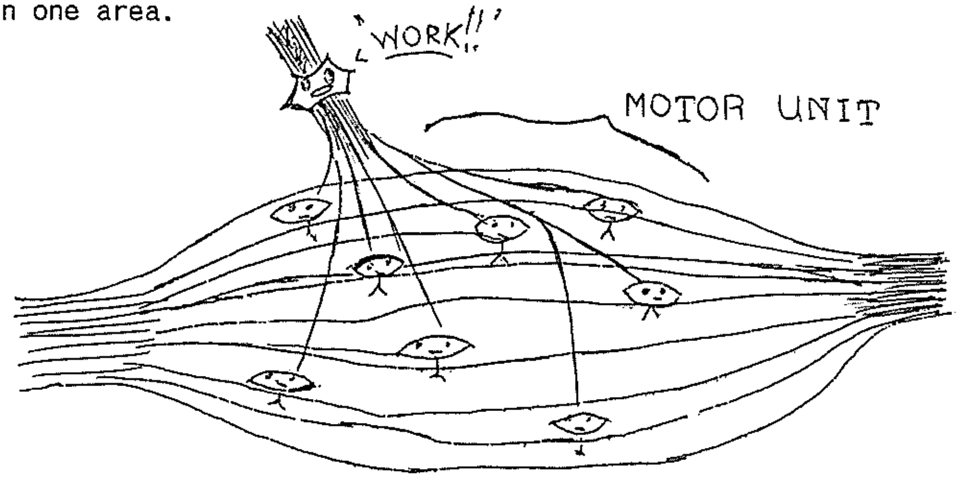
Each fiber is the same length as the muscle that it is in.

One messenger will tell more than one muscle fiber to work.

When a messenger tells these muscle fibers to work, they will work as hard as they can or not at all.

The muscle fibers that a messanger is responsible for are not all in the same place; they are located in different areas of the muscle.

This is to allow equal movement in all of the muscle, and not just in one area.



A NERVE is a road from the brain that carries messages.

One nerve will divide into many smaller nerves (roads) to be able to contact many muscle fibers.

The nerve and the muscle fibers that it goes to are called a MOTOR UNIT. In one muscle, there are many motor units.

Because a muscle fiber is working as hard as it can, it cannot work for a very long time.

When a movement does not need all of the motor units in a muscle, the different motor units will take turns working and relaxing.

In this way, a movement that is very easy can be continued for a long time.

If a movement is difficult to do (if you need more strength to do it), most of the motor units will have to work.

If a movement requires maximum strength, perhaps all motor units must work.

For these actions, the muscle will be able to work for only a short time.

Activity:

A. You are sitting on a chair with knees flexed 90 and feet flat on the floor. Plantarflex your left ankle (your toes will remain on the ground and your heel will go up and down) 50 times without stopping. The speed should be two lifts for every second.

B. Come to a standing position. Repeat the same exercise as in "A" with you right ankle. (Plantarflex the right ankle 50 times - two times for each second - in standing position.) Your left foot should not touch the floor.

<u>Activity</u>: (continued)

* What exercise was more easy?

____

* Did you feel pain in either exercise?

____

* If yes, with what exercise did you feel the pain, and where did you feel the pain?

____

____

In activity "A", not many motor units were needed to plantarfflex your left ankle.

In activity "B", you had to lift the weight of your body everytime you plantarflexed your foot and so more motor units had to work to help you do this.

They had to work very hard in the calf muscles ... in these areas you may have felt pain.

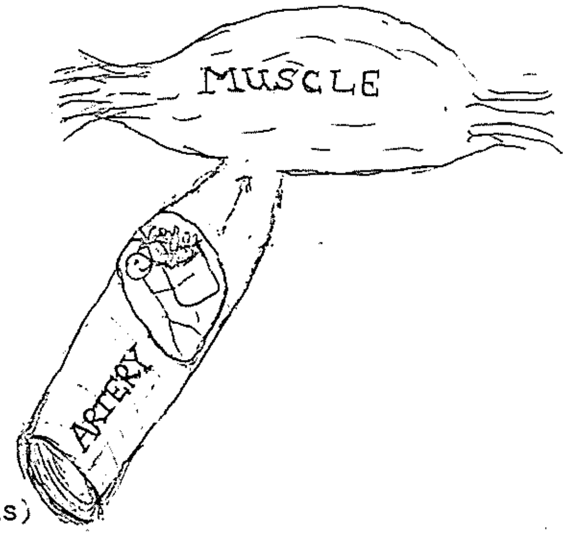
In the next section we will discuss what causes this pain.

4. Nutrition and Wastes -- What happens when a muscle is tired?

Muscles are alive - just as bones and tendons and ligaments are alive.

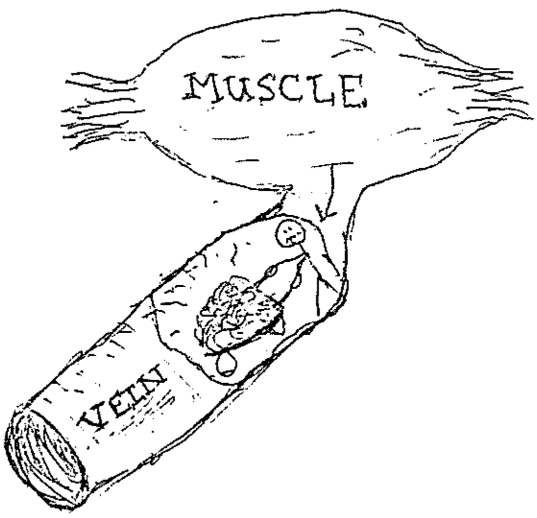
The same as the others, muscles need food to live. They also need special air (oxygen) to work.

The blood brings food and oxygen to the muscles. The blood carries the food through small tubes called ARTERIES.



When you muscles are very active, they need more food and oxygenl they need more blood! Your heart is the muscle that helps to push blood through the arteries.

Your heart normally beats (works) faster during exercise so that it can push blood more quickly to the muscles that need it.



After they finish using the food, the muscles produce waste. (Just the same as after people eat food, they will produce waste.)

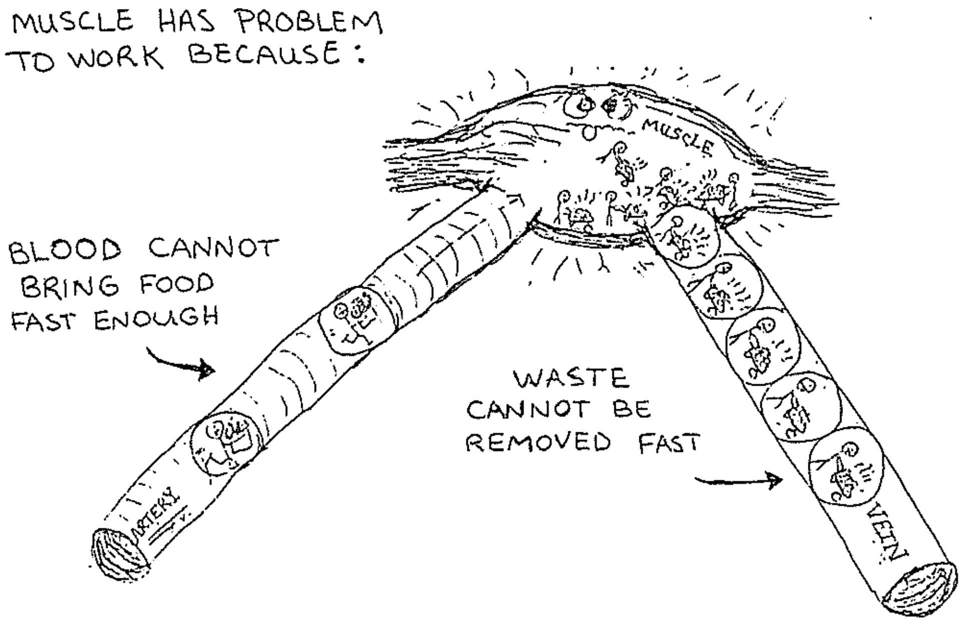
Normally, waste is carried away from the muscles soon after it is produced.

Small tubes called VEINS carry the "used blood" (not much food or oxygen and a lot of waste) away from the muscles.

When a muscle is working so hard or so quickly that the blood cannot bring food and oxygen fast enough, and the wastes cannot be taken away fast enough, then the muscle fibers will find it more and more difficult to work.

In summary, if the muscle does not have enough food, it will not work well (the same as people).

If the muscle has too much waste in it, the muscle will not work well (the same as people).



If there is too much waste in the muscle or the muscle does not have enough food, the muscle may begin to work more slowly or may become more jerky (movement less smooth and less coordinated).

You may also begin to feel pain in the working muscle; soon after this, the muscle may refuse to work at all.

All of the above are the muscle's way of saying that it needs more oxygen and food, and needs to have the wastes carried away.

Severe pain in working muscles from too much waste or not enough food and oxygen is called a CRAMP.

When you stop the activity, the muscles can relax while the blood continues to bring oxygen and food, and wastes are carried away.

Activity:

You are in sitting position. Your right arm is pronated and on the table in front of you. Your palm and fingers are flat on the table. Completely lift and lower your index finger as fast as you can and as many times as you can. All other fingers remain on the table.

After one minute, stop. Do this activity with your left index finger 2-3 times.

Compare the actions of the two fingers.

* What did you observe and feel?

____

____

* Why did this happen?

____

____

5. How and when a muscle stops working

Nerves from the brain can only tell the muscle to work. If these nerves don't work, then normally the muscle will not work.

It is important to know that normally, the muscles never completely stop working. If they did, then we would be FLOPPY (like a doll).

Normally our muscles are always working a little bit. This small but continuous contraction is called muscle TONE. Muscle tone is the brain's way of always having the muscles prepared to move.

When we are nervous or afraid, the tone increases so that we are able to move or respond very quickly if we need to.

When we are sleeping, our muscle tone decreases and all of the muscles are more relaxed.

If there is a problem in the brain or spinal cord, sometimes this tone may abnormally increase or decrease without our control.

6. Naming muscles

In this manual we will focus on the function and location of muscles more than remembering their specific names.

For muscles which have names that are used often, the specific name will be given in this chapter.

It is important that the PTA know that the muscles will have the same name as the movements that they make.

This is a general way to "name" the muscles.

Example:

a) Muscles that flex the elbow are called elbow flexors.

b) Muscles that extend the knee are called knee extensors.

c) "Knee extensors" are muscles that extend the knee.

d) "Elbow flexors" are muscles that flex the elbow.

Activity:

1. What is the general name for the muscles that dorsiflex the ankle?

____

2. What do finger flexors do? _______________

____

3. When you bend the hip, what muscles are working?

____

____

7. Muscle opposites

We have said that muscles can make only movement -- contract. Normally, muscle contraction is what causes joint movement.

For a joint to be able to flex and extend, it must have a flexor muscle on one side of the joint and an extensor muscle on the opposite side of the joint.

For every muscle that makes a movement, there must be at least one muscle that makes the opposite movement. (Example: Flex and Extend are OPPOSITE movements.)

Questions:

* What muscles make the movement opposite to the hip ADDUCTORS?

____

Questions: (continued)

* What muscles make the movement opposite to the shoulder INTERNAL ROTATORS?

____

____

* What muscles make the movement opposite to ankle DORSIFLEXORS?

____

* What muscles make the movement opposite to the forearm SUPINATORS?

____

Activity:

You are sitting and your neck is completely flexed with your chin on your chest.
If you have no neck extensors, how will you lift your head up so that you are in a neutral position of the neck?

____

____

Will you be able to maintain this neutral position?

____________________ Why or why not?

____

It is also important to know that when one muscle contracts, the opposite muscle must slowly relax.

If both a muscle and its opposite muscle contract at the same time, then there will be difficulty in moving a joint at all.

In summary, when one muscle contracts, the muscle making the opposite movement slowly relaxes.

Activity:

You are in a supine and in anatomical position.

* You ABDUCT your right shoulder. What muscles must contract to do this?

  ____

  What muscles must relax to do this?

  ____

* You ADDUCT your right shoulder. What muscles must contract to do this?

  ____

  What muscles must relax to do this?

  ____

D. GRAVITY

Activity:

1. Hold a pen or pencil in the air in front of you. Release it. What happens?

____

2. Take a small object (rock, paper clip, wood) and hold it away from you. Release it. What happens?

____

3. Take a piece of paper and hold it near you. Release it. What happens?

____

4. Hold your arm out in front of you. Relax the muscles. What happens?

____

In the activity above, the answer to all the questions should be the same: the object or body part should have fallen in the direction of the ground.

It is very difficult to understand the details of WHY it happens, but the PTA should know that the ground would like to PULL everything close to it.

This pulling force is called GRAVITY.

We will now apply gravity to the different movements that we make in our joints.

Activity:

* You are in a standing position with your right shoulder in 160 of flexion. Relax your muscles.
  What is the end position of your shoulder?

____

* You are in a supine position with your right shoulder in 160 of flexion. Relax your muscles.
  What is the end position of your shoulder?

____

* You are lying on left side side with the right shoulder in 160 of flexion. Relax your muscles.
  What is the end position of your shoulder?

____

* You are in prone position with your right shoulder off the side of the table. Your right shoulder is in 160 of flexion. Relax the muscles.
  What is the end position of your shoulder?

____

In the above activity you have have observed that all of the end positions of the shoulder were different.

But, in the relaxed position, all of the arms fell (were pulled) toward the ground.

They were moved by gravity (in the same direction as gravity pulls) ... towards the ground.

Observe that it did not take any muscle power; gravity did all the work.

Activity:

You are in standing position. You begin to flex your right shoulder. The arm is moving in a direction against gravity .. .. moving away from the ground. To move against gravity, you need to have the muscles work.

Activity:

* In what position does your knee extend AGAINST gravity?

___

* In what position does your elbow flex WITH gravity?

___

* Is your forearm in pronation or supination to have your wrist flex AGAINST gravity?

___

* In what position do your dorsiflex your ankle AGAINST gravity?

___

* In what position do you flex your knee WITH gravity?

___

* In what position do you extend your elbow WITH gravity?

___

* Is your forearm in pronation or supination to have your wrist extend WITH gravity?

___

In summary, GRAVITY is the ground trying to pull everything close to it.

Gravity pulls everything in the same direction .. toward the ground.

To go against this pulling force, you need muscles to work.

If muscles are completely relaxed, gravity will try to pull all of the body toward the ground (you are moved with gravity .. in the same direction as the ground).

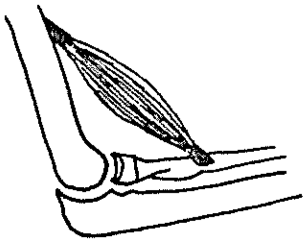
E. TYPES OF MUSCLE CONTRACTION

There are three basic types of muscle contractions: ISOMETRIC, CONCENTRIC, and ECCENTRIC.

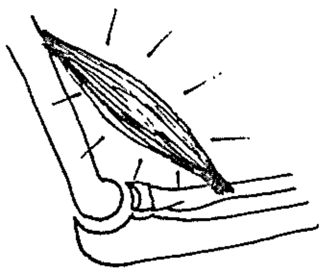
We have said many times that a muscle can do only one thing ... CONTRACT.

When a muscle contracts, it would like to become shorter and so cause joint movement.

1. Isometric muscle contraction



MUSCLE CONTRACTS, BUT THERE IS NO CHANGE IN MUSCLE LENGTH.



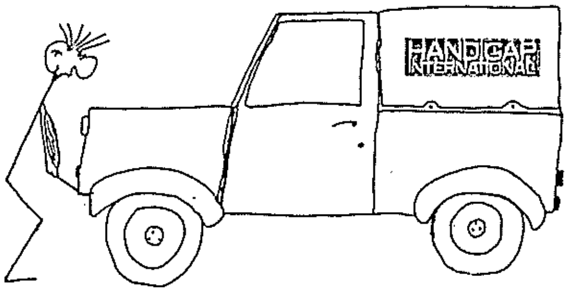
Your muscles contract (try to become shorter) but do not change their length; this is called an ISOMETRIC muscle contraction.

Examples:

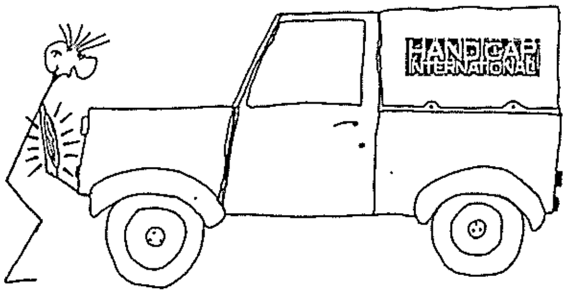
a) To lift something, normally the elbow flexors will contract and the elbow will bend.

You now try to lift a truck. Your elbow flexors are contracting very hard, but the elbow joint is not moving.

This is an ISOMETRIC contraction of the elbow flexors. (See picture).



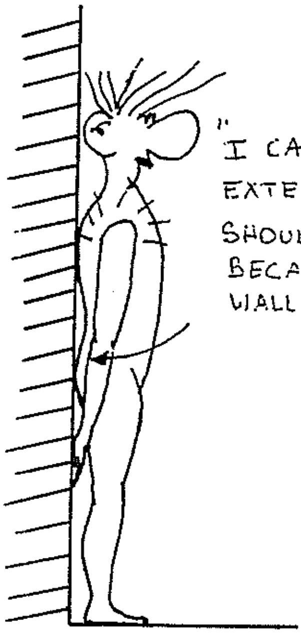
"I will try to lift this truck".



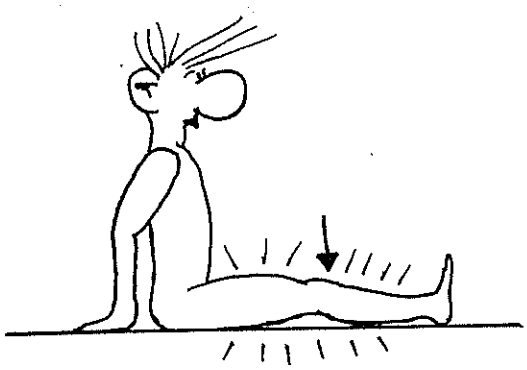
"I cannot lift this truck at all".

b) You are standing with your back against a wall. Your try to extend your right arm; you make no movement at the joint because the wall prevents this.

You contract the shoulder extensors, they work but there is no joint movement. This is an ISOMETRIC contraction of the shoulder extensors. (See picture).



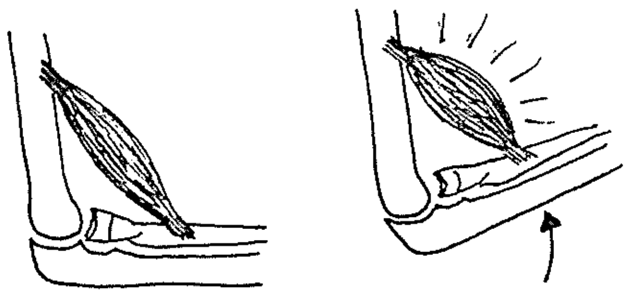
c) Sit on the floor with your lower limbs extended and relaxed. Contract your knee extensor muscles by pushing your knee into the ground. There is no joint movement, but this muscle is working. This is an ISOMETRIC contraction of the knee extensors. (See picture).



2. Concentric muscle contraction

MUSCLE CONTRACTS AND BECOMES SHORTER; THE JOINT MOVES

Your muscles contract and the muscle shortens; the two ends of the muscle come together causing joint movement. This is called a CONCENTRIC muscle contraction.



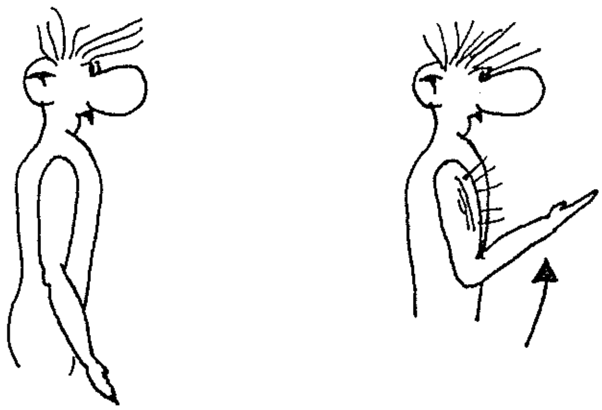
Examples:

a) You are standing in anatomical position. You contract your right elbow flexors so your right elbow bends.

Your elbow flexors have become more "short" and there is joint movment.

This is a CONCENTRIC muscle contraction of the elbow flexors.

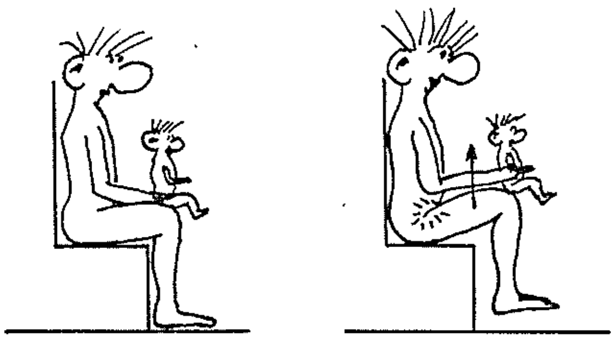
Remember that gravity is trying to pull your forearm to the ground so the muscles must work <u>against</u> gravity. (See picture).

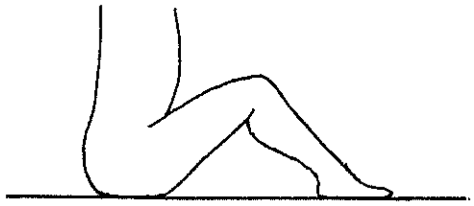


b) You are in sitting position with a small baby on your right knee. You contract your right hip flexors to lift the baby higher in the air.

The hip flexor muscles shorten (their ends become closer together) and the joint moves.

This is a CONCENTRIC muscle contraction of the hip flexor muscles. (See picture).





c) You are in sitting position with both feet on the floor. You contract your right ankle dorsiflexors.

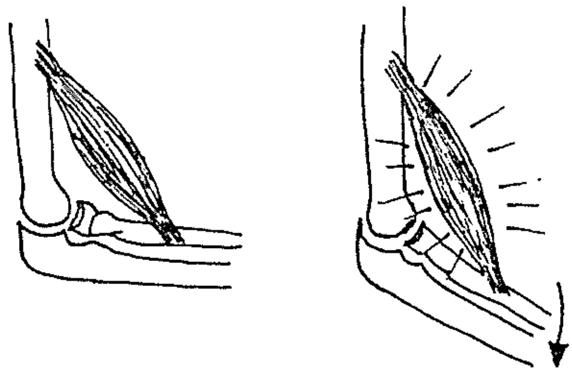
The muscles shorten and the joint moves. This is a CONCENTRIC muscle contraction of the ankle dorsiflexors.

(Remember that gravity is trying to pull your foot towards the ground so the dorsiflexors must work <u>against</u> gravity to lift your foot in an upward direction. (See picture).

3. <u>Eccentric muscle contraction</u>

MUSCLE IS WORKING BUT IS BECOMING MORE LONG!

Your <u>muscles contract</u> (work) but the <u>ends of the muscle move away from each other</u>; the muscle "lengthens" <u>permitting joint movement</u>; this is called an ECCENTRIC muscle contraction. (See picture).



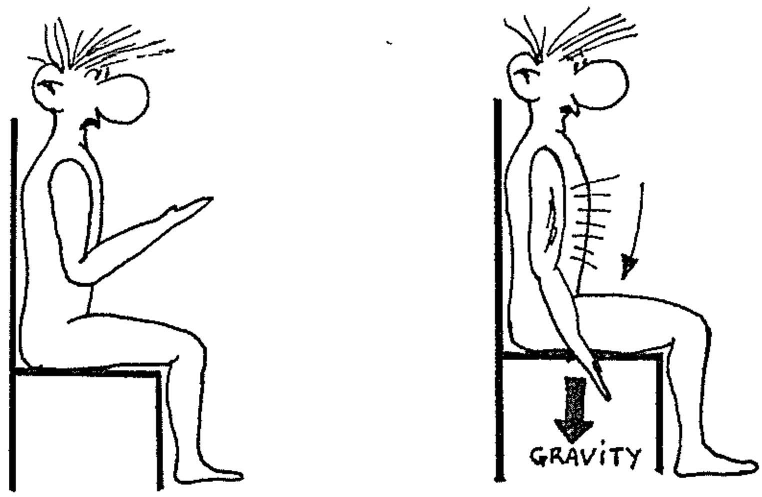
<u>Examples</u>:

a) You are in sitting position with your right elbow in flexion. You slowly allow your elbow to extend (remember that gravity is trying to pull your forearm towards the ground very fast!)

   Your elbow flexors are contracting (working) to <u>allow</u> the <u>extension</u> of the elbow. * The ends of the elbow flexor muscles are moving farther apart and there is joint movement.

   This is an ECCENTRIC muscle contraction.

   (* If the elbow flexors did not work, the forearm would fall quickly because gravity is pulling it to the ground. If the elbow flexors did not become "longer", the elbow would remain in a flexed position.) (See picture).

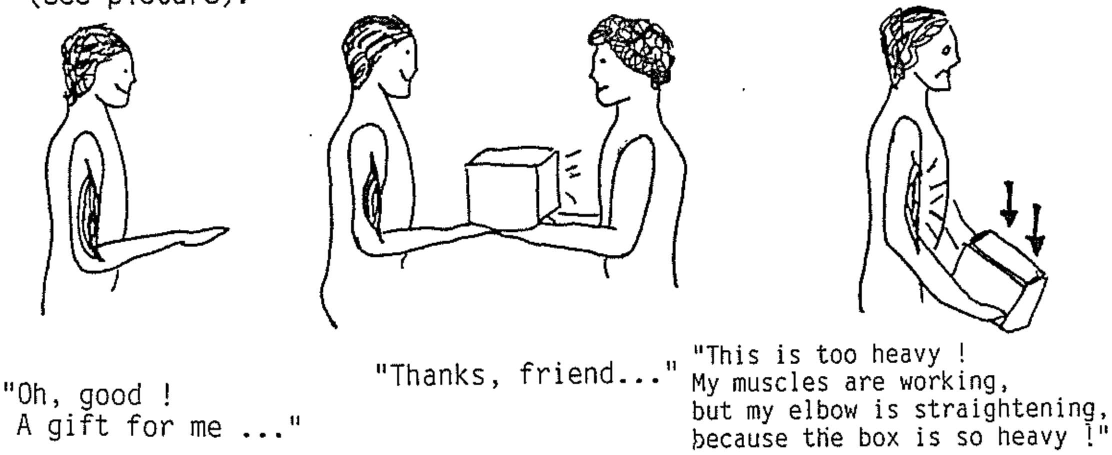


b) You are in standing position with your elbows flexed about 90 . A friend gives you a heavy box to hold. It is so heavy that you cannot continue to hold it, and you slowly lower it to the ground.

Your elbow flexors are contracting (working), but the weight of the box is too heavy and it slowly lowers toward the ground.

The end of the elbow flexor muscles are moving farther apart when the elbow flexors are contracting.

This is an ECCENTRIC muscle contraction of the elbow flexors. (See picture).

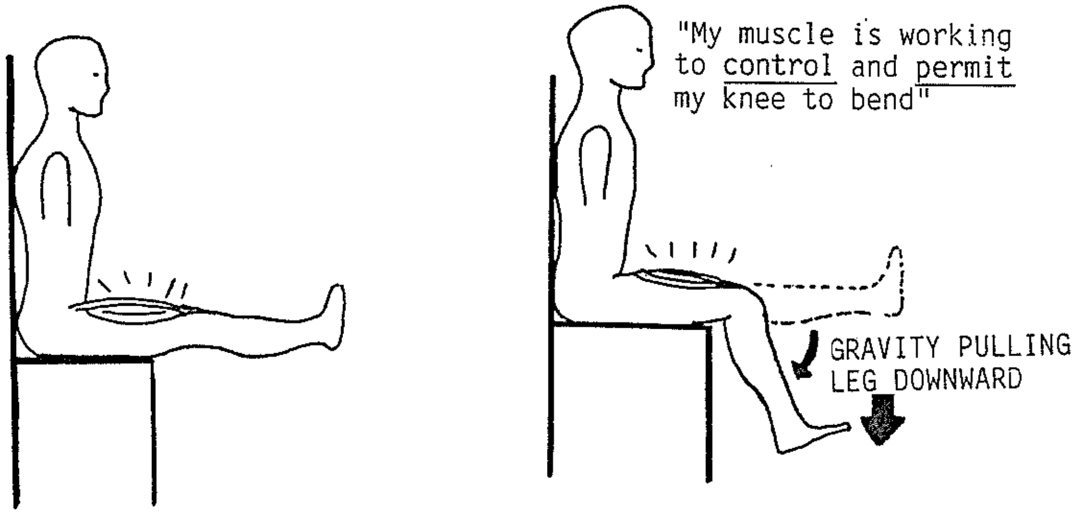


c) You are in sitting position on a chair with your right knee extended. You slowly allow your knee to flex (remember that gravity will try to pull your leg quickly to the floor).

Your knee extensors are working to allow your knee to flex.* The ends of the knee extensor muscles are moving further apart and there is joint movement.

This is an ECCENTRIC contraction of the knee extensors.

(* If the knee extensors did not work, the leg would fall quickly towards the ground because gravity is pulling it in that direction. If the knee extensors did not become "longer", then the knee would remain in an extended position.) (See picture).



In summary, the three basic basic types of muscle contractions are:

* ISOMETRIC MUSCLE CONTRACTION :

The muscle is contracting (working) but there is NO joint movement. The distance between the ends of the muscle does not change.

* CONCENTRIC MUSCLE CONTRACTION :

The muscle is contracting (working) and there IS joint movement. The ends of the muscle come closer together causing joint movement.

* ECCENTRIC MUSCLE CONTRACTION :

The muscle is contracting (working) and there IS joint movement. The ends of the muscle move farther apart allowing joint movement.

Questions:

1. You are sitting in class listening to a teacher. You have a question and raise your arm so the teacher will call on you. What type of muscle contraction have you made with you shoulder flexors?

____

2. You continue to hold your arm above your head. What type of muscle contraction are you making with the shoulder extensors?

____

3. The teacher has called on you and you lower your arm. What type of muscle contraction have you made with the shoulder flexors?

____

Questions: (continued)

4. You are in supine position. You move your right leg away from your left leg. What type of muscle contraction have you made in the right hip abductors?

   ____

   Are the right hip adductors working when you do this?

   Yes ____________ No ____________

   Why or why not?

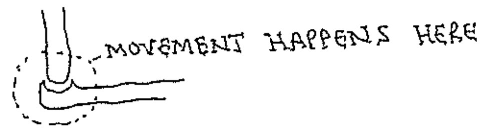
   ____

   ____

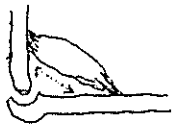
F. ATTACHMENT OF MUSCLES TO BONE

* Muscles are attached to bones by tendons. The tendon is part of the muscle, but it is not able to contract like the muscle fibers can.

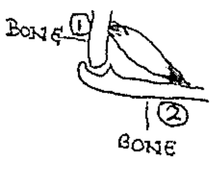
* Movement happens at a joint (the place where two or more bones come together).



* Muscles must cross a joint to make it move.



* To cross a joint, every skeletal muscle must attach to at least two bones.



Question:

If a skeletal muscle is attached to one bone ONLY, would you have movement at a joint?

Yes _______ No _____

Why or why not?

____

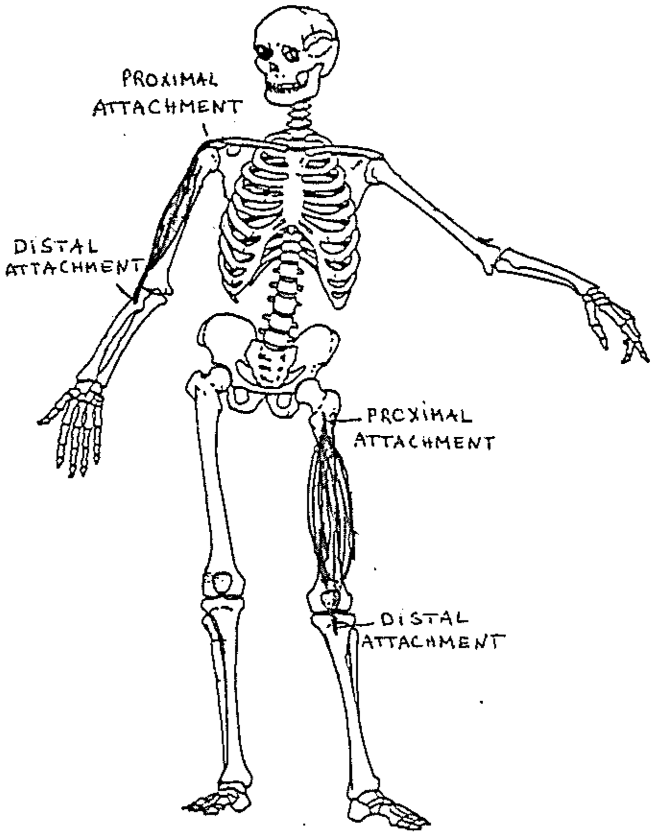
____

____

* There are at least two tendons for every muscle; generally, there is one tendon on each end of the muscle.

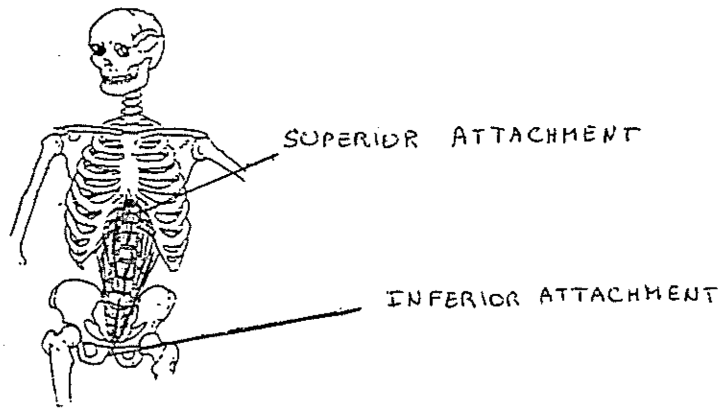
The tendon that attaches to the bone more proximal to the trunk is called the PROXIMAL ATTACHMENT.

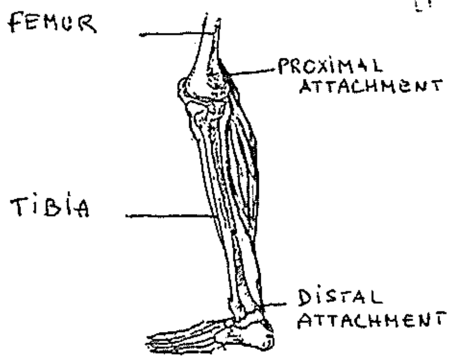
The tendon that attaches to the bone that is more distal from the trunk is called the DISTAL ATTACHMENT.



For the muscles that attach to the trunk only, the attachment more near the head is called the SUPERIOR ATTTACHMENT.

The other attachment is called the INFERIOR ATTACHMENT.





A muscle crosses the knee joint. One tendon attaches to the femur, and one tendon attaches to the tibia. The PROXIMAL ATTACHMENT of this muscle is to the <u>femur</u>.

The DISTAL ATTACHMENT of this muscle is to the <u>tibia</u>.

<u>Question</u>:

A muscle crosses the hip joint. One tendon attaches to the <u>pelvis</u>, and one tendon attaches to the <u>femur</u>.

Where is the PROXIMAL ATTACHMENT of this muscle?

____

Where is the DISTAL ATTACHMENT of this muscle?

____

G. WHERE MUSCLES CROSS A JOINT

There can be many muscles that cross a joint.

There can also be more than one muscle that causes a specific movement. (Example: There is more than one muscle that flexes the knee.)

It is very important to know where the muscles crosses the joint (the LOCATION of the muscle).

If you know the location of the muscle, then you will know what movement the muscle will cause when it contracts (shortens).

The function of the muscle can be learned by knowing where the muscle crosses the specific joint.

There are many ways that muscles could cross joints and cause movement:

* ANTERIOR to the joint:
  Shortening causes movement in an ANTERIOR direction.

* POSTERIOR to the joint:
  Shortening causes movement in a POSTERIOR direction.

* SUPERIOR to the joint:
  Shortening causes movement in an UPWARD direction.

* INFERIOR to the joint:
  Shortening causes movement in a DOWNWARD direction.

* EXTERNAL side of joint:
  Shortening causes movement toward the OUTSIDE.

* INTERNAL side of the joint:
  Shortening causes movement toward the INSIDE.

Activity:

For each of the picture given below, please write where the muscle crosses the joint and what movement it will cause when it contracts (shortens).

EXAMPLE

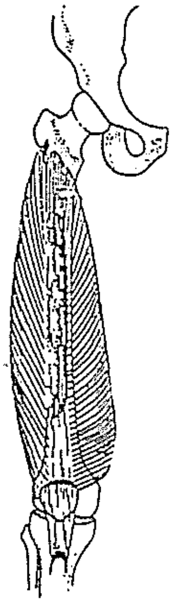
A. This muscle passes

____

to the knee joint.

When it shortens, it causes

_________________ of the knee.



(ANTERIOR VIEW)

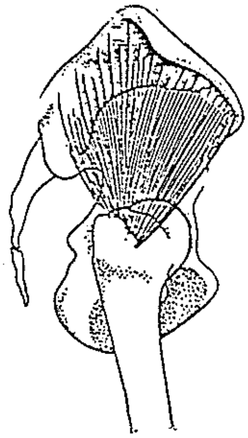
B. This muscle passes

____

to the hip joint.

When it shortens, it causes

________________ of the hip.



(LATERAL VIEW)

Activity: (continued)

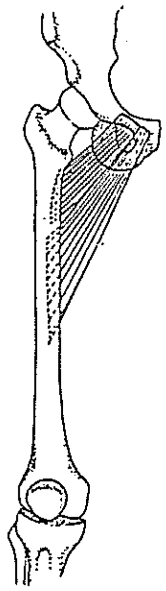
C. This muscle passes

____

to the hip joint.

When it shortens, it causes

__________________ of the hip.



(ANTERIOR VIEW)

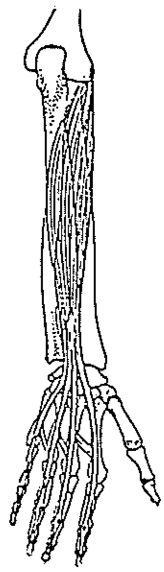
D. This muscle passes

____

to the wrist joint.

When it shortens, it causes

__________________ of the wrist.



(POSTERIOR VIEW)

H. MUSCLES THAT CROSS TWO JOINTS

We have said that <u>every skeletal must cross at least one joint to be able to make movement</u>.

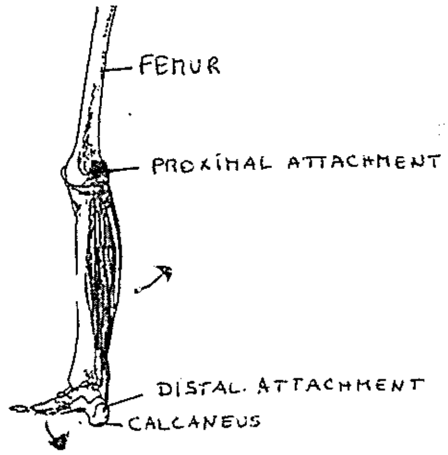
Some muscles are special and cross <u>two</u> (or more!) joints.

For these "TWO JOINT MUSCLES", it is important to remember that when they <u>contract</u>, they may cause movement at TWO joints.

<u>Example</u>:

A muscle has its PROXIMAL ATTACHMENT on the posterior side of the femur, and the DISTAL ATTACHMENT on the posterior side of the calcaneus.

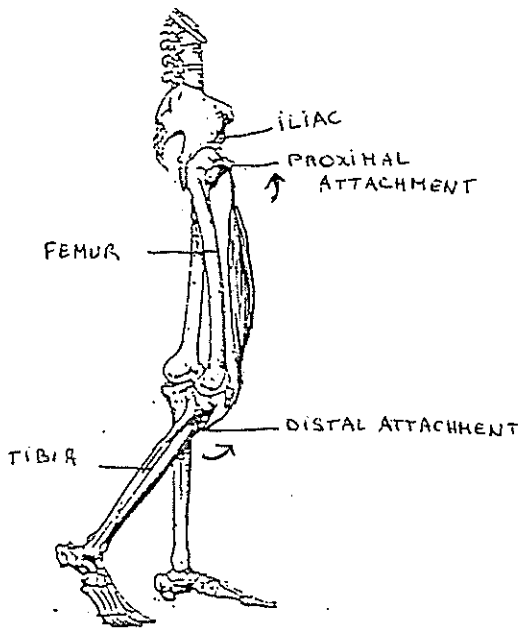
When this muscle contracts, it may cause movement in the knee joint AND the ankle joint.



<u>Example</u>:

A muscle has its PROXIMAL ATTACHMENT on the inferior part of the iliac bone, and the DISTAL ATTACHMENT on the proximal tibia (anterior side).

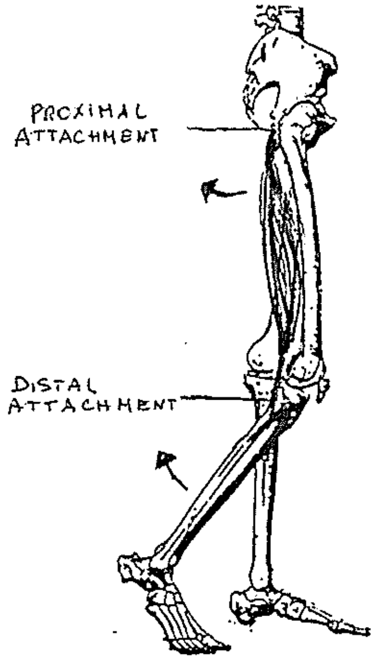
When this muscle contracts, it may cause movement in the hip joint AND the knee joint.



Example:

A muscle has its PROXIMAL ATTACHMENT on the ischium and the DISTAL ATTACHMENT on the proximal part of tibia and fibula on the posterior side.

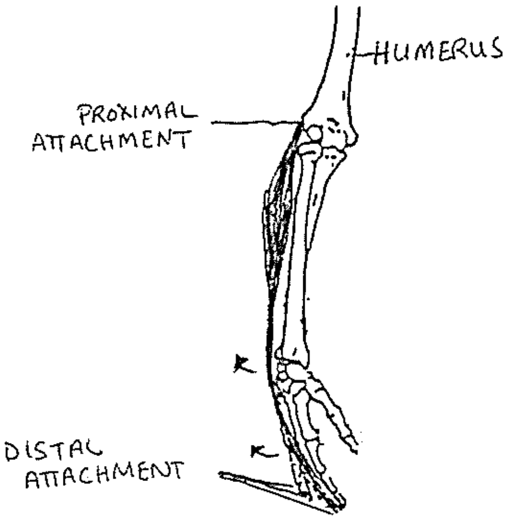
When this muscle contracts, it may cause movement at the hip and knee.



Example:

A muscle has its PROXIMAL ATTACHMENT on the distal humerus on the external side and its DISTAL ATTACHMENT on the distal phalanges.

When this muscle contracts, it may cause movement at the wrist and fingers.



It will be important to learn the <u>main</u> "two joint muscles" to be able to apply good stretching techniques for different joints. (See STRETCHING chapter, Volume 2.)

I. SPECIFIC MUSCLE ATTACHMENTS IN THE BODY

In this section more detail will be given about where specific muscles pass different joints (or body areas) in the body.

The joints (or body areas) will be presented in the following order:

I.	THE SHOULDER	VII.	THE HIP
II.	THE ELBOW	VIII.	THE KNEE
III.	THE FOREARM	IX.	THE ANKLE
IV.	THE WRIST	X.	THE FOOT
V.	THE FINGERS	XI.	THE TOES
VI.	THE THUMB	XII.	THE TRUNK

For each movement in the joint (or body area) there is a description of the main muscle that is responsible for the movement.

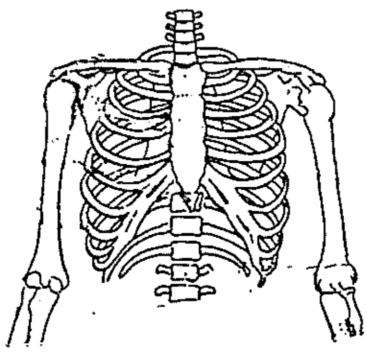
There is a picture beside each muscle that is described.

The student is expected to DRAW the muscle on the picture from the location given in the description.

The student will also write the function of each muscle.

I. THE SHOULDER

A) Shoulder FLEXOR



PROXIMAL ATTACHMENT:
External part of clavicle.

DISTAL ATTACHMENT:
Anterior and middle part of humerus.

LOCATION:
Muscle passes anterior to shoulder joint.

FUNCTION:

____

B) Shoulder EXTENSOR

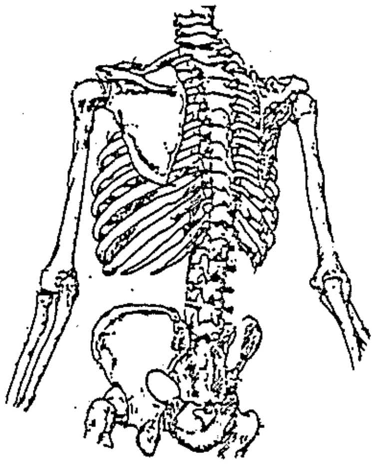
PROXIMAL ATTACHMENT:
Spines of lower thoracic vertebrae, lumbar and sacral vertebrae.

DISTAL ATTACHMENT:
Proximal part of humerus on the anterior side.

LOCATION:
Muscle passes posterior and inferior to the shoulder joint.

FUNCTION:

____



C) Shoulder ABDUCTOR

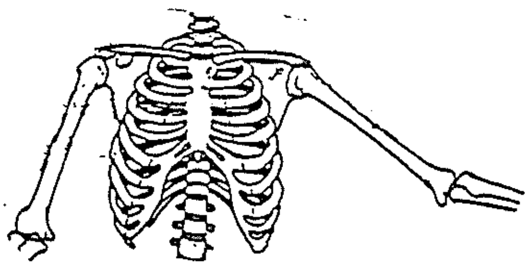
PROXIMAL ATTACHMENT:
Superior part of scapula and clavicle.

DISTAL ATTACHMENT:
Middle of external side of humerus.

LOCATION:
Superior and external to shoulder joint.

FUNCTION:

____



D) Shoulder ADDUCTORS

ANTERIOR PROXIMAL ATTACHMENT:
Sterum

POSTERIOR PROXIMAL ATTACHMENT:
Spines of lower thoracic, lumbar and sacral vertebrae

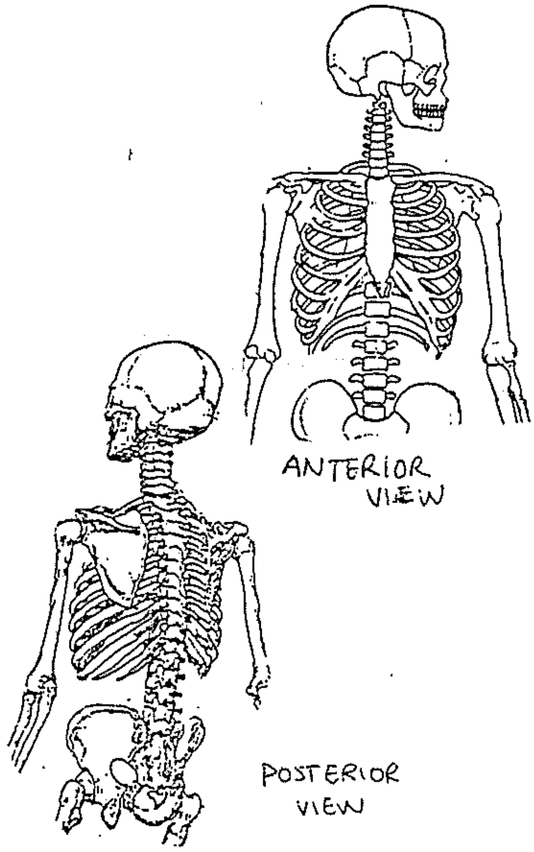
DISTAL ATTACHMENT:
Proximal part of humerus

ANTERIOR LOCATION:
Muscle passes anterior to the the shoulder joint

POSTERIOR LOCATION:
Muscle passes posterior to the shoulder joint.

FUNCTION:

____



E) Shoulder INTERNAL ROTATOR

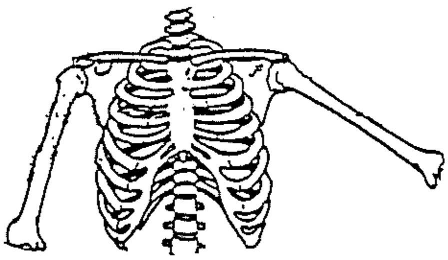
PROXIMAL ATTACHMENT:
Anterior side of scapula.

DISTAL ATTACHMENT:
Proximal part of humerus on the external side.

LOCATION:
Muscle passes anterior to the shoulder joint.

FUNCTION:

____



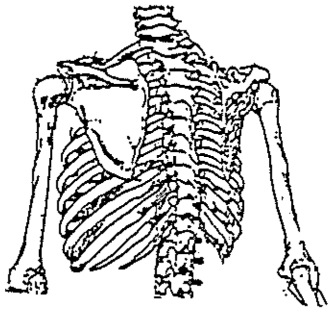
F) Shoulder EXTERNAL ROTATOR

PROXIMAL ATTACHMENT:
Posterior side of scapula.

DISTAL ATTACHMENT:
Proximal part of humerus on the external side.

LOCATION:
Muscle passes posterior to the shoulder joint.

FUNCTION:



____

II. THE ELBOW

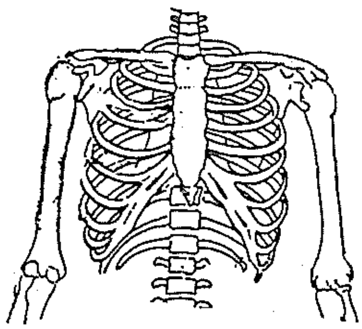
A) Elbow FLEXOR (BICEPS)

PROXIMAL ATTACHMENT:
Superior and external side of the scapula.

DISTAL ATTACHMENT:
Proximal part of the radius. external side.

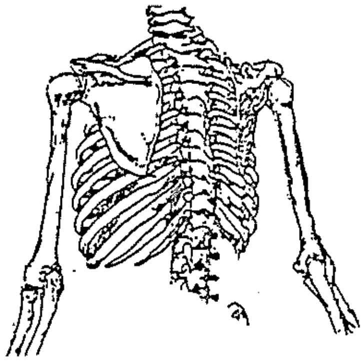
LOCATION:
Muscle passes anterior to elbow joint.

FUNCTION(S):



____

B) Elbow EXTENSOR (TRICEPS)



PROXIMAL ATTACHMENT:
External side of scapula, proximal and posterior side of humerus.

DISTAL ATTACHMENT:
Proximal part of the ulna on the posterior side.

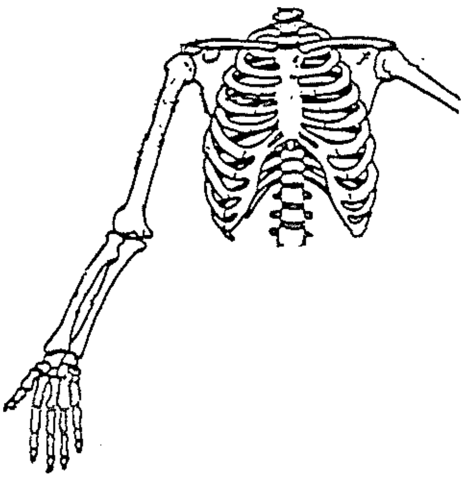
LOCATION:
Muscle passes posterior to elbow joint.

FUNCTION(S):

____

III. THE FOREARM (An area, not a joint)

A. Forearm SUPINATOR



PROXIMAL ATTACHMENT:
Distal humerus on the external side.

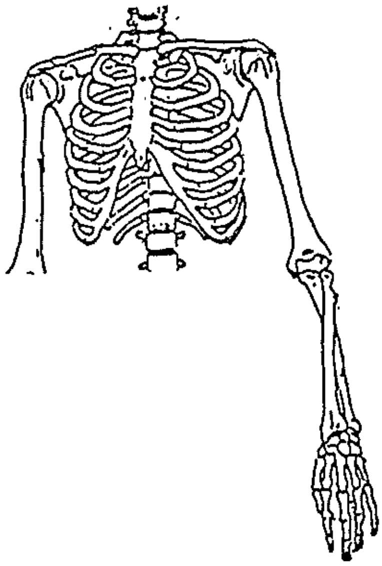
DISTAL ATTACHMENT:
Proximal part of the raduis on the dorsal and external side.

LOCATION:
Muscle passes on the external side of the elbow joint.

FUNCTION:

____

B) Forearm PRONATOR



PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Middle of radius on the external side.

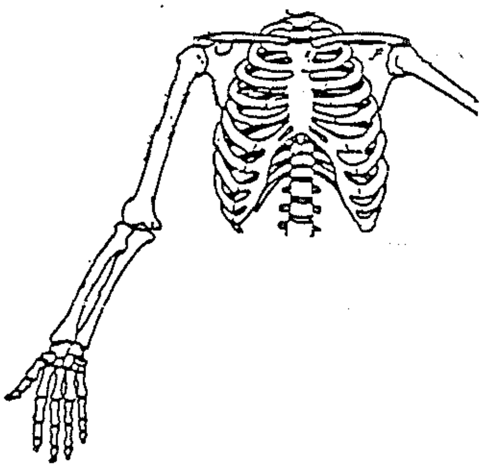
LOCATION:
Muscle passes anterior to elbow joint.

FUNCTION:

____

IV. THE WRIST

A) Wrist FLEXOR



PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Proximal part of the metacarpal bones.

LOCATION:
Tendon passes anterior to wrist joint.

FUNCTION:

____

B) Wrist EXTENSOR

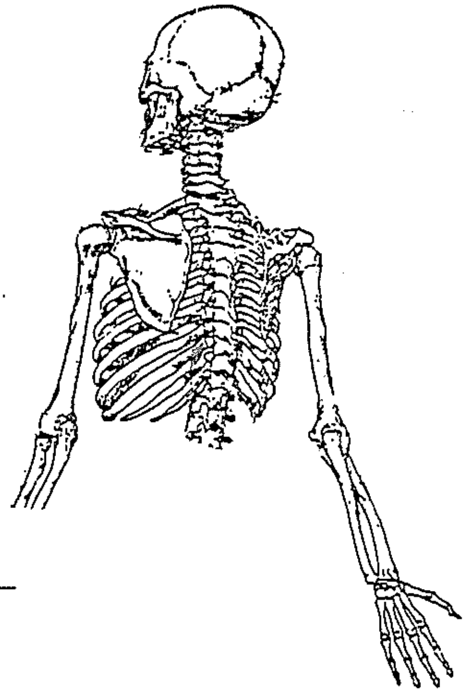
PROXIMAL ATTACHMENT:
Distal humerus on the external side.

DISTAL ATTACHMENT:
Proximal part of the metacarpal bones.

LOCATION:
Tendon passes posterior to wrist joint.

FUNCTION:

____



C) Wrist ADDUCTOR

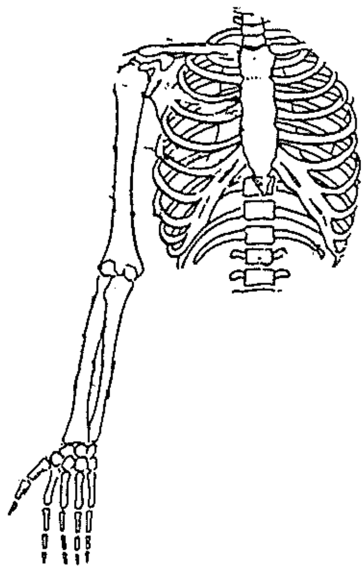
PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Proximal part of the 5th metacarpal.

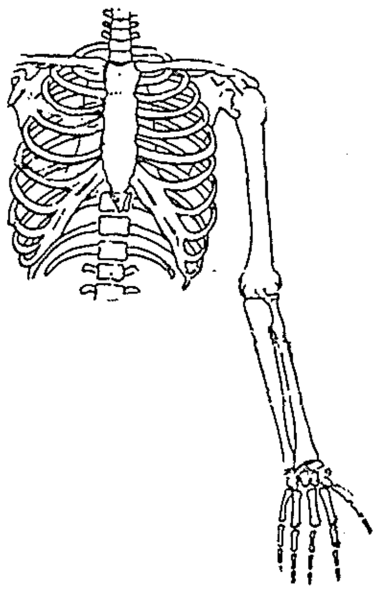
LOCATION:
Tendon passes wrist joint on the internal side.

FUNCTION:

____



D) Wrist ABDUCTOR



PROXIMAL ATTACHMENT:
Distal humerus on the external side.

DISTAL ATTACHMENT:
Proximal part of the 1st metacarpal.

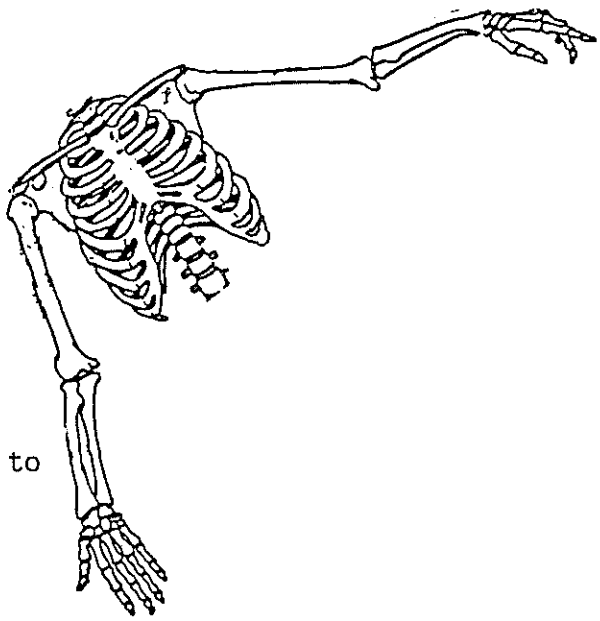
LOCATION:
Tendon passes wrist joint on the posterior and external side.

FUNCTION:

____

V. THE FINGERS

A) Finger FLEXORS



PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

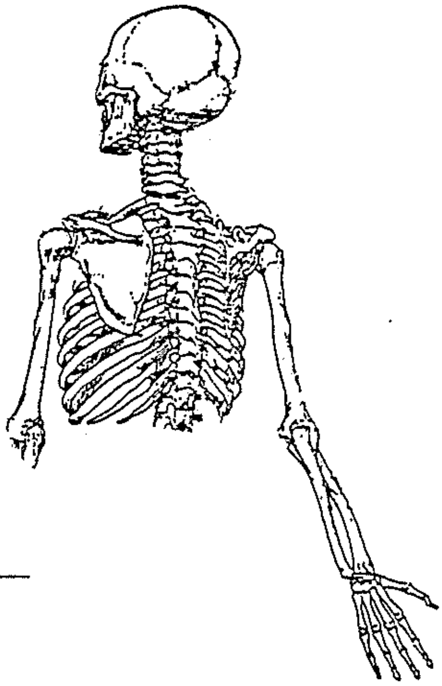
DISTAL ATTACHMENT:
Distal phalanges.

LOCATION:
Tendon passes anterior to wrist and fingers

FUNCTION(S):

____

B) Finger EXTENSORS



PROXIMAL ATTACHMENT:
Distal humerus on the external side.

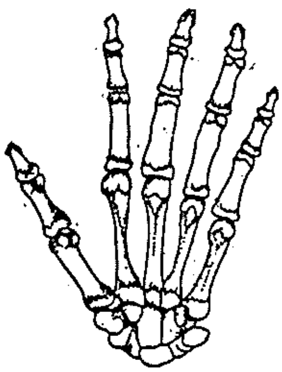
DISTAL ATTACHMENT:
Distal phalanges.

LOCATION:
Tendon passes posterior to wrist and fingers

FUNCTION(S):

____

C) Finger ABDUCTORS (Reference is to middle of hand; 3rd phalange)



PROXIMAL ATTACHMENT:
Metacarpal bones.

DISTAL ATTACHMENT:
Proximal part of phalanges (2, 3, 4, 5)

LOCATION:
Muscles pass on the external side of the 2nd phalange, both sides of the 3rd phalange, and on the internal sides of the 4th and 5th phalanges.

FUNCTION:

____

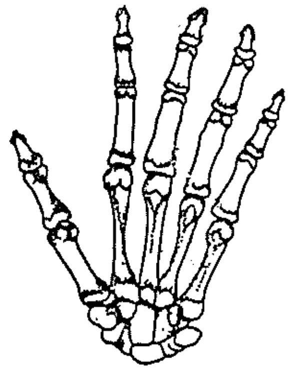
D) Finger ADDUCTORS (Reference is to middle of hand; 3rd phalange)

PROXIMAL ATTACHMENT:
Metacarpal bones.

DISTAL ATTACHMENT:
Proximal part of phalanges (2, 4, 5)

LOCATION:
Muscles pass the internal side of the 2nd phalange, external sides of the 4th and 5th phalanges.

FUNCTION:



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VI. THE THUMB

A) Thumb ABDUCTOR

PROXIMAL ATTACHMENT:
External carpal bone on external side.

DISTAL ATTACHMENT:
Proximal phalange of thumb.

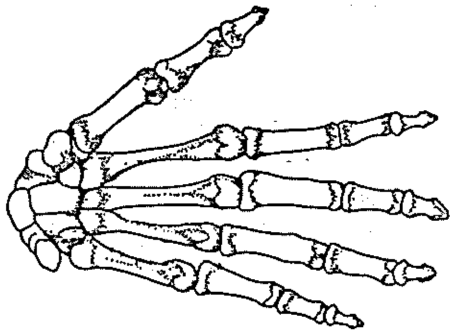
LOCATION:
Muscle passes posterior to wrist and thumb.

FUNCTION:

____

B) Thumb OPPOSITION

PROXIMAL ATTACHMENT:
Middle carpal bone on anterior side.



DISTAL ATTACHMENT:
Length of 1st metacarpal bone on anterior side.

LOCATION:
Muscle passes anterior to the proximal joint of thumb on external side.

FUNCTION:

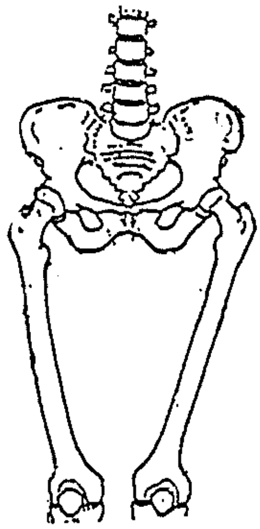
____

<u>NOTE</u>: The thumb can also make the movements of flexion, extension, and adduction. These are small movements and details of their proximal and distal attachments are not important for the PTA to learn.

VII. THE HIP

A) Hip FLEXOR

PROXIMAL ATTACHMENT:
Transverse processes of the lumbar vertebrae, and on the inside of the iliac bone.



DISTAL ATTACHMENT:
Proximal femur on the internal side.

LOCATION:
Muscle passes anterior to hip joint.

FUNCTION:

____

B) Hip EXTENSOR

PROXIMAL ATTACHMENT:
Posterior part of sacrum and iliac bone.

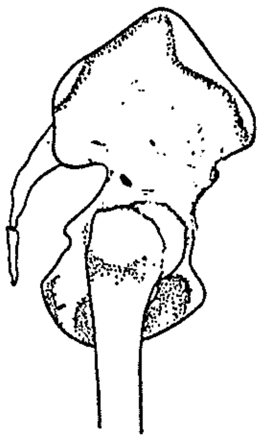
DISTAL ATTACHMENT:
Proximal part of femur on the posterior and lateral side.

LOCATION:
Muscle passes posterior to hip joint.

FUNCTION:

____

C) Hip ABDUCTOR



PROXIMAL ATTACHMENT:
External part of iliac bone.

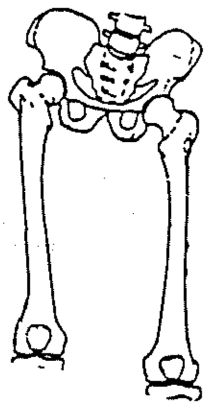
DISTAL ATTACHMENT:
Greater trochanter

LOCATION:
Muscle passes on the external side of the hip joint.

FUNCTION:

____

D) Hip ADDUCTOR



PROXIMAL ATTACHMENT:
Ischium

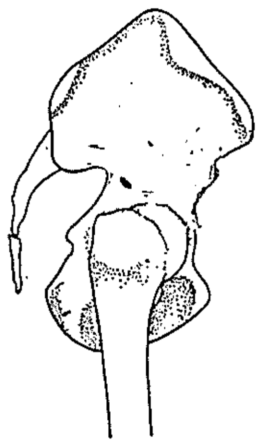
DISTAL ATTACHMENT:
The length of the femur on the internal side.

LOCATION:
Muscle passes on internal side of the hip joint.

FUNCTION:

____

E) Hip INTERNAL ROTATOR



PROXIMAL ATTACHMENT:
Exernal side of liliac bone

DISTAL ATTACHMENT:
Greater trochanter on anterior side.

LOCATION:
Muscle passes anterior to hip joint.

FUNCTION:

____

E) Hip EXTERNAL ROTATOR

PROXIMAL ATTACHMENT:
Near ischium on posterior side.

DISTAL ATTACHMENT:
Near neck of femur on posterior side.

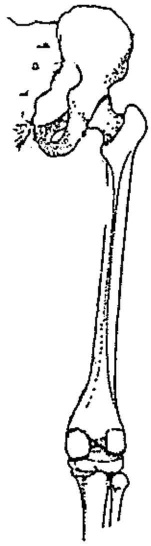
LOCATION:
Muscle passes posterior to hip joint.

FUNCTION:

____

VIII. THE KNEE

A) Knee FLEXOR (HAMSTRINGS)



PROXIMAL ATTACHMENT:
Ischium (ischial tuberosity)

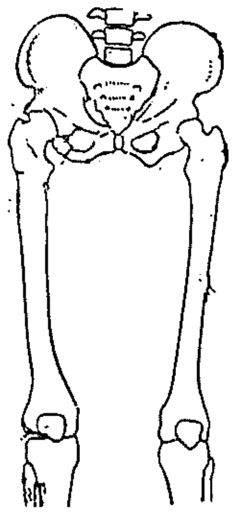
DISTAL ATTACHMENT:
Proximal part of tibia and fibula on posterior side.

LOCATION:
Muscle passes posterior to hip and knee.

FUNCTION:

____

B) Knee EXTENSOR (QUADRICEPS)



PROXIMAL ATTACHMENT:
Inferior part of iliac bone.

DISTAL ATTACHMENT:
Patella, and proximal part of tibia on the anterior side.

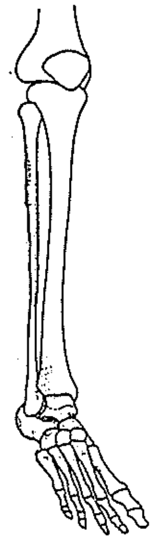
LOCATION:
Muscle passes anterior to hip and knee.

FUNCTION:

____

IX. THE ANKLE

A) Ankle DORSIFLEXOR



PROXIMAL ATTACHMENT:
Proximal tibia on the anterior and external side.

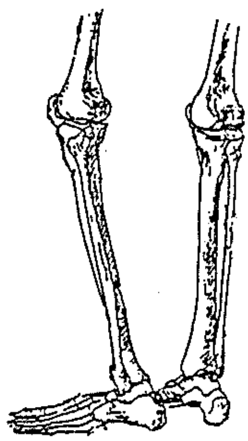
DISTAL ATTACHMENT:
Proximal part of 1st metatarsal bone.

LOCATION:
Muscle passes anterior and internal to the ankle joint.

FUNCTION:

____

B) Ankle PLANTAR FLEXOR



(TRICEPS SURAE, GASTROCNEMIUS)

PROXIMAL ATTACHMENT:
Distal femur on posterior side.

DISTAL ATTACHMENT:
Posterior part of calcaneus.

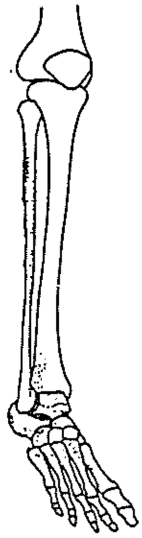
LOCATION:
Tendon passes posterior to ankle joint.

FUNCTION:

____

X. THE FOOT

A) Foot EVERTOR



PROXIMAL ATTACHMENT:
Length of fibula on external side.

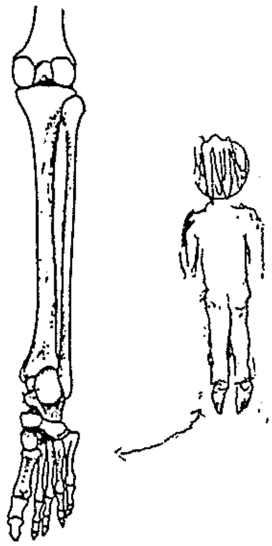
DISTAL ATTACHMENT:
Proximal part of 5th metatarsal bone.

LOCATION:
Muscle passes behind external malleolus on external side of ankle joint.

FUNCTION:

___

B) Foot INVERTOR



PROXIMAL ATTACHMENT:
Posterior side of tibia.

DISTAL ATTACHMENT:
Tarsal bones on internal side of foot.

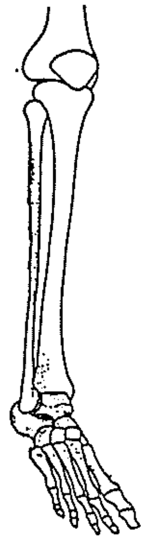
LOCATION:
Tendon passes on internal side of the ankle joint.

FUNCTION:

___

XI. THE TOES

A) Toe EXTENSORS



PROXIMAL ATTACHMENT:
Length of fibula on the anterior side.

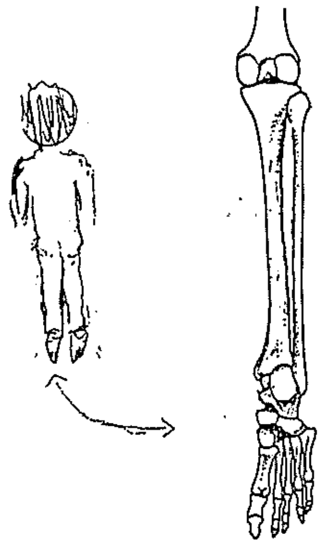
DISTAL ATTACHMENT:
Distal phalanges on dorsal side of the foot.

LOCATION:
Tendon passes anterior to ankle joint.

FUNCTION:

____

B) Toe FLEXORS



PROXIMAL ATTACHMENT:
Posterior tibia.

DISTAL ATTACHMENT:
Distal phalanges on plantar side of the foot.

LOCATION:
Tendon passes posterior to ankle.

FUNCTION:

____

XII. THE TRUNK

A) Trunk FLEXORS (ABDOMINAL MUSCLES)

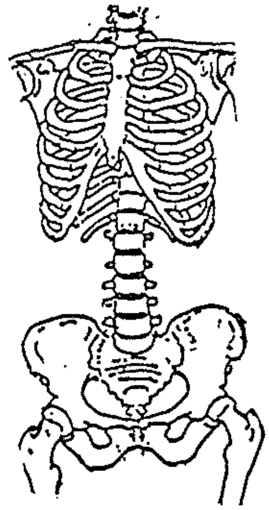
INFERIOR ATTACHMENT:
Pubis (the anterior part of the pelvis where the two iliac bones meet).

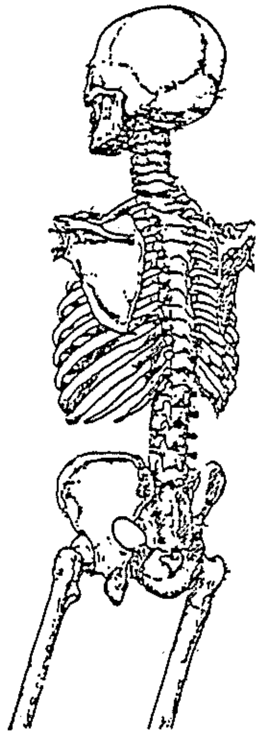
SUPERIOR ATTACHMENT:
5th, 6th and 7th ribs.

LOCATION:
Muscle passes on anterior side of the trunk.

FUNCTION:

____





B) Trunk EXTENSORS

INFERIOR ATTACHMENT:
Near sacrum and pelvis on posterior side of the trunk.

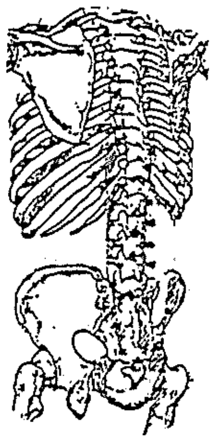
SUPERIOR ATTACHMENT:
Posterior part of ribs and vertebrae.

LOCATION:
Muscles pass posterior to vertebral joints on the right and left sides of vertebral column.

FUNCTION:

____

C) Trunk LATERAL BENDER



INFERIOR ATTACHMENT:
Posterior iliac crest.

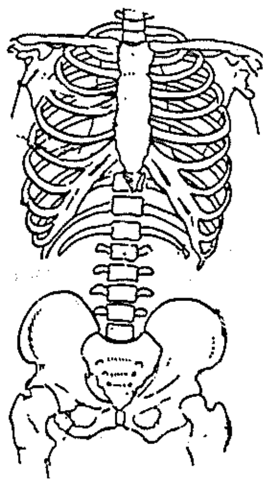
SUPERIOR ATTACHMENT:
Last rib, transverse.

LOCATION:
Muscle passes on external side of lumbar vertebrae.

FUNCTION:

____

D) Trunk ROTATOR



INFERIOR ATTACHMENT:
Pubis (the anterior part of the pelvis where the two iliac bones meet).

SUPERIOR ATTACHMENT:
Inferior part of the lower ribs.

LOCATION:
Muscle obliquely passes anterior to the trunk.

FUNCTION:

____

It is interesting to be able to <u>say</u> the attachments of muscles and even better to be able to draw them on a skelton.

Of most importance is to be able to work with the body and FEEL the muscles as they work.

In this way, you can observe what the muscle does and even find that there may be <u>many</u> muscles that could help make the same movement.

Activity:

Form groups of two people in each group. One student will be making different joint movements while the other student will be observing and feeling the muscles that work.

If the student cannot feel the muscle working, then he should add resistance (try to push the joint in the opposite direction to make the muscle work harder.

Example:
Student "A" demonstrates elbow flexion.
Student "B" cannot feel the elbow flexors work.
Student "B" tries to extend the elbow while student "A" tries to keep the elbow in flexion.
With this resistance, student "B" should be able to more clearly see and feel the elbow flexors.

Below are each of the joints and movements to be tested. For each joint movement, write the area where you feel and see the muscle working.

JOINT/MOVEMENT	LOCATION OF WHERE MUSCLE IS SEEN AND FELT
Elbow Flexion	______________________
	______________________
Elbow Extension	______________________
	______________________
Knee Extension	______________________
	______________________
Knee Flexion	______________________
	______________________
Ankle Plantarflexion	______________________
	______________________
Ankle Dorsiflexion	______________________
	______________________
Hip Extension	______________________
	______________________

<u>Activity</u>: (continued)

JOINT/MOVEMENT	LOCATION OF WHERE MUSCLE IS SEEN AND FELT
Hip Flexion	
Hip Adduction	
Hip Abduction	
Trunk Flexion	
Trunk Extension	
Foot Eversion	
Shoulder Abduction	
Shoulder Adduction	
Shoulder Flexion	
Shoulder Extension	

<u>Activity</u>: (continued)

JOINT/MOVEMENT	LOCATION OF WHERE MUSCLE IS SEEN AND FELT
Wrist Flexion *	
Wrist Extension *	
Finger Extension *	
Finger Flexion *	
Thumb Abduction	
Thumb Opposition	

* In the wrist and fingers you may feel the tendons easily, but try to locate the <u>muscle</u> itself.

J. LEVELS OF MUSCLE STRENGTH

We have learned about gravity.

We have learned where specific muscles are and the movement that they make.

We have practised to observe muscles and feel them as they work.

We must now be able to <u>clearly</u> and <u>objectively</u> say how strong a muscle is.

Question:

Why do you want to test or know how strong a muscle is?

____

____

If a PTA reports that a muscle is "strong" or a muscle is "weak", the listener will have a general idea of what the muscle is like.

Another PTA may describe the SAME muscle as being "strong" and "okay".

Because you want to give clear and precise information that will be the same for everyone who tests a muscle, a system was developed for testing and naming different muscle strengths.

This system is accepted in many areas of the world, and is used by Physical Therapists, Doctors, Nurses and other medical professionals.

THERE ARE SIX DIFFERENT LEVELS OF MUSCLE STRENGTH.

These levels begin at the point where there is no muscle contraction and continue to name the strength until the muscle is normal.

For all the muscle contractions that you test, you ask the patient to make the muscle work as much as he/she can.

It is useful for the PTA to look at both sides of the body to be able to compare the left and right sides.

The following descriptions are the SIX different ways to identify how strong or weak a muscle is.

0 NO MUSCLE CONTRACTION AT ALL

The patient tries to make the muscle work, but because of some nerve damage or other problem, the muscle does not contract.

This is often described as ZERO or "0" muscle strength.

CAN SEE OR FEEL THE MUSCLE CONTRACTING, BUT IS NOT STRONG ENOUGH TO MOVE THE JOINT

The patient tries to make the muscle work and the PTA can see or feel the muscle working, but no movement happens at the joint.

This is often described as TRACE or "1" muscle strength.

THE MUSCLE CAN MOVE THE JOINT, BUT ONLY IN A POSITION THAT IS NOT AGAINST GRAVITY.

The patient tries to make the muscle work, but against gravity it cannot make much joint movement.

When the joint is in a position where it does not move against gravity, then the muscle is able to contract and cause complete joint movement.

This is often described as POOR or "2" muscle strength.

THE MUSCLE CAN MOVE THE JOINT AGAINST GRAVITY

The patient tries to make the muscle work and it is able to make the full joint movement against gravity.

This is often described as FAIR or "3" muscle strength.

THE MUSCLE CAN MOVE THE JOINT AGAINST GRAVITY AND WITH SOME RESISTANCE

The patient tries to make the muscle work and it is able to make full joint movement against gravity.

The PTA will then add resistance to make the movement more difficult; the patient is able to make full joint movement even with this resistance.

This is often described as GOOD or "4" muscle strength.

THE MUSCLE IS NORMAL STRENGTH

The patient tries to make the muscle work and is able to make full joint movement against gravity and with resistance.

If you compare this muscle with the normal muscle on the opposite side of the patient, the two will be the same.

This is often described as GOOD or "5" muscle strength.

K. MUSCLE TESTING

In the beginning, muscle testing may seen difficult and confusing.

For practical muscle testing, the PTA should remember three types of information.

1. Where the muscle is and the movement that it makes.
2. What direction gravity is pulling the part being tested.
3. The six levels of muscle strength and what they mean.

If the PTA can apply this information, then muscle testing will seem more logical and easy.

Below are the general guidelines to follow when doing a muscle test.

a) Begin in the test position against gravity ("3" muscle strength), and change as needed.

b) Instruct your patient clearly so he/she knows what movement to make.

c) If resistance is needed, give it just distal to the joint being tested.

d) Stabilization may be needed to prevent unwanted parts from moving.

e) Comparing right and left side is very useful in determining levels of strength.

f) You do not muscle test hemiplegic or brain injured patients; (explanation will be given in future chapters).

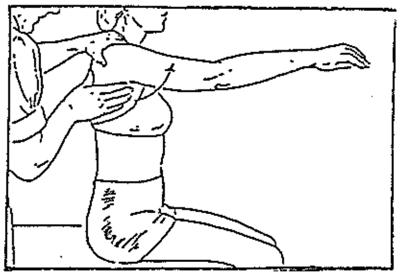
For the larger body parts, gravity will have a big effect on the movement.

For the smaller parts (fingers/toes) gravity has less of an effect and so the testing position is not as important.

The next section will provide pictures of the big joints in the testing position against gravity ("3"). Next to each picture is a space open for COMMENTS. This area should be used to describe the test position without gravity and/or specific information about testing that particular joint movement.

SHOULDER
FLEXOR

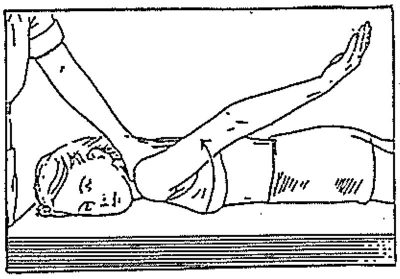
(against gravity
position)



COMMENTS

SHOULDER
EXTENSOR

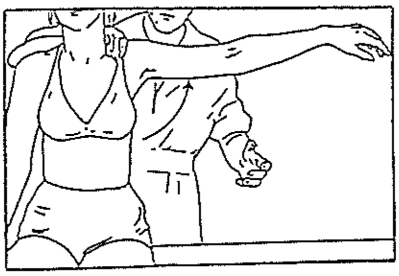
(against gravity
position)



COMMENTS

SHOULDER
ABDUCTOR

(against gravity
position)

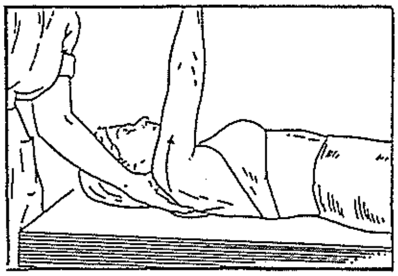


COMMENTS

SHOULDER
ADDUCTOR

COMMENTS

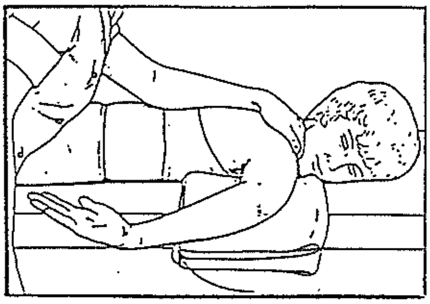
(against gravity
position)



SHOULDER
INTERNAL ROTATOR

COMMENTS

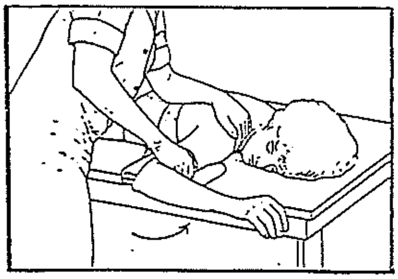
(against gravity
position)



SHOULDER
EXTERNAL ROTATOR

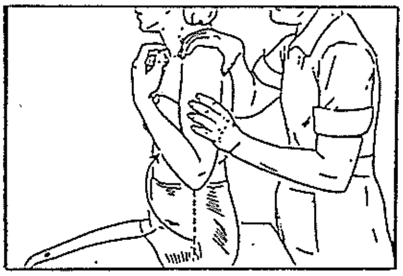
COMMENTS

(against gravity
position)



ELBOW
FLEXOR

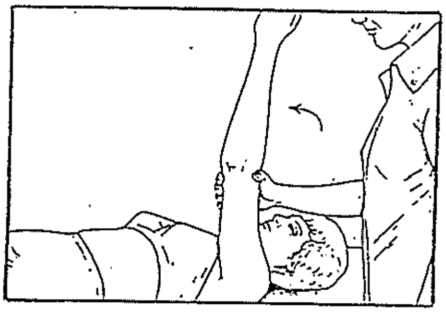
(against gravity
position)



COMMENTS

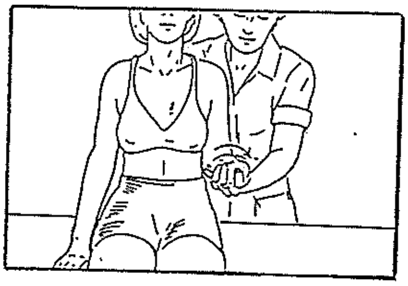
ELBOW
EXTENSOR

(against gravity
position)



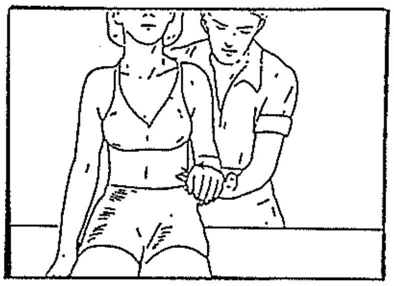
COMMENTS

FOREARM
SUPINATOR



COMMENTS

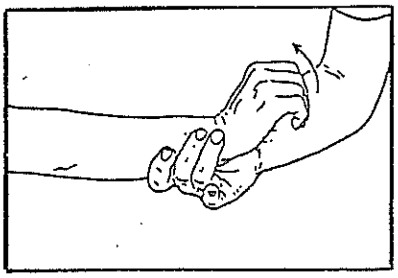
FOREARM
PRONATOR



COMMENTS

WRIST
EXTENSOR

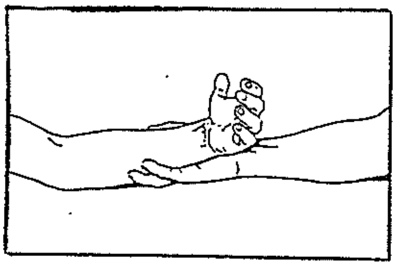
(against gravity
position)



COMMENTS

WRIST
FLEXOR

(against gravity
position)



COMMENTS

No pictures are given for the following muscles; testing is similar to the movements made.

WRIST ABDUCTOR/ADDUCTOR

FINGER FLEXOR/EXTENSOR

FINGER ABDUCTOR/ADDUCTORS

THUMB ABDUCTION

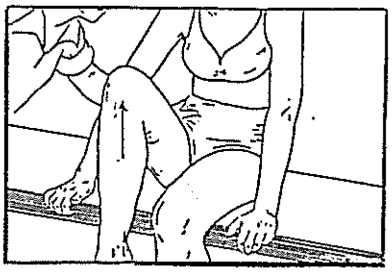
THUMB OPPOSITION

****

HIP
FLEXOR

COMMENTS

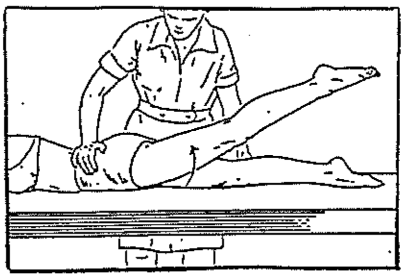
(against gravity position)



HIP
EXTENSOR

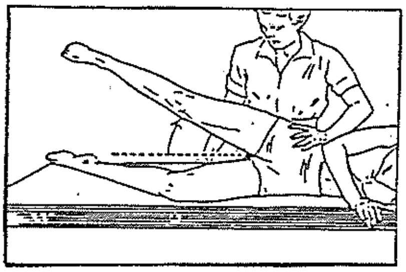
COMMENTS

(against gravity position)



HIP
ABDUCTOR

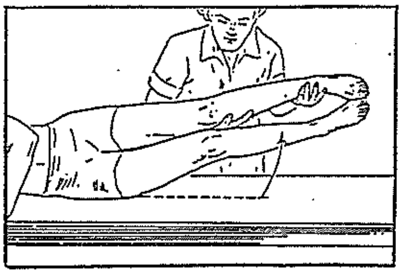
(against gravity position)



COMMENTS

HIP
ADDUCTOR

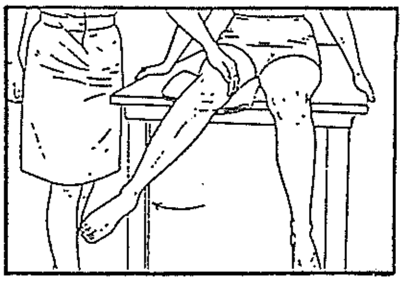
(against gravity position)



COMMENTS

HIP
INTERNAL ROTATOR

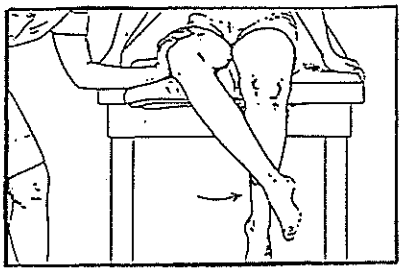
(against gravity position)



COMMENTS

HIP
EXTERNAL ROTATOR

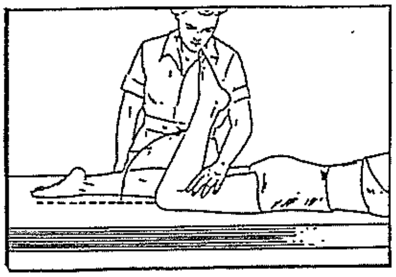
(against gravity position)



COMMENTS

KNEE
FLEXOR

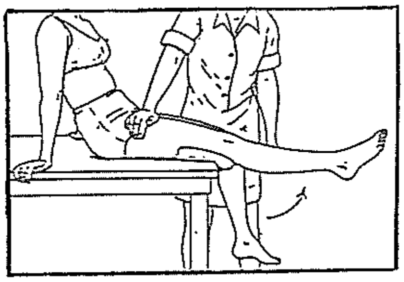
(against gravity position)



COMMENTS

KNEE
EXTENSOR

(against gravity position)



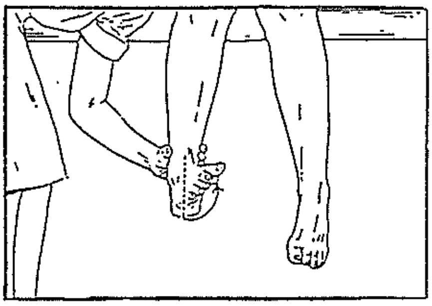
COMMENTS

ANKLE
EVERTOR

SAME POSITION
AS FOR
ANKLE INVENTOR,
BUT A
DIFFERENT MOVEMENT

COMMENTS

ANKLE
INVERTOR



COMMENTS

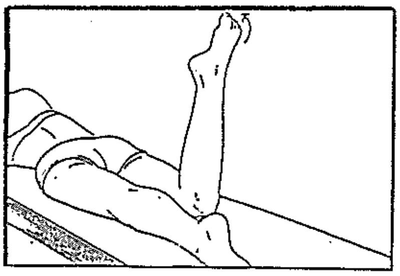
ANKLE
DORSIFLEXOR

SAME POSITION
AS FOR
ANKLE INVENTOR,
BUT A
DIFFERENT MOVEMENT

COMMENTS

ANKLE
PLANTAR FLEXOR

(against gravity
position)



COMMENTS

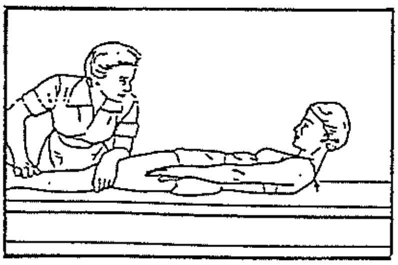
No pictures are given for the following muscles; testing is similar to the movement made.

TOE EXTENSOR

TOE FLEXOR

TRUNK
FLEXOR

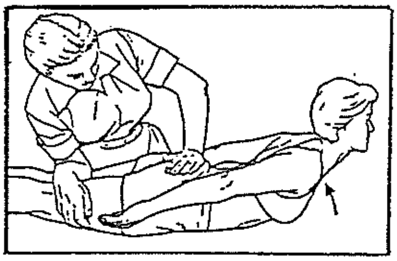
(against gravity position)



COMMENTS

TRUNK
EXTENSOR

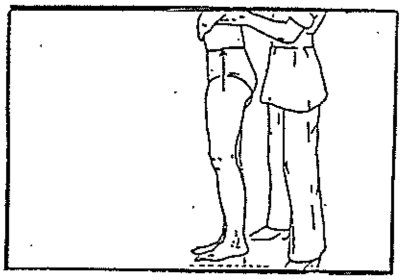
(against gravity position)



COMMENTS

TRUNK
LATERAL BENDER

(against gravity position)



COMMENTS

7.

NEUROLOGY

NEUROLOGY is the study of nerves.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify the differences between the central nervous system and the peripheral nervous system.
2. apply the fact that one side of the brain controls the opposite side of the body.
3. identify the differences between a sensory nerve and a motor nerve.
4. describe the difference between a reflex and a voluntary movement.
5. state the main functions of different spinal cord levels.

CHAPTER CONTENTS

A. INTRODUCTION

NEUROLOGY is the study of nerves. Nerves are like small roads that carry messages to and from all parts of our body.

B. THREE MAIN NERVOUS SYSTEMS

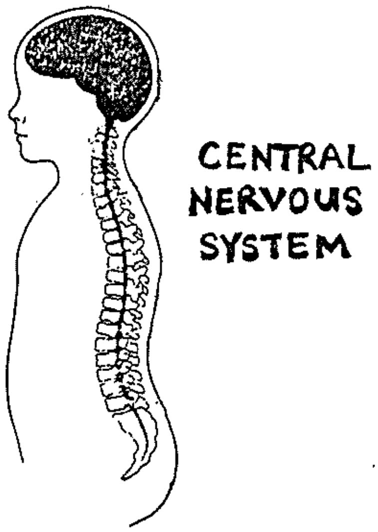
Because this is such a big job, there are three main parts (or systems) that help send and receive messages.

These parts are the CENTRAL NERVOUS SYSTEM, the PERIPHERAL NERVOUS SYSTEM, and the AUTONOMIC NERVOUS SYSTEM.

1. CENTRAL NERVOUS SYSTEM (CNS)

This includes the BRAIN and SPINAL CORD.

The central nervous system can make messages and receive messages also.

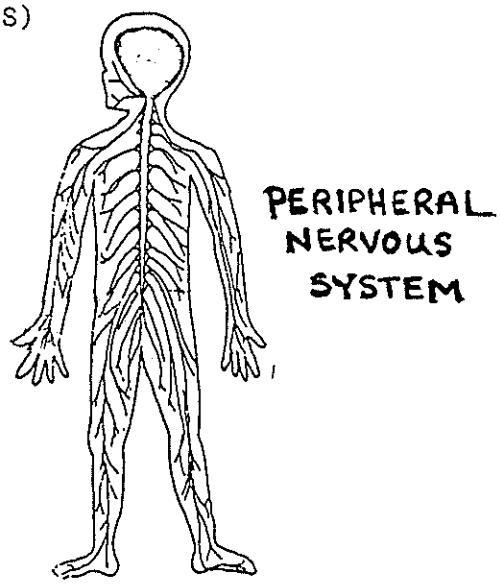


2. PERIPHERAL NERVOUS SYSTEM (PNS)

This includes all of the "roads" that connect the parts of the body to the central nervous system.

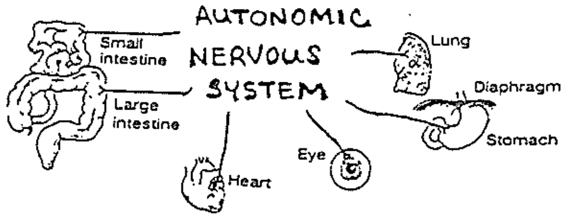
The peripheral nervous system carries messages to and from the CNS.

Peripheral nerves and voluntary muscles work together.



3. AUTONOMIC NERVOUS SYSTEM (ANS)

This includes the "roads" that connect our internal organs (stomach, intestines, blood vessels, heart, etc) to the CNS.



This system works by itself without our telling it to.

Autonomic nerves and involuntary muscles work together.

Questions:

1. The biceps muscle has received a message to contract. Was this message carried by a peripheral nerve or an autonomic nerve?

____

2. You have finished eating. Your stomach muscles contract to mix the food and push it toward your intestines. Is this action controlled by the peripheral nervous system or the autonomic nervous system?

____

So that the PTA can better understand patients with neurological problems (problems with nerves), moe details will be given about the central nervous system and the peripheral nervous system.

It will not be important for the PTA to know details of the autonomic nervous system.

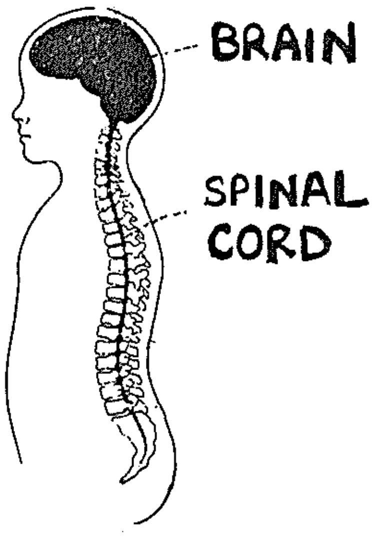
C. CENTRAL NERVOUS SYSTEM (CNS)

The central nervous system is made of two main parts;

I. THE BRAIN

II. THE SPINAL CORD

Each of these areas have a special function in sending and receiving messages.



I. THE BRAIN

The topics given in this section include:

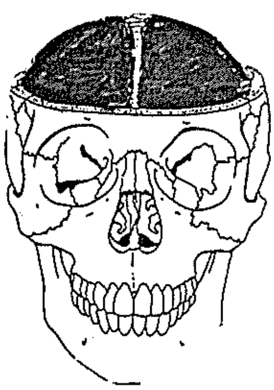
1. General information

2. Function of the brain

3. Blood supply to the brain

4. Movement area of the brain

1. <u>General Information</u>

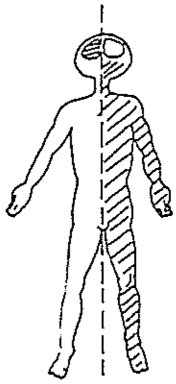


* The BRAIN is located in the head and protected by the bony skull.

* The BRAIN makes, sends, and receives messages to and from the body.

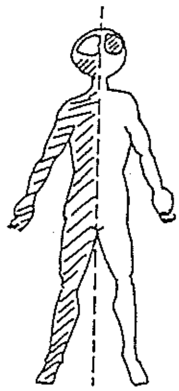
* The BRAIN is soft and is divided into right and left sides that are connected together. Each side has the shape similar to a small mango.

* It is important to know that one side of the brain controls the opposite side of the body.



THE RIGHT SIDE OF THE BRAIN IS RESPONSIBLE FOR THE LEFT SIDE OF THE BODY.

THE LEFT SIDE OF THE BRAIN IS RESPONSIBLE FOR THE RIGHT SIDE OF THE BODY.



Questions:

1. Your write with your right hand.
   What side of the brain is controlling this?

   ____

2. Your lift your left hip.
   What side of the brain is controlling this movement?

   ____

3. Your move your left toes.
   What side of the brain is controlling this movement?

   ____

4. You right knee feels hot.
   What side of the brain receives this message?

   ____

5. You have damage to the right side of the brain.
   What side of the body will you find a problem?

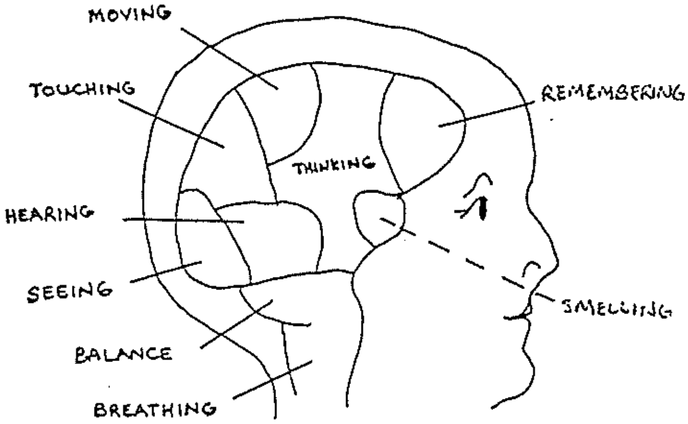
   ____

2. Function of the Brain

Our brain is for many things; thinking, remembering, controlling all parts of the body, receiving messages from all parts, coordination, speaking, emotions, and more.

Different parts of the brain are responsible for different functions.

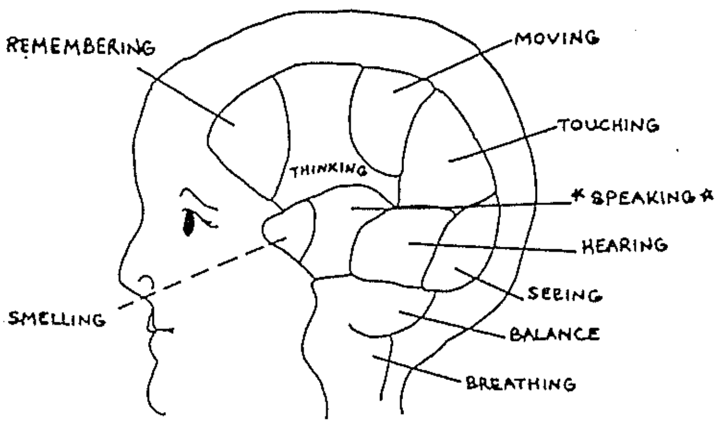
Each area has a special job to do. Below are pictures to show the jobs of different areas.



RIGHT BRAIN

The right and the left sides of the brain have the same parts <u>except</u> for the LANGUAGE (SPEAKING) AREA; this area is normally found only on the LEFT SIDE of the brain.

LEFT BRAIN



Activity:

Color the part of the brain that is responsible for language/speaking.

Color the part of the brain that is responsible for movement.

Color the part of the brain that is responsible for feeling (sensation).

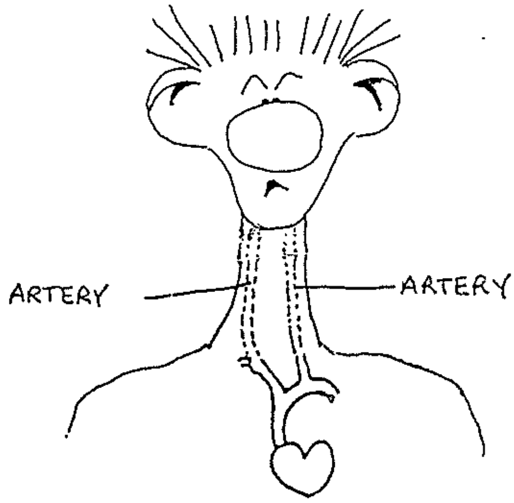
3. Blood supply to the brain

The brain is ALIVE just like other parts of our body are alive.

It must have food and oxygen to be able to work.

As we have said, arteries bring food and oxygen to the brain.

There are two big arteries that bring food and oxygen to the brain; they are located on the anterior side of the neck.

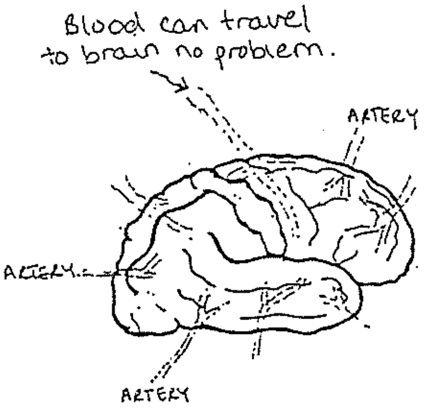


> Activity:
>
> Put your fingers on your neck and try to find the arteries that carrry blood to the brain.
>
> When you gently press on them, you can feel the blood pushed toward your brain by the heart.
>
> Each time more blood is pushed through the arteries, you can feel them expand (get bigger) and then contract (get smaller).

If no food and oxygen arrive at the brain it will die. If the brain dies, the body dies also.

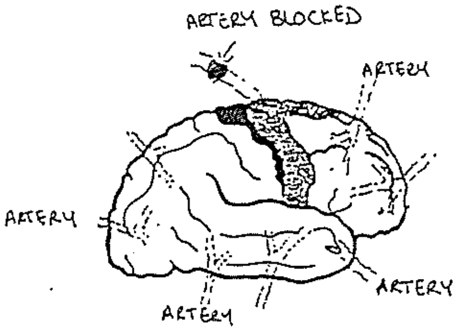
There are many small arteries that feed many parts of the brain; if one of these arteries has a problem, then that area of the brain will also have a problem. Other parts of the brain may still be normal.

Please see pictures on the next page.



NORMAL BRAIN

Blood can travel to the brain - no problem.



ABNORMAL BRAIN

The artery bringing food is blocked. The brain receives no foot and dies. The dark area is the dead area.

<u>Question</u>:

No food and oxygen arrive at the part of the brain that controls MEMORY (ability to remember) and this part of the brain is now <u>unable to work</u>.

List four problems or difficulties that you will have during a normal day.

1. ______________________________

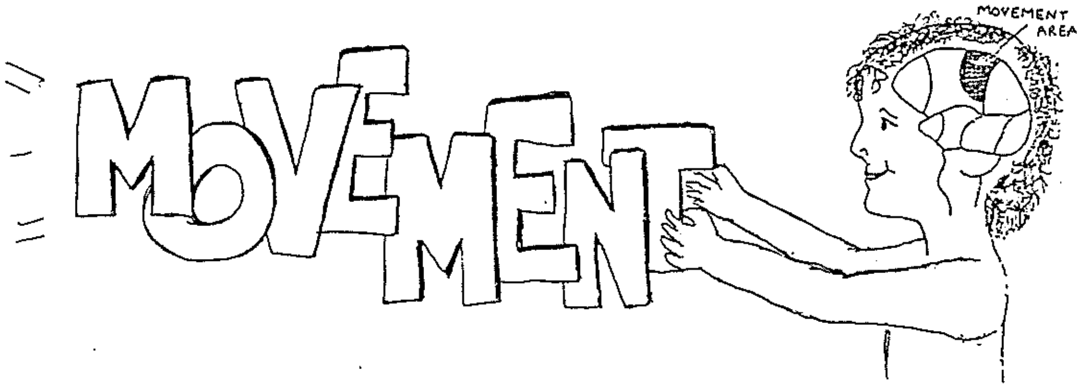
2. ______________________________

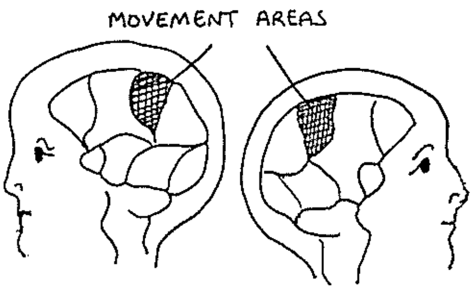
3. ______________________________

4. ______________________________

4. Movement area of the brain

Of the different parts of the brain, the area responsible for MOVEMENT will be the most important for the PTA to be familiar with.





The movement area is located near the front part of the brain on the left side and right side.

If there is damage in the movement area, it will have an effect on the movement of a body part on the opposite side of the body.

Remember, the left side of the body is controlled by the right side of the brain.

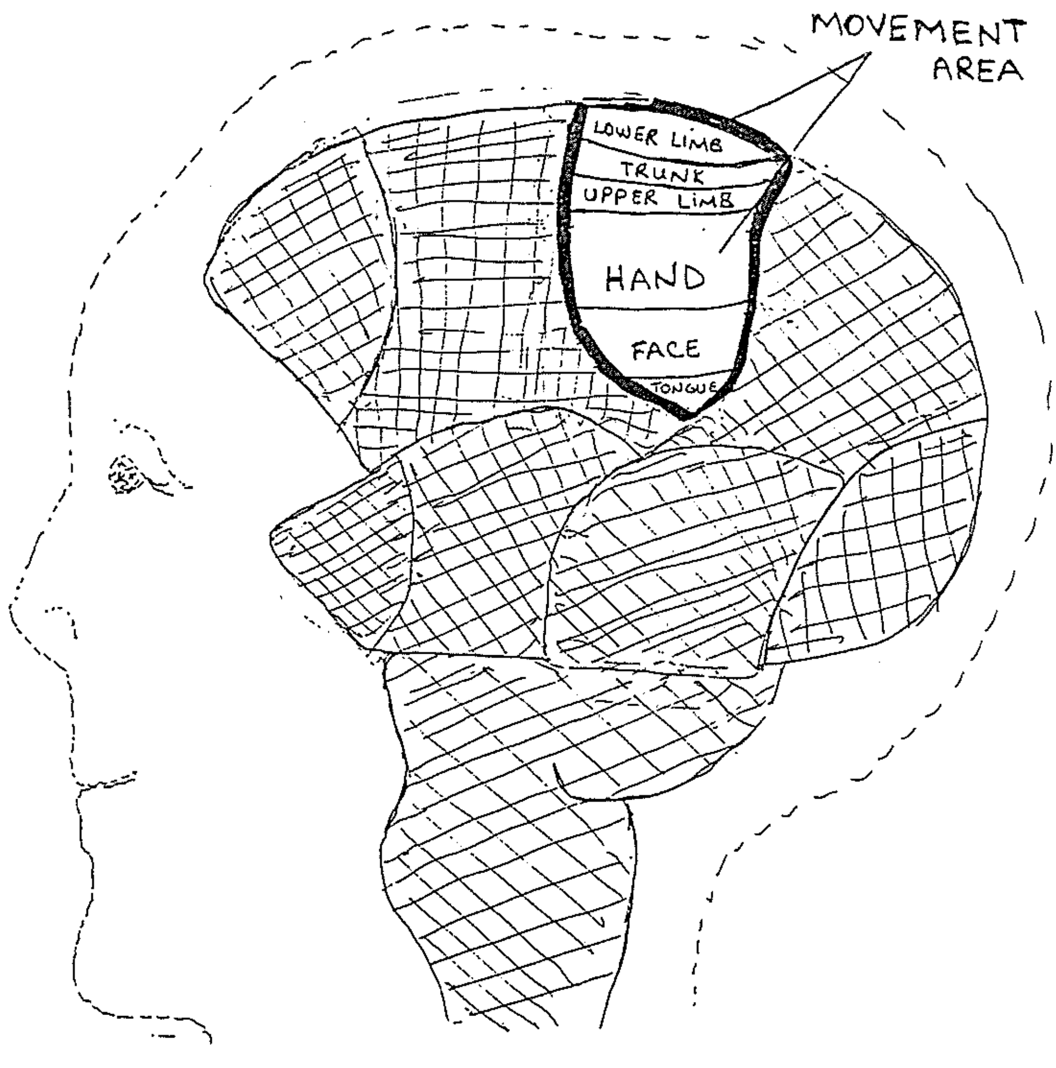
Just as specific parts of the brain control specific areas of the body, specific parts of the <u>movement</u> area control <u>movement of specific parts</u>.

EVERY PART OF THE BODY IS REPRESENTED IN THE MOVEMENT AREA OF THE BRAIN.

The amount of space that each part has will depend on the different movements that it makes.

The picture below gives a general idea of where the body parts are and how much space different parts will take in the movement area of the brain.

<u>For example</u>: The area for the trunk is very small while the area for the hand and face is very large.



Questions:

When there is a problem in the movement area of the brain, why does the hand often have a problem?

____

Why is the HAND area such a big area?

____

II. THE SPINAL CORD

The topics given in this section include:

1. General information

2. Organization of the spinal cord

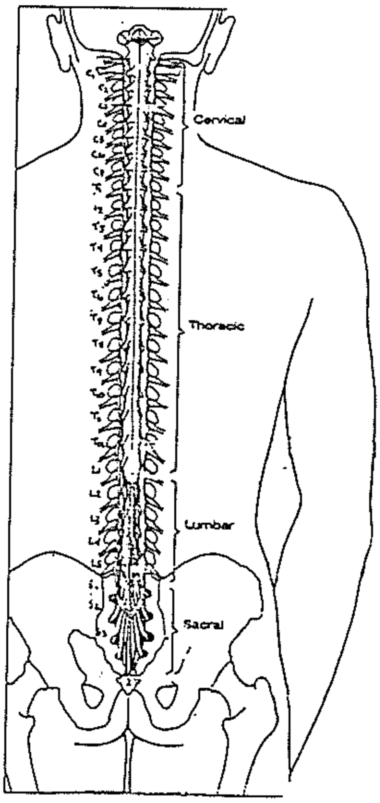
3. Functions of the spinal cord

1. General information

* The SPINAL CORD is located along the dorsal side of the back and is protected by the vertebral column.

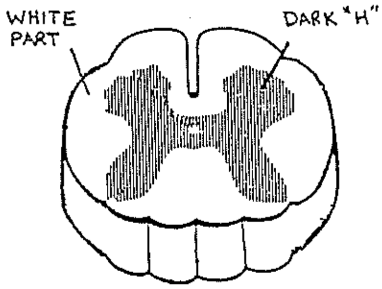
* The SPINAL CORD is like a long rope that is about the same thickness as your thumb.

* The SPINAL CORD begins at the bottom of the skull and ends at L2 (the second lumbar vertebra).



2. Organization of the spinal cord

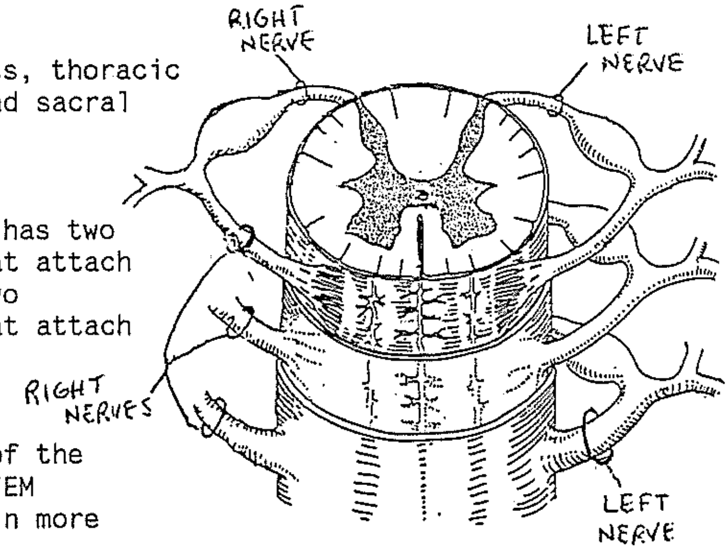
The spinal cord is like a rope. If you cut this rope, the end would look like a cut banana with a dark gray "H" in the center.



The white part and the gray "H" each have specific functions that will be discussed in the next section.

The spinal cord is divided into parts just as the vertebral column is divided into parts.

There are cervical parts, thoracic parts, lumbar parts, and sacral parts.



Each part (or segment) has two main roads (nerves) that attach to the left side and two main roads (nerves) that attach to the right side.

These nerves are part of the PERIPHERAL NERVOUS SYSTEM and will be discussed in more detail in that section. (see page 20).

3. Functions of the spinal cord

The SPINAL CORD has two main functions:

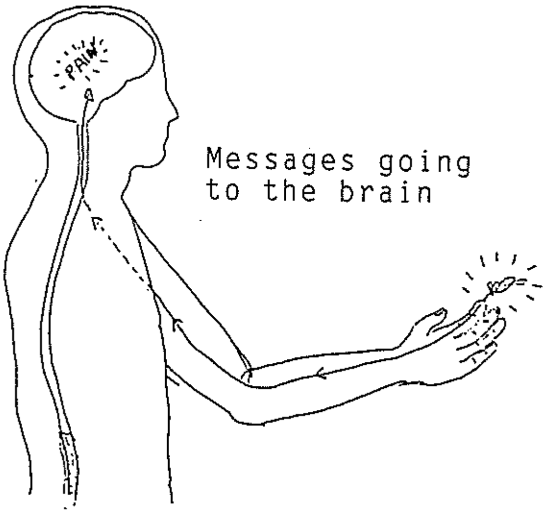
a) Acts as the roadway for messages to travel to and from the brain. This is the most important function.

b) Can make fast decisions without the brain.

a) The spinal cord as a roadway

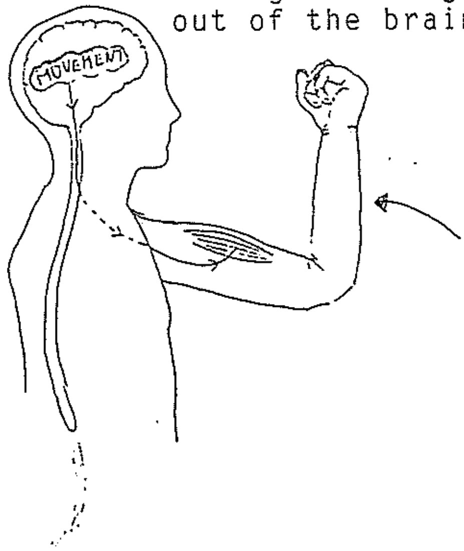
The white part of the spinal cord is the area that contains all roads to and from the brain.

Messages can travel
in two directions.



Messages going
to the brain

Messages coming
out of the brain



*** There are messages sent FROM the brain TO the muscles to tell them what to do.

Nerves that carry these messages are called MOTOR NERVES.

*** There are messages that come FROM the muscles/skin TO the brain to tell the brain how we are feeling.

Nerve that carry these messages are called SENSORY NERVES.

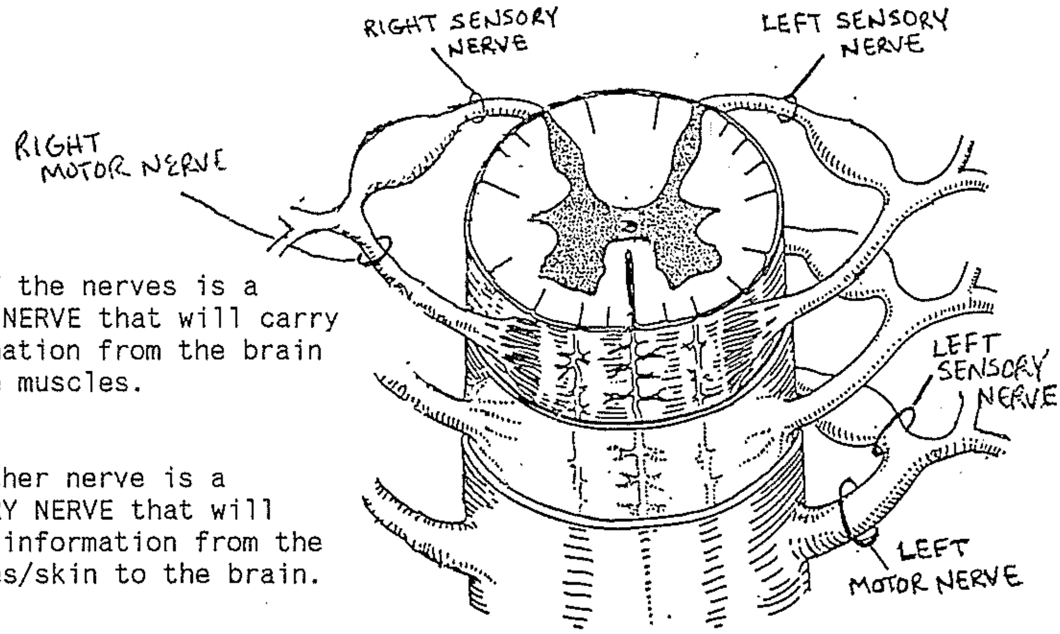
The spinal cord is the roadway for all of these nerves.

There are always many messages that are travelling in the spinal cord.

These messages must travel in <u>specific directions</u> and to <u>specific places</u>.

Each type of message has a specific road that it travels on. The spinal cord is very well organized to carry all of these roads and messages.

As we have said before, each spinal cord segment has two nerves that attach to the left side and two nerves that attach to the right side.



One of the nerves is a MOTOR NERVE that will carry information from the brain to the muscles.

The other nerve is a SENSORY NERVE that will carry information from the muscles/skin to the brain.

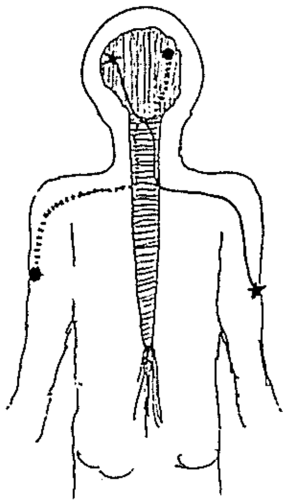
The organization of these nerves is important for know so that the PTA can better understand reflexes.

It is important to understand <u>how</u> sensory and motor nerves (roads) travel in the spinal cord and brain.

REMEMBER!

* ONE SIDE OF THE BRAIN <u>CONTROLS</u> THE OPPOSITE SIDE OF THE BODY.

* ONE SIDE OF THE BRAIN <u>RECEIVES MESSAGES</u> FROM THE OPPOSITE SIDE OF THE BODY.



The nerves coming to and from the brain CROSS in the area where the brain and spinal cord meet.

<u>Example</u>: YOU WANT TO MOVE YOUR LEFT HAND

1. The message starts in the <u>movement area</u> of the <u>right brain</u>.

2. The message travels along <u>a motor nerve</u> (road).

3. The message arrives at the place where the brain and the spinal cord meet and CROSSES to the <u>left side</u>.

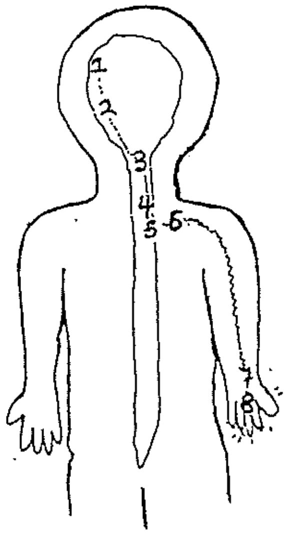
4. The message continues to travel along a motor nerve (road). This "road" is in the <u>white part</u> of the <u>left spinal cord</u>.

5. The motor nerve connects to a <u>new motor nerve</u> in the area where it leaves the spinal cord.

6. This new motor nerve leaves the spinal cord continuing toward the left hand.

7. The message continues to follow the motor nerve (road) until it arrives at the left hand.

8. Once at the hand, the message causes the hand to move.



(ANTERIOR VIEW)

<u>Example</u>: YOU FEEL COLD WATER WITH YOUR RIGHT TOE

1. Information is received in the <u>sensory</u> part of your <u>right</u> toe.

2. The message travels in a <u>sensory</u> nerve on the <u>right</u> side of the body until it arrives at the spinal cord.

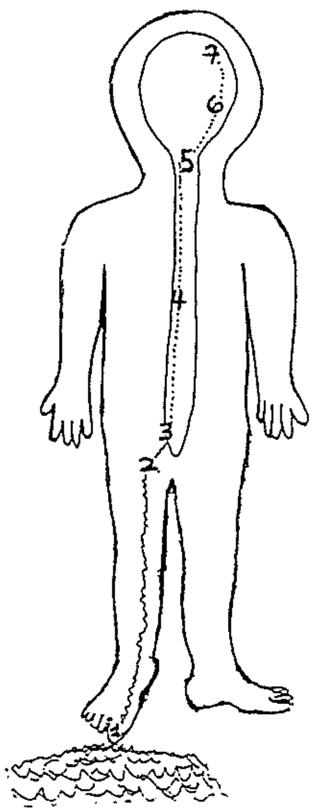
3. At the spinal cord it connects to a <u>new</u> sensory nerve.

4. The <u>new sensory nerve</u> carries the message in the <u>white part</u> of the <u>right spinal cord</u>.

5. At the place where the brain and the spinal cord meet, the sensory nerve CROSSES to the <u>left side</u>.

6. The message continues to travel in the <u>left</u> side of the brain until it arrives in the <u>sensation</u> (feeling) <u>area</u> on the left side of the brain.

7. Once at the sensation area, the message informs the brain what the right toe is doing.

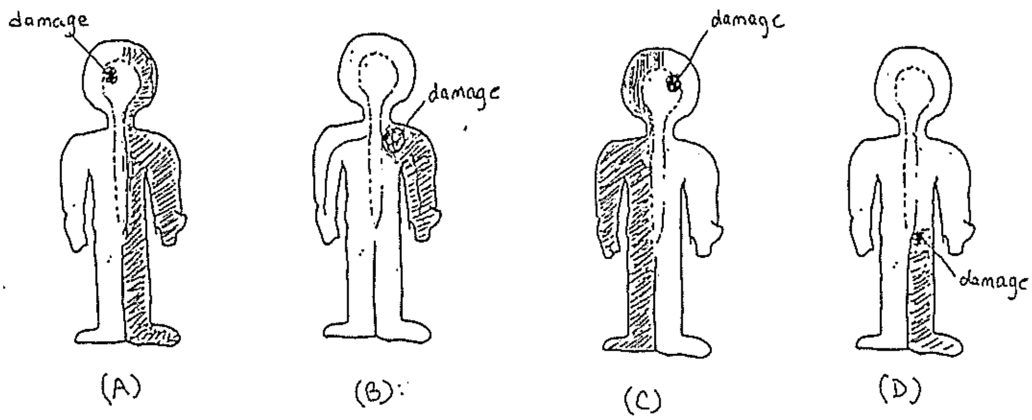


(ANTERIOR VIEW)

Note:

If there is damage in the brain ABOVE WHERE THE NERVES CROSS, the problem will be in the <u>opposite side of the body</u>. (A), (C).

If there is damage in an area BELOW WHERE THE NERVES CROSS, the problem will be on the <u>same side of the body</u>. (B), (D).



Activity:

The picture shows five different areas where there has been damage to the nervous system. For each of the areas given, please write what part of the body will be affected.

Example:
Damage at "A"

RIGHT SIDE OF THE BODY

Damage at "B"

____

Damage at "C"

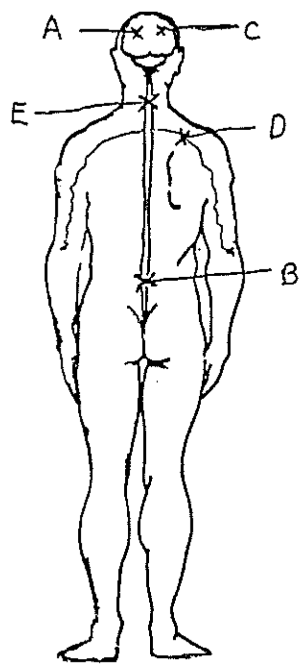
____

Damage at "D"

____

Damage at "E"

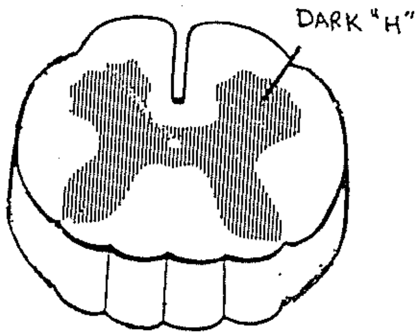
____



(POSTERIOR VIEW)

b) The spinal cord as a decision maker

The dark "H" colored area in the spinal cord is where fast decisions are made without the brain.



A decision without the brain is called a REFLEX.

HOW REFLEXES HAPPEN:

1. All reflexes start with a sensory nerve message from the body (from muscle or skin).

2. This message arrives at the spinal cord.

3. Because a fast decision is necessary, it goes into the dark "H" area.

4. In the "H" area it connects to a motor nerve.

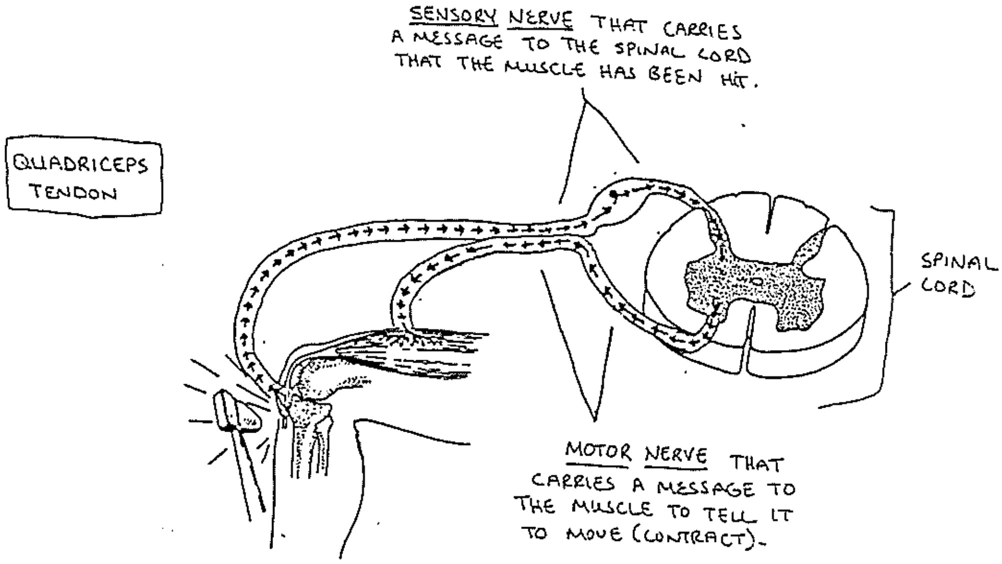
5. The message travels in the motor nerve and goes directly to the muscle causing a movement to happen.

<u>Example</u>:

If you a hit a muscle quickly, the muscle will contract.

If you hit directly on the tendon of some muscles, you can see this REFLEX CONTRACTION.

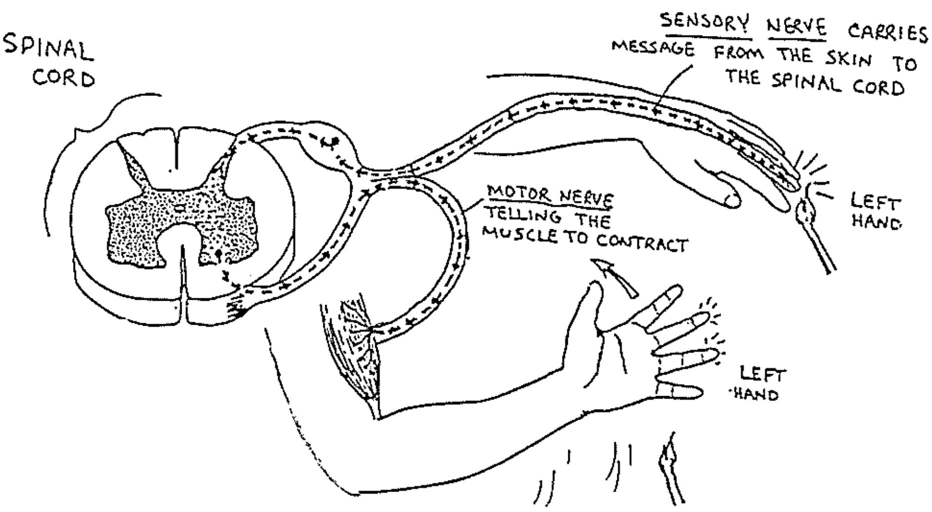
Tendons that are easy to observe are the biceps tendon, triceps tendon, and quariceps tendon.



<u>Example</u>:

The sensory nerves in the skin feel something hot. you quickly remove your hand before even thinking.

This is another type of REFLEX RESPONSE.



REFLEXES ARE IMPORTANT FOR TWO REASONS:

1. They can act more quickly than message going to and from the brain. This is good to protect the body from injury.

2. If the roadway to and from the brain is cut, then REFLEXES are responsible for any movement that can occur.

<u>Activity</u>:

In this activity you will try to test the REFLEX movement of the knee extensor (Quadriceps) muscle.

You are sitting on a chair. Cross your left leg over the right one so that the left knee is flexed and relaxed/

With the internal side of your right hand, hit the patellar tendon (it is just below the patella).

What did you observe?

____

____

Explain how this happened.

____

____

____

D. PERIPHERAL NERVOUS SYSTEM

In this section the following topics will be discussed.

1. Sensory and motor nerves.
2. General function of nerves going to and from different spinal cord levels.
3. Specific sensory nerve information.
4. Specific motor nerve information.

1. Sensory and motor nerves

The peripheral nervous system is made of many nerves (roads) that carry messages to and from the spinal cord.

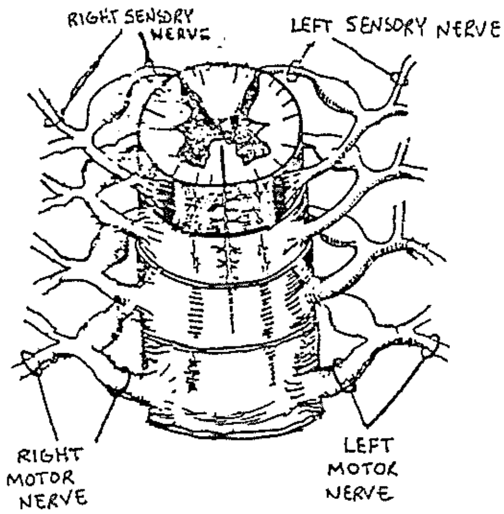
More specifically, it is made of two parts:

a) MOTOR NERVES - "roads" that carry information from the spinal cord to the muscles.

b) SENSORY NERVES - "roads" that carry information from the skin/ muscles to the spinal cord.

There are sensory and motor nerves that work on the left and on the right side of the body.

(ANTERIOR VIEW OF SPINAL CORD)



The spinal cord is divided into different parts. Each part has two motor nerves and two sensory nerves that attach to it.

* One motor nerve goes to specific muscles on the right side; the other motor nerve goes to those same muscles that are on the left side.

* One sensory nerve comes from the skin and muscles on the left side, and the other sensory nerve comes from the same skin and muscles on the right side.

The nerve that is anterior is the one that carries the messages from the spinal cord to the muscles.

* THE ANTERIOR NERVE IS A MOTOR NERVE.

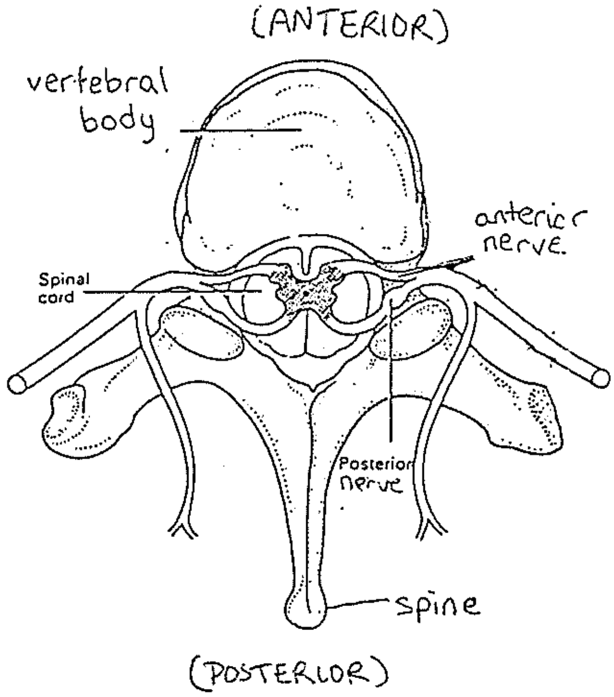
The nerve that is posterior is the one that carries the information from the muscles/skin to the spinal cord.

* THE POSTERIOR NERVE IS A SENSORY NERVE.

These anterior and posterior nerves come together in a bigger nerve (like two small roads joining one large road).

They do this only for a short time.

They join together so they can pass through the space where they enter and leave the protection of the vertebral column.

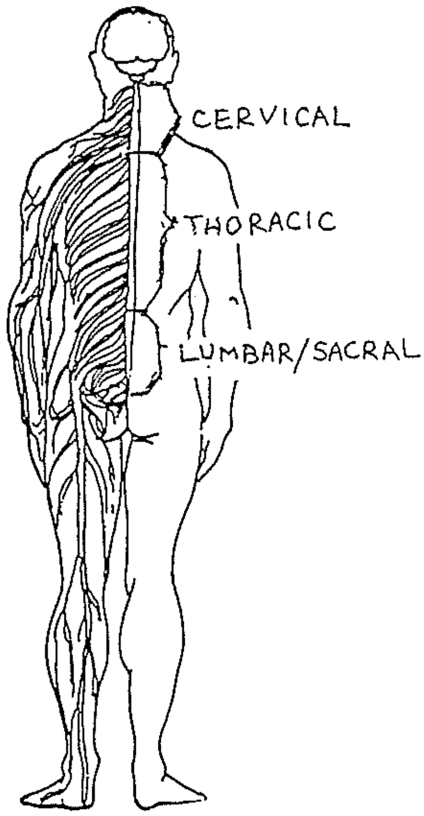


2. General function of nerves going to and from different spinal cord levels

The CERVICAL part of the spinal cord is where the nerves going to and from the upper limb are located.

The THORACIC part of the spinal cord is where the nerves going to and from abdominal and trunk muscles are located.

The LUMBAR and SACRAL parts of the spinal cord are where the nerves going to and from the lower limbs are located.



Different sensory nerves are responsible to give information about different areas from the muscles and skin.

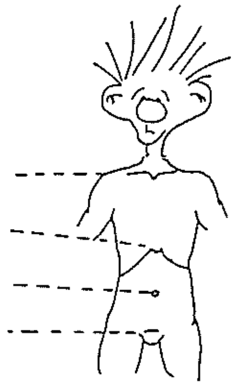
It is NOT necessary to remember all of the skin areas and sensory nerves, but some are easy to remember.

SKIN AT THE TOP OF STERNUM LEVEL : T 3

* SKIN AT THE END OF STERNUM LEVEL : T 6

SKIN AT THE BELLY BUTTON LEVEL : T 9

SKIN AT THE PUBIC BONE LEVEL : T 12



* This means that the sensory nerve arriving at the spinal cord near the sixth thoracic vertebra will give information about the skin area at the level where the sternum ends.

3. Specific sensory nerve information

In this section, we will give information about:

a. different sensory areas of the body

b. sensory tests

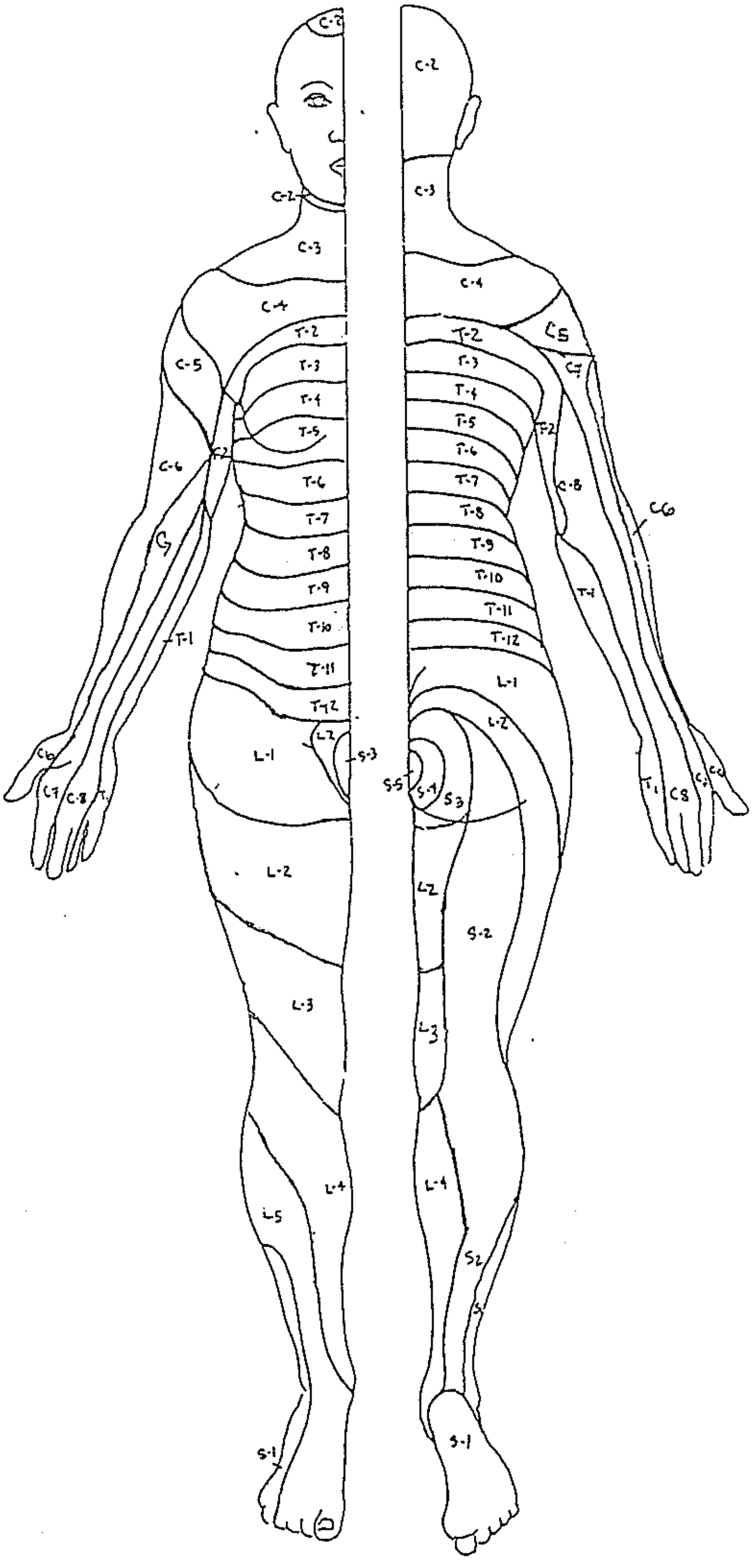
a. different sensory areas of the body

The picture on the following page shows the different areas of skin that sensory nerves receive information from.

Note: Many skins areas have more than one sensory nerve that brings information to the central nervous system (CNS).

It is NOT important for the PTA to remember all of these areas, the picture is only a reminder.

This picture gives the PTA a <u>general</u> idea of in what areas different sensory nerves work.



ANTERIOR VIEW

POSTERIOR VIEW

b. Sensory tests

Sensory tests are ways of knowing if a sensory nerve is damaged.

It is important to know if a patient cannot feel an area so that future damage can be prevented (pressure sores, burns).

Two general tests are:

i) skin sensitivity

ii) joint sensitivity

i) skin sensitivity

This test is to identify the areas of skin that may have decreased feeling.

Technique:

* The PATIENT'S EYES MUST BE CLOSED

* The PTA will touch the patient lightly with his finger.

* Every time the patient feels a touch, the patient should say "yes" and tell where he feels a touch.

  (The PTA should not ask "do you feel?" after every touch.)

* The PTA should compare right and left sides of the patient.

* The PTA should write areas that have decreased feeling.

This test is to identify if the patient can feel different joint movements.

Technique:

* The PATIENT'S EYES MUST BE CLOSED

* The PTA will passively move different joints in different directions.

* When the PTA stops the movement, the patient must say the position of the joint.

* The PTA should compare right and left sides of the patient.

* The PTA should write areas that have decreased feeling.

Questions:

Use the skin sensory picture to answer the following questions.

1. What sensory nerves take information to the spinal cord about the skin around the thumb?

____

2. What sensory nerve takes information to the spinal cord about the posterior knee area?

____

3. What sensory nerve takes information to the spinal cord about the dorsal/internal side of the foot?

____

Questions: (continued)

4. The sensory nerve C3 has been damaged. In what area of the body will have have decreased feeling?

____

5. The sensory nerve L3 has been damaged. In what area of the body will have have decreased feeling?

____

4. Specific motor nerve information

Different motor nerves carry information from the spinal cord to different muscles.

A muscle test (see MYOLOGY and SPINAL CORD INJURIES chapters) can be used to help identify what motor nerves may be damaged.

The charts on the following pages tell the main motor nerves that are responsible for main muscle groups.

The PTA does NOT have to know the specific nerves, but may find it useful to use these charts to better understand patients who have spinal cord injuries or peripheral nerve injuries.

Specific Muscles at Different Joints		Motor nerves that carry messages to tell muscle to work				
MUSCLES		C5	C6	C7	C8	T1
SHOULDER	Flexor	x	x	x		
	Extensor		x	x	x	
	ABductor	x	x			
	ADductor	x	x	x	x	
	Int. Rot.	x	x			
	Ext. Rot	x	x			
ELBOW	Flexor	x	x			
	Extensor			x	x	
FOREARM	Supinator	x	x			
	Pronator		x	x		
WRIST	Flexor		x	x		
	Extensor		x	x		
	ABDuctor		x	x		
	ADDuctor		x	x		
FINGERS	Flexor			x	x	x
	Extensor		x	x	x	
	ABDuctor				x	x
	ADDuctor				x	x
THUMB	Extensor		x	x	x	
	Opposition		x	x	x	x

Specific Muscles at Different Joints		Motor nerves that carry messages to tell muscle to work					
MUSCLES		L2	L3	L4	L5	S1	S2
HIP	Flexor	x	x				
	Extensor				x	x	x
	ABDuctor			x	x	x	
	ADDuctor		x	x			
	Int. Rot.			x	x	x	
	Ext. Rot.		x	x	x	x	
KNEE	Flexor				x	x	x
	Extensor	x	x	x			
ANKLE	Dorsiflexor			x	x	x	
	Plantarflexor					x	x
FOOT	Invertor				x	x	
	Evertor			x	x	x	
TOES	Flexor			x	x	x	
	Extensor			x	x	x	

Diaphragm and Trunk Muscles		Motor nerves that carry messages to tell muscle to work
DIAPHRAGM		C3, C4, C5
TRUNK	Flexor	T5 - T11
	Extensor	T1 - T12, L1 - L5. S1 - S3
	Rotator	T7 - T11
	Lat. Bend.	T12. L1 - L4

Activity:

Using the charts shown on the two preceding pages, please answer the following questions.

1. What motor nerves carry messages to the HIP FLEXOR muscle to tell it to work?

   ____

2. What motor nerves carry messages to the ELBOW EXTENSOR muscle to tell it to work?

   ____

3. What motor nerves carry messages to the FINGER FLEXOR muscles to tell them to work?

   ____

4. What motor nerves carry messages to the ANKLE DORSIFLEXOR muscle to tell it to work?

   ____

E. CHAPTER SUMMARY

NEUROLOGY is the study of nerves. Nerves are like small roads that carry messages to and from all parts of our body.

The CENTRAL NERVOUS SYSTEM (CNS) is the brain and the spinal cord.

brain	Located in the head and protected by the skull. Makes, sends, and receives messages to and from the body. ONE SIDE OF THE BRAIN is responsible FOR THE OPPOSITE SIDE OF THE BODY.
spinal cord	Located along the dorsal side of the back and protected by the vertebral column. Spinal cord acts as a roadway for messages to travel to and from the brain. Can make fast decisions without the brain (reflex).

The PERIPHERAL NERVOUS SYSTEM (pns) are nerves that connect the body parts to the central nervous system.

Two types of peripheral nerves are:

* SENSORY NERVES - take messages from the muscles/skin to the CNS giving information of how we are feeling.

* MOTOR NERVES - take messages from the CNS to the muscles telling them to work.

Because nerves (roads) CROSS in the area where the brain and spinal cord meet, ONE SIDE OF THE BRAIN IS RESPONSIBLE FOR THE OPPOSITE SIDE OF THE BODY.

A VOLUNTARY MOVEMENT occurs because of a message from the brain telling it to happen.

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