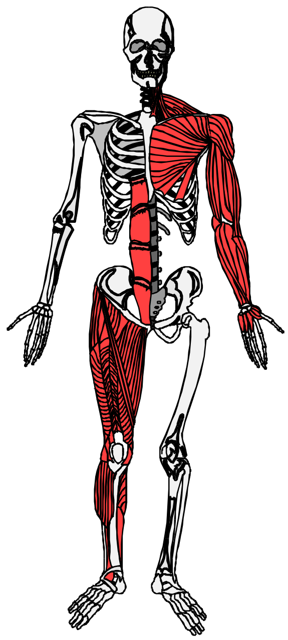
MUSCULAR AND SKELETAL SYSTEMS



CFE 3272V

CLOSED CAPTIONED
NATIONAL GEOGRAPHIC
SOCIETY
1994
Grade Levels: 5-10
20 minutes

DESCRIPTION

A strong, healthy body moves freely and rapidly in its daily activities, thanks to its team of 206 bones and 600 muscles. Clear graphics and close-up photography of model and actual bones and muscles help illustrate this complex interdependence of human body systems. Couples many scientific and common names of bones and muscles with related visuals. THE HUMAN BODY SERIES.

INSTRUCTIONAL GOALS

- To associate scientific names of some bones and muscles with their locations in the human body.
- To explore the mechanics of human movement.
- To illustrate the relationship of the skeletal and muscular systems.
- To identify the number and arrangement of bones in the hands and feet which allow for dexterity and weight-bearing ability.
- To emphasize that bones and muscles can be strengthened with proper diet and exercise.

BEFORE SHOWING

1. Read the CAPTION SCRIPT to determine unfamiliar vocabulary and language concepts.
2. Review the overall appearance of the human skeleton by showing a model. Discuss the appendicular and axial skeletons.
3. Display a poster of the muscular system for use during and after the video.
4. Pretest viewers in a general discussion of bones and muscles to determine on which facts to focus in the video.

DURING SHOWING

1. View the video more than once, with one showing uninterrupted.
2. Pause after every grouping of bones. Feel those bones for identification and movement. Also refer to the skeletal model.
3. Pause after demonstration of contracting and relaxing muscles. Tighten or contract arm and leg muscles. Discuss.

AFTER SHOWING

Discussion Items and Questions

1. Explain the process of *fossilization*. Discuss why bones are the last part of the body to decay.
2. What are the scientific names for the bones in the middle ear, commonly called the hammer, anvil, and stirrup?
    a. Research how these bones are related to deafness.
    b. Research if these three bones are components in the ears of other animals.
3. What happens to the body in paralysis? Why are some bones unable to move? What other body systems are involved?
4. The video states that more than half of a human's bones are in the hands and feet.
    a. Is this true for any other species of animal?
    b. How is the function of human hands different than that of feet?
5. Identify dangers of muscle overuse.
6. What makes teeth different from bones?
7. Name two differences between the skeletons of a man and a woman. Determine if the muscular systems are different between the two.
8. Name a variety of jobs that require strenuous activity of the hands, the feet, or the spine. Discuss some common injuries of each.

9. What are the major organs of the human body?
    a. Which bones protect them?
    b. Is it easier to repair damaged body organs or the bones that protect them?

10. Discuss the variety of muscle types. Guess which muscles in the body are typically used most. Check references to determine accuracy.
    a. What is the difference between a tendon and a ligament? Where are they found on the body? How are they related to joints?
    b. How are the chemicals *actin* and *myosin* stimulated? What happens if one or both are deficient? How does aging affect these chemicals?

11. Find the names of the three types of joints. Discuss why each is best suited for its particular location in the body.

12. Compare the frailty and strength of the neck bone.
    a. Describe the role of the nervous system in relation to the spinal cord.
    b. Discuss why breaking the neck causes such rapid death. Name predatory animals that break the necks of their prey.
    c. Explain why an infant is unable to hold up its head. Demonstrate the development and relationship of the axis and atlas.
    d. Describe how the neck assists the skull to rotate.

13. Contrast voluntary and involuntary muscles. Determine why the human body has both.

<u>Applications and Activities</u>

1. Using a tabletop model skeleton, vertically cover one half of it with "muscles" created from oil-based modeling clay.
    a. Refer to texts for accuracy of size and placement.
    b. Make muscles appear striated.

2. Purchase a beef soup bone and a poultry drumstick from a grocery store.

   a. Examine how muscle tissue is connected. Identify and touch cartilage. Compare with pictures of human muscle tissue and bones.
   b. Using an electric knife, make a crosscut and examine the inside and spongy bone under a microscope.
   c. Sketch or photograph a bone, then manually break it. Observe the break and glue it together according to the photograph.

3. Make a fossil using plaster and chicken or beef bones. Carefully place the bones in half-dry plaster and remove later.

4. Write or call a local hospital and ask for several x-rays of broken bones. Ask for descriptions of the breaks and bone names.

   a. For each x-ray, decide what is necessary to set it properly.
   b. Write or call the hospital again, thank them for their help, and share project results.

5. Produce a video on muscle building. Include footage of particular exercises and name the muscles used for each.

6. Create a health poster encouraging proper care of bones and muscles. Mention what improper care or poor posture can cause.

7. Demonstrate the correct position to lift a heavy package. Explain the dangers of lifting and carrying incorrectly.

8. Conduct a morning aerobics class. Analyze how specific exercises contribute to healthy bones and muscles.

9. Conduct an experiment about bones. Using three similar turkey thigh or drumstick bones, set each one in a jar filled with tap water, thick sugar water, or water and dissolved calcium tablets.

   a. Keep the bones immersed in the water and refill when needed.

b. After approximately two weeks, remove the bones and compare.
c. Test breakage of each and draw conclusions.
d. Discuss results.

10. Invite the track or football coach to speak about injuries related to strenuous use of muscles. Include questions about overexertion and first aid.

11. Look at the bone structure of prehistoric humans and note differences in the modern human skeleton. Hypothesize what caused these changes.

12. Research the effects of steroids on muscle tissue. Discuss the controversy of steroid use by athletes.

COMMUNICATION SKILLS

1. Find the meaning of these prefixes: *meta-*, *osteo-*, *myo-*. Give examples of words related to bones or muscles.

2. Role-play a scene between a hearing doctor and a patient who is deaf or hard of hearing at a clinic. Assume the patient is in need of help due to an injury. Practice speechreading the following sentences:
   a. "You have a slight fracture."
   b. "How did you land when you fell?"
   c. "Tell me when it hurts."
   d. "You broke your arm."
   e. "You pulled a muscle."

WEBSITE

Explore the Internet to discover sites related to this topic. Check the CFV website for related information. (http://www.cfv.org).

CAPTION SCRIPT

Following are the captions as they appear on the video. Teachers are encouraged to read the script prior to viewing the video for pertinent vocabulary, to discover language patterns within the captions, or to determine content for introduction or review. Enlarged copies may be given to students as a language exercise.

(male narrator)
Like all of us,

Jim and Sharon depend
on strong, healthy bodies

that enable them
to take part

in their daily activities.

And, like us,

they seldom stop to think
about how remarkable,

how complex and durable
their bodies are.

We owe our strength
and flexibility,

our very ability
to remain upright and move,

to our bones
and muscles.

The adult human body

is made up
of 206 bones,

which together
with more than 600 muscles,

support our bodies,
give us shape,

and enable us to move.

The bones of the skull
include the facial bones

and a hard covering
called the *cranium*,

which encloses
the brain.

The spinal column,
or backbone,

consists of segmented bones
called *vertebrae*.

The spinal column

forms the central support
for the body

and protects the spinal cord
and its nerves.

The rib cage,

together with the breastbone,
or *sternum*,

forms the chest.

Attached
to the breastbone

by the collarbones,
or, *clavicles*,

and the shoulder bones,
or *scapulae*,

are the arms.

The long bone of the arm
is the *humerus*,

which connects
at the elbow

to the *ulna*
and *radius*

of the forearm.

These bones extend
to the wrist,

joining the hand.

At the bottom
of the spinal column

is the *pelvis*,

where the legs attach.

The body's longest
and strongest bone

is the thigh bone,
or *femur*.

At the knee joint,

the femur
joins the *tibia*,

the larger, stronger bone
of the lower leg.

The smaller bone--
the *fibula*--

with the tibia,

forms the ankle joint
at the foot.

26 bones in each foot,

together with the 27 bones
in each hand and wrist,

make up more than half
of the body's 206 bones.

Every day we use
our body's bones and muscles

without even thinking
about how they work.

Yet the smallest movement
depends on the body's team

of bone, muscle, joints,
ligaments, and tendons.

There are many parts
that have to cooperate.

It is perhaps only when
they no longer function,

as a result
of injury or disease,

that we start to wonder
about how they actually work.

The human skeleton

is divided
into two principal parts:

the *axial skeleton*

and the *appendicular skeleton*.

The axial,
or central, skeleton

is composed of the bones
of the skull, spine, and chest.

The appendicular skeleton

consists of the bones

of the shoulder
and pelvis girdle

and of the upper extremities--

the arms
and the hands--

and the lower extremities--

the legs and feet.

The spine
is a vertical column

composed of 33 vertebrae.

Together
with soft intervertebral disks

that absorb shock

and prevent bones
from rubbing against each other,

the vertebrae create
a powerful but flexible column.

When linked together,

the arched vertebrae
form the channel

through which
the spinal cord passes.

The vertebrae
at the bottom

form the *coccyx*
and the *sacrum*.

They support
the five lumbar vertebrae.

The 12 thoracic vertebrae
are linked to the ribs,

and the 7 cervical vertebrae
form the neck.

The cervical vertebra
at the top of the spine

is called the *atlas*.

It supports
the skull's weight

and pivots
on the second cervical vertebra,

called the *axis*.

The axis
has a projection

that fits into the opening
in the atlas vertebra.

This enables the atlas
to rotate,

allowing us
to turn our head.

The 29 bones of the skull
include the cranium,

which encloses
and protects the brain,

the eyes,
parts of the ear,

and the facial bones.

The facial bones create
a person's unique features.

Rigid bones are capable
of fluid movement

because of movable joints...

the places where bones
are held together

by strong connective tissues
called *ligaments*.

Here, we see
a knee joint,

where ligaments
connect the femur

to the tibia.

The ends of the bone
at each joint

are coated
with a smooth surface

made of *cartilage*,

seen glistening
on this femur.

The shoulder girdle

consists
of two shoulder blades,

or scapulae,

each of which connects
to a collarbone,

or clavicle.

The scapula
joins the humerus--

the long bone
of the upper arm--

at the shoulder joint,

the most mobile joint
in the body.

The other end
of the humerus

connects
at the elbow joint

with the bones
of the forearm:

the radius
and the ulna.

At the wrist, the radius
joins the *carpal*,

or wrist bones
of the hand.

The rest of the hand

consists
of the five *metacarpal* bones.

Each of these supports
the fingers and thumb.

Fingers have three bones,
or *phalanges*,

while the thumb
has only two phalanges.

The many joints
and muscles of the hand,

combined
with muscles of the forearm,

enable us to move
this specialized structure

in many different ways.

The foot
is the platform

on which
we stand and land.

It is designed
to support

the weight
of the entire body.

The 26 bones
of the foot

are similar
to those of the hand

but are constructed less
for precise movement

and more for weight-bearing
and locomotion.

The bones of the foot

are arranged
in the shape of an arch--

an effective
weight-bearing construction.

When walking and jumping,

tendons and ligaments
that bind the foot bones

allow a degree of give

and, with the arch,

provide spring and lift
for movement.

The largest joint
in the body

is the knee.

It connects the femur,
or thigh bone,

with the tibia and fibula
of the lower leg.

The knee joint
is a hinge joint,

moving in one plane only.

The pelvis
supports the spine

and joins
the lower extremities

at the hip joints.

The back of the pelvis

is composed
of the sacrum and coccyx.

With the two
pelvic bones,

they form
the *pelvic girdle,*

which protects the urinary
and reproductive systems.

The female pelvis
is broad,

creating
a larger opening

that allows a baby
to pass through.

The 12 ribs

are attached
to the sternum,

or breastbone,

by cartilage,

protecting
the heart, lungs,

and other chest organs.

The bones
of the middle ear--

The *hammer*, *anvil*,
and the *stirrup*--

are the smallest bones
in the body.

The stirrup
is 4 millimeters long.

The longest bone--
the femur--

is about
46 centimeters long

and accounts
for about one-quarter

of a person's height.

Bone is composed
of living cells

that grow and change
with time.

Bone tissue
also contains

inorganic,
nonliving material,

such as calcium salts,

which help
make bones hard.

There is a difference
between the bone tissue

in the inner and outer
sections of bones.

Inside
is a woven structure

called spongy
or *cancellous* bone.

Under
greater magnification,

we see that spongy bone
has a lighter structure--

spikes of bone

with open spaces
between them.

The hard outer shell
that appears to be solid

is called *compact bone*.

This architecture

combining spongy
and compact bone

provides maximum strength
with minimum weight.

The spaces
in the spongy bone

are filled

with *bone marrow,*

which has been removed
from this spongy bone.

Marrow produces
red and white blood cells.

Our bones, joints,
and muscles

must be
in good working order

for us to be able
to sit, stand, walk, run, work,

and play sports.

Bones cannot move
by themselves.

Some 600 skeletal
or voluntary muscles

attached to the bones
by tendons

pull on the bones

and, by their contractions,
create motion.

If we want our muscles
to work properly,

we must
keep them moving.

This means everything
from gentle, everyday activities

to hard,
purposeful training.

Sharon has found

that if she trains
her muscles,

they become stronger.

Skeletal muscles
usually work together.

As the *bicep*
or *flexor* muscles

on the front of the arm
contract,

drawing the forearm
toward the shoulder,

the opposing *tricep*
or *extensor* muscles

on the back of the arm
relax.

As you straighten the arm,

the tricep contracts
and the bicep relaxes.

Good coordination
of muscles working together

is necessary
for smooth movements.

The skeleton
and attached muscles

give the body
its framework and shape.

Several layers of muscles
are hidden under the skin.

The muscles
directly beneath the skin

can be seen
as they contract and relax.

Each muscle consists
of bundles of muscle cells,

or fibers.

Under the microscope,

the cells have
a banded appearance;

hence the name *striated*,
or striped, muscles.

This appearance is caused

by smaller cellular units
called *myofibrils,*

which contract,

creating movement.

Our skeletal muscles
could not create motion

without the nervous system.

The brain sends impulses,
or messages,

through
motor nerve fibers

to the appropriate
muscle groups.

These motor nerve fibers

branch out
inside the muscle,

ending in nerve endings
called *motor end plates*.

When the impulse
reaches the nerve ending,

a chemical is released

that makes the muscle fibers
contract.

The nerve cells
can stimulate

many muscle fibers,
or only a few, to contract.

This allows us
great precision

in our movements.

The myofibrils
inside the muscle cells

are composed
of the chemical proteins

actin and *myosin*.

During muscle contraction,

the actin,
which is thinner,

glides in

between the myosin,

which is thicker.

When the muscles lengthen
during relaxation,

the fibers glide apart again
to their original length.

This is a process
in which chemical energy

is transformed
into mechanical movement.

One-quarter of the energy
our muscles produce

is converted into motion.

The rest is released
as heat.

Using a thermavision camera
that detects heat,

we can see how
the heat increases locally

across the muscles.

Heat generated
by muscles functioning

is circulated
throughout the body

by the blood,

helping maintain
body temperature.

When we get cold,

it is the muscular contractions
we call "shivering"

that help us keep warm.

Our facial muscles
enable us to create

an enormous range
of expressions.

The muscles of the face

allow us to open
and close our eyes,

chew our food,

and to communicate
with other people.

In addition
to the skeletal muscles,

the body has two
other kinds of muscles

that create movement:

smooth muscle
and *cardiac muscle*.

Smooth,
or involuntary muscles,

which usually work
without conscious control,

operate
the internal organs,

such as those
of the digestive system.

The muscular walls
of the stomach

relax and contract

to break down food
mechanically.

The heart is made up
of specialized muscle tissue

called *cardiac muscle*

and is our body's
most important muscle.

The cardiac muscle
pumps the blood

that carries
oxygen and nourishment

out of the heart
to the rest of the body.

The heart
works automatically.

People say
that most of the muscles

are controlled
by the will,

but we don't have
to tell individual muscles

what to do
to carry out every movement.

The brain
deals with movements

so we don't have
to think about them--

from everyday activities
to more specialized ones.

Muscles and bones

are exposed
to enormous stresses,

even during
everyday activities.

And the loads
are even greater

when we exercise.

Fortunately,
the muscles and the skeleton

become more powerful
and durable

when they are exposed
to the right kind of loads.

That's why exercise
is important.

Our bones, muscles, joints,
tendons, and ligaments

form a complex system--

a system so well-designed

that we can control it
when we want to,

but fully capable
of functioning smoothly

without ever thinking
about it.

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