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Mathematical Journey Through the Human Body: Integrating Science, Mathematics, and Social Studies at Elementary School Levels.

by

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Mathematical Journey Through the Human Body: Integrating Science, Mathematics, and Social Studies at Elementary School Levels.

Among the problems which elementary students encounter is the development of mathematical skills. Skills such as measuring, converting numbers, producing ratios, interpreting numbers, and generating conclusions from data are sadly lacking in elementary school students. One reason that students lack these skills is that math and science have no significance to them. To make students respond positively to math and science, teachers must give these subjects full social significance by relating theoretical processes to realistic situations. When interesting and lifelike examples are used to teach mathematical and scientific concepts, students become involved in the learning experience and better understand the concepts.

Activities using the human body as a teaching tool can be extended to science, math, and language arts classes. In science classes, students can learn about the morphological and anatomical structure of the human body, as well as the functions of its organs and organ systems. The facts, data and information learned in science class can then be used to illustrate mathematical concepts. The students can also write stories and short essays about the human body, thereby utilizing the information that was taught in science class to learn language arts.

Introducing The Human Body

To introduce students to the human body, teachers should begin with the morphological organization and structure of the body. Students should learn the common terms used to describe the location of external body parts. It should be pointed out to students that the human body is made up of a number of organ systems that work together to maintain the body's equilibrium and homeostasis. When students become familiar with the external functions of the human body, teachers can have the students measure their external body parts.

Part One

Measurement of The Human Body

In the following activities, each student uses his or her body as the investigated object.

Activity # 1

1. Each student is asked to do the following:

a). Measure the distance between your right elbow and right wrist and compare it to distance between your right wrist and right shoulder. Repeat the same on the left side.

b). Measure distance between your right ankle and right knee, and compare it to distance between your right knee and right hip bone. Repeat the same on the left side

c). On your right hand, measure from the top of your middle finger to its base (where it connects to the palm). Compare this distance to the width of the palm of your right hand. Repeat the same on the left side.

d). On your right hand, measure from the top of your middle finger to the knuckle. Compare this distance to the length of the palm of your right hand. Repeat the same on the left side.

e). Select the skinniest finger of your right hand (usually the smallest/shortest). Use the amount of string needed to wrap around your wrist once, and record how many times it wraps around your skinny finger.

2. Select four people of the same gender as you to repeat the above measurements (from a-to-e). The age difference between the four people should be ten years (i.e. one person would be under eight, one would be under sixteen, one would be around twenty, and one would be around thirty. This can be an assignment to be done at home.

3. Compare the data of each of the five subjects (including yourself) and develop a general ratio for the distance between:

a). Elbow to wrist with wrist to shoulder.

b). Ankle to knee with knee to hip bone.

c). Top to the base of the middle finger with the width of the palm.

d). Top to the knuckle of middle finger with the length of the palm.

3. Fill all your gathered data in table 1 and then convert all your data to the scientific system of measurement (the metric system). See appendix 1.

Activity # 2:

1. Think of other distances and lengths along your body, and list them down.
2. Choose three of these additional lengths and compare them to lengths of four other students in the same gender as you, but who are different ages.
3. Convert your measurement into the scientific system of measurement, interpret the data, and come up with a conclusion.

Activity # 3: Making Inferences and Generalizations:

1. Write the word "Inferences" on the blackboard, and then ask each students to write down the meaning of the word. Then ask a number of the students to read their definitions and discuss them in the class. Make sure that each student understanding the meaning of the word. In simple words, "inferences" are best guesses that connect an observation with an established fact or association. In other words, inferring is the use of what you observe to explain what has happened.

2. Ask each student to do the following:
   i. Look around your class and find a classmate of a different gender and very close in age to the people you've selected in activity # 1.
   ii Compare your data to his or her data.
   iii Interpret your findings, and come up with a generalization.

Activity # 4 The Golden Ratio In The Human Body:

Martha Bole and Rochelle Newman wrote in thier book *Universal Patterns: The Golden Relationship: Art, Math & Nature*" that

> One *mean proportion* which appears with amazing frequency in nature and mathematics, and has been used throughout the centuries by artists, is called the **Divine Proportion.** This proportion is derived from dividing a line segment into two segments with the special property that the ratio of the whole segment to the longer part is the same as the ratio of the longer part to the shorter part.
>
> A_____C_____B
>
> **AB/AC = AC/CB**
>
> The ratio expressed by either side of the equation is called **Golden Ratio** or the **Golden Mean.** (p. 26).

American researcher, Jay Hambridge, established that indeed the Golden Ration can be found not only in Greek temples and sculpture, but also in the proportions of the human skeleton. The ratio of the total height to the height of the navel is a close approximation to the Golden Ratio (which is 1.618). Other writers and researchers have claimed that ratios of many other parts of the human body are also in the Golden Ratio. In other words, we probably all have the same proportions close to the Greek ideal somewhere in our bodies. (Serra, 1993, 478)

Part Two

More Activities About The Human Body

How Much Blood Is There In Our Classroom?

While teaching the circulatory system, teachers can, for example, incorporate the concept of Scientific Notation (the order of magnitude) that is the expression of the larger number in the power of ten. The students also can learn how to find percentage, multiples, rate and ratio. Also the conversion of English system of measurement to metric system (the scientific system).

Blood is vital to the life of human beings and other living organisms. It is the tissue of transport that carries needed materials to living cells and waste materials away from the living cells. In humans, blood makes up approximately 9% of a given person's body weight; this equals six liters of blood in an adult human.

Blood is made up of two materials--plasma and blood cells . Plasma is the liquid part of the blood. Because plasma is made up of about 90% water, it functions perfectly as the transport system of the blood. It carries digested food and dissolved chemical substances to the living cells, as well as carrying waste materials away from the living cells. There are three kinds of blood cells: red blood cells, white blood cells, and platelets. In general, blood in humans is made up of about 55% plasma, 43% red blood cells, and 2% of while blood cells.

In an adult human, there are about 25 trillion (25.000.000.000.000) red blood cells continuously flowing throughout the human body. Each red blood cell (erythrocyte) contains approximately 300 million molecules of hemoglobin pigment. This enables the cell to carry oxygen from lungs to tissues. Red blood cell also carries carbon dioxide from tissues to lungs.

The white blood cells are the primary defense mechanism against invading organisms and other foreign materials. There is one white blood cell (leukocyte) for every 600-700 red blood cells in human body.

Activity No. 1 Too Much Blood In This Classroom:

Provide the students with the above data and information to use in the following activity. Then ask each student to:

1. weigh him or herself.
2. find out how many pounds of blood his or her body has. (Blood makes up approximately 9% of a given person's body weight).
3. convert their results from pounds to liters.
4. find out how much of his or her weight is plasma, red blood cells, and white blood

cells.

5. find out how many liters of blood the entire class has.
6. find out how much plasma, red blood cells, and while blood cells are there in the entire class.

Activity No. 2. Heart Beat and Heart Pump:

The human heart starts to beat about 8 months before a baby is born. Human hearts are made up of muscle tissue that enables the heart to pump blood. The muscle tissue of the heart constricts and relaxes repeatedly. As a result, the heart beats and pumps blood to every part of the body through the body's blood vessels. One contraction and one relaxation together make up a single heart beat (pulse). The heart of a resting adult human beats about 70 times a minute while the heart of a resting adolescent beats slightly faster at 70-80 times a minute. In the average adult, the heart beats about 100,000 times every 24 hours and pumps about 3,600 gallons of blood throughout the body's blood vessels. During a person's lifetime, the human heart will have beaten, on the average, about 2.5 billion (2.5×10^9) times and pumped some 80 million (8×10^7) gallons of blood.

1. Think of a way to measure the heart beats and then find out how many times your heart beats in one minute, in one hour, and in 24 hours.
2. If in 24 hours your heart pumps about 3,600 gallons of blood throughout the body's blood vessels, how many gallons of blood does your heart pump in one hour, in one minute, and in one second?
3. If, for example, an oil drum holds 80 gallons of liquid, how many oil drums could be filled by the amount of blood that passes through a person's heart in a single day (24 hours)?
4. How many times has your heart beaten from birth to your last birthday?
5. How many times has all the hearts in your family beat from their births to each of their last birthdays?
6. How many gallons of blood has your heart pumped from birth to your last birthday ?
7. How many gallons of blood have all the hearts in your family pumped from their births up to each of their last birthdays?
8. Decide how many years you would like to live and then find out how many times your heart will have beaten during your lifetime. How many gallons of blood will your heart have pumped during your lifetime?

ABO Blood Type System.

Every student in your class could be one day a donor and or recipient in a blood transfusion. Blood transfusion is needed when a given person is severely injured and lost much of his or her blood. But blood transfusion can only be successful if both the donor and the recipient have the same blood type. Transfusing unmatching or incorrect blood type will have such a dire effect on the recipient. Therefore every human being should know his or her blood type. Furthermore, it is important to properly identify the various blood types before a blood transfusion takes place.

> Blood type is determined by the presence of specific carbohydrates (sugars) that are bound to fatty acid (lipid) molecules at the surface of the red blood cell membrane. These carbohydrates are called antigens. Blood group antibodies are proteins, produced in conjunction with blood group antigens, with the ability to bind to specific foreign antigens. Unlike antigens which are attached to the surface of the red blood cell (RBC), antibodies are found in plasma. Most transfusions include only the donor's blood cells and not the plasma. Therefore, two important considerations in a transfusion are the antigens present on the donor's blood cells and antibodies present in the recipient's plasma. (p. S1).

ABO Blood Type System is one example of the antigen/antibody blood typing system. In this system, there are four blood types: A, B, AB, and O. As you can see in table 1, many people (about 42 % in population) have antigen A on their red blood cells and antibody B in their plasma, and so are called Type A. Some people (about 10 % in population) have antigen B on their red blood cells and antibody A in their plasma, and so are called Type B. A few people (about 4 % in population) have antigen A and B on their red blood cells and no antibody in their plasma, and so are called Type AB. Many people (about 45 % in population) have no antigen on their red blood cells and antibody a and B in their plasma, and so are called Type O.

Table 1- ABO Blood Type

Blood Type	Antigens On Cells	Antibodies In Plasma	Can accept Blood From Type	Can Donate Blood to Type
A	A	Anti-B	A or B	A or AB
B	B	Anti-A	B or O	B or AB
AB	A, B	None	All Types	Only AB
O	None	Anti-A, Anti-B	Only O	All Types

Activity 3 - Determine Individual Student Blood Type In the Classroom.

1. Ask the students to raise their hand if they know their blood type. Record the name of the students and their blood type in the black bored. Then, ask each student of those who don't

know their blood type to ask their parents and to bring this information into the class. Allow students a few days to do so. You may want to write a note to all the parents regarding this.

2. In the following class, collect all the data, and write them on the blackboard.
3. Ask each student to act once as a donor and once as recipient, and to write the names of all the students in the class who can accept blood from him or her and the names of all the students who can donate blood to him or her in the class.
4. Ask each student if he or she can come up with general statment regarding person with blood type O and person with blood type AB.

Activity # 4. Determining Whether The Class Blood type Data Represents A cross Section of The Human Population.

1. Using the data they already collected, ask each student to fill out table 2.
2. Ask each student to compare the percentage of blood type with human population and the percentage of blood type with the class.
3. Ask each student to make generalization from the gathered data and information. Students must know how to get the percentage.

Table 2- Number of students With Various Blood type I The Class

Blood Type	Number of Students In Class With Blood Type	% In Student Population	% In Human Population With Blood Type
A			
B			
AB			
O			

Discovering The Length of Your Small Intestine

Every living thing needs energy to live and survive. This energy comes from the nutrients found in food. Before the food can be used for its nutrient by the human being, it must first be changed physically and chemically in a process called digestion. Digestion takes place in a long curved tube called the digestive tract which extends along nearly the entire upper half of the body. This digestive track is about 30 feet (9 meters) long and is made up of the mouth, the esophagus, the stomach, the small intestine, and the large intestine. Food takes about one-to-two days to pass through the entire digestive track.

The mouth begins the digestive process by breaking the food into smaller pieces with the

help of teeth and saliva. The food is then passed into the stomach through the esophagus where food is further broken down into even smaller pieces. The chemical digestion of protein starts in the stomach. After the stomach, all of the partially digested food moves to the small intestine where most of the digestion takes place and where it is completed. Undigested food is passed into the large intestine to be stored as a solid waste, which later will be passed out of the body.

The small intestine is the chief organ of digestion system. It is the place where most of the digestion in the body takes place with the help of two large digestive glands -- the liver and pancreas. In an adult person, the small intestine is about 22 feet long and 2.5 inch wide or about 4 times as long as the height of an average adult.

Table 3- Human Body Systems and Their Functions

System	Job and Function	Organs
Circulatory	Moves materials throughout the body.	Heart, Arteries, veins & capillaries
Skeletal	Supports & protects the body.	Bones & cartilage.
Muscular	Allows movement.	Muscles
digestive	Breaks down and absorbs food.	Mouth, esophagus, stomach, intestines, liver, & pancreas.
Excretory	Removes waste.	Kidneys & bladder.
Integumentary	Gives the body a waterproof protective covering.	Skin, hair and Nails.
Respiratory	Takes in oxygen & gets rid of carbon dioxide.	Nasal passages, trachea & lungs.
Nervous	Gives control and sensation to the body.	Brains, nerves, eyes and ears.
Endocrine	Provides internal chemical control.	Hormone producing glands: pituitary, thyroid, adrenal.
Reproductive	Allows humans to produce children.	Testes, penis, ovaries uterus & vagina.

Activity No. 5. Identify the Parts of and Construct a Digestive System:

Provide the students with the above inforation, and then ask each student to:

1. determine how many parts does his or her digestive system have.
2. write down the parts of the digestive system in an alphabetical order.

3. write down the parts of the digestive system in order.
3. identify the part in where the food remains longest, and the part in which the food doesn't stay long.

Activity No. 6. Who Is Taller, You or Your Small Intestine?

Since, the small intestine is about 22 feet long and 2.5 inch wide or about 4 times as long as the height of an average adult, ask each student to:

1. measure his or her height.
2. calculate approximately how long his or her small intestine is.
2. draw himself or herself side by side with his or her small intestine.

Working Together

The fundamental structural and functional unit in all living things is the cell. All living things are made of cells. Each cell is the smallest complete unit of living matter. It is bounded by a cell membrane, has cytoplasm, and contains genetic material in the form of DNA. All living cells are three-dimensional structures and occur in a variety of shapes and sizes, and internal complexity. Simple living organisms are made of one cell that must take on all the life activities needed for the organism to survive and reproduce. Complex living organisms are made of many cells. Each group of cells are specialized to do specific jobs within the body and contribute to the maintenance and survival of that organism.

In complex organisms, similar cells are arranged in groups called tissues. Tissue consists of a group of similar cells that work together as a team to perform a special job. When different tissues work together to do a special job, they are called organs; such as the heart, lungs, eyes, and stomach. When certain organs team together to do a certain job, they are called an organ system or body system. See table 3.

Activity # 7. How Is The Body Like a Nation?

1. Write the following words on the blackboard and ask all the students to write them in their notebooks: Body systems (organ system), cells, citizens, factories, industries, living organism, nation, production departments, organs, tissues.
2. Pair the students and ask each pair to classify these words in two columns, based on the meaning of the words, letting them reason out what should belong in each column
3. Ask each pair of students to match the words in the first column to the words on the second

column based on their comparative function.

4. Finally ask each student to write one meaningful paragraph using all these words.

The following is an example of what your student could do:

> A complex living thing, or organism, is something like a large nation. The body systems are like major industries, each one dependent on the others. The organs are like factories, with tissues being like the different production departments. Each cell, like each citizen of a well-ordered nation, does a tiny but necessary part of the work of the whole. And each in turn depends upon all the actions of the whole to provide what it needs to live.
>
> (Building Basic Skills in Science, 1988, p. 22)

Discovering The Human Tongue

The tongue in the human body is sensitive to certain chemicals that enable us to taste sweet, salty, sour and bitter. Every tongue is covered with little bumps which have tiny openings that lead to about 3000 taste buds on the surface of the tongue.

> The taste buds lie in little projections on the surface of the tongue called papillae. There are three kinds of papillae. Some are shaped like tiny mushrooms, others look like miniature hills with moats around them, and finally there are tiny threadlike or conical ones. In general, only the first two kinds of papillae contain taste buds. (Wilson, 1959, p. 60).

The taste buds are specialized receptors which are sensitive to one kind of the four primary taste -- sweet, sour, bitter, and salt. Inside each taste bud there are many nerves that send messages to the brain. The brain in turn tells the person what he or she is tasting, whether sweet, sour, salty or bitter.

The taste buds are located along the rim and cross the back of the tongue. In the middle is a large area where nothing is tasted (Wilson, 1959). Taste buds sensitive to bitterness are found in the rear of the tongue, sour on the side, salty in the front, and sweet at the tip. (The taste map for the human tongue can be found in any book of human biology.) The tongue has many uses such as chewing and moving food, tasting food, and enabling a person to speak and make sounds.

Activity No. 8. Discovering The 3.000 Taste Buds On The Surface of Your Tongue:

1. Give each pair of students a magnifying glass, a rule, and a paper.
2. Have one student in each pair open his/her mouth, and have the other student measure the with and more than half the length of the tongue. Then have the other student

measure the first student's tongue.

3. Have each student draw a diagram of the other person's tongue.
4. Using a magnifying glass, have each student examine the little projections, which are called papillae, on the surface of the tongue. There are three kinds of papillae; one kind looks like tiny mushrooms; one like tiny hills with moats around each one; and one like tiny thread or conical. Ask the students to identify in which area each kind of the papillae is located on the surface of the tongue.
5. Discuss the finding with your students and explain that, only the first two kinds of papillae contain taste buds

Activity No. 9. Mapping The Human Tongue:

1. Divide the students into groups of four.
2. Give each group of four students five beakers, four droppers, five 8.5 x 11" sheets of paper, five pencils, and paper tissue, and one diagram of a human tongue (as shown in the figure 1). Each beaker is filled with only one of the following: water, sugar solution, salt solution, lemon juice solution, and black coffee solution. Use one tablespoon of sugar in 100 ml of water, and the same for the salt and lemon juice. For coffee just use a plain brewed coffee.
3. Ask each group to:
    a). to come up with three essential functions of the tongue.
    b). to draw or copy the diagram of the tongue on each of the five sheets of paper.
    c). to find the location of various taste buds on their own tongues. Every group now has a piece of paper with a diagram for each student plus one extra blank sheet of paper to use in the following experiment:
        i. Find the areas which are sensitive to bitter taste and mark them on the diagram of the tongue.
        ii. Find the areas which are sensitive to sour taste and mark them on the diagram of the tongue.
        iii. Find the areas which are sensitive to sweet taste and mark them on the diagram of the tongue.
        iv. Find the areas which are sensitive to salty taste and mark them on the diagram of the tongue.
4. Ask all the students of each group to compare their findings to each other and to use the fifth sheet to map the human tongue and its various taste areas.
5. At the end, collect all the results, compare the maps to each other, and discuss the results with the students.

Constructing the Human Body With Common Shapes and Objects.

There are approximately 206 bones in the growing body that work together in groups to protect the inner organs (such as the brain, spinal cord, heart, and lungs), to maintain body shape, and to enable a person to move around. Bones come in many varied sizes and shapes, such as long, short, round, flat, etc.

Activity No. 10

1. Divide the class into groups of five students.
2. Ask each group of students to collect objects with the following shapes over the weekend: cylinder, cube, sphere, cone, and sheet. Or ask each group of students to make these shapes in the class from clay.
2. Ask each group of students to measure the surface area of each object they have. If they don't know how, this is a good time to teach them how .
4. Ask each group of students to construct the human body using only the objects they collected or made from clay.

Activity No. 11

1. Give each student two 8.5 x 11 inch sheet of papers, ruler, and pencil.
2. Ask each student to divide one of the two 8.5 x 11 inch sheet of papers using horizontal and vertical lines of one inch each.
3. Ask each student to measure and record his or her height.
4. Ask each student to draw him or herself standing on the 8.5 x 11 inch sheet of paper using a one inch square for each foot of his or her length.
5. Ask each student to divide the other 8.5 x 11 inch sheet of paper into horizontal and vertical lines of one centimeter each.
6. Working in groups of two students, ask each student to draw him or her self again on the other 8.5x11 inch sheet of paper. The figure must be in the same size and length as the one on the first page. Every two students working to gather must first to discuss and figure out how they will draw the same figure in length and size using different measurement systems.

How Do Boys and Girls Grow?

Activity No. 12

In this activity students will find out the growing rate of their legs throughout the years, as well as how girls and boys grow in height.

1. Ask those students who have their baby pictures at birth, including their weight and their length to bring them to the class the following week. Make sure that you have at least five students who bring their baby pictures at birth to the class.

2. Ask all the students to measure the length of their arms, legs, and to measure their height.
3. Ask each student to find out the ratio of the length of their arm to the height of their body and the ratio of the length of their leg to the height of their body.

4. Using the ratio they generated from question # 3, and their length at birth, ask each student to find out:
    a. How many times longer is his or her leg compared to when he or she was born?
    b. How many times longer is his or her arm compared to when he or she was born?
    c. How many times longer will his or her leg be at the age of 20?
    d. How many times longer will his or her arm be at the age of 20?

Notice that in order for the students to do this exercise, they need to know how to do a number of mathematical concepts such as. When they finish this exercise, engage the students with the following activity.

Activity # 13.

1. Divide the class into groups of five. Then ask the members of each group to divide the following task among them equally.
2. Ask the students to look for a one year old boy and girl and measure their height.
3. Ask the students to look for a three year old boy and girl and measure their height.
4. Ask the students to look for a six year old boy and girl and measure their height.
5. Ask the students to look for a nine year old boy and girl and measure their height.
5. Ask the students to look for an eleven year old boy and girl and measure their height.
6. Ask the students to look for a thirteen year old boy and girl and measure their height.
7. Ask the students to look for a sixteen year old boy and girl and measure their height.
8. Collect all the gathered data, make them available to all the students. Then ask each group to find out on the average how boys and girls grow.

Your students will discover that on the average, boys and girls grow at the same speed up to age 11 or 12. Then the girls grow faster for 3 -to- 4 more years. Later, the boys catch up and grow even faster up to the age of 20 where both boys and girls' bodies stop growing in height.

Clues From The Bones

How do scientidts obtain clues from bones? In November of 1974, Donald Johanson, a young unknown American paleoanthropolgist, found a partial skeleton approximately 3.5 million years old, in a remote region of Ethiopia called Afra. Johanson named his new discovery of the partial skeleton, Lucy (*Australopithecus afarensis*). Lucy was the oldest, most complete, best-preserved skeleton of any erect-walking human ancestor ever found, and the first new species to be named in more than 15 years before Johanson's discovery in 1974. Paleontologists, in their search for fossils, rarely find more than a few scattered bone fragments. However, Quincy, for example, solved a murder mystery by the discovery of a single bone, the radius. So how do paleontologists, or criminologists determine the height of individual, just from a few remaining bones?

According to Scientific American Frontiers (show # 702) hosted by Alan Alda (aird on November 20, 1996), scientists usually use the following two mathematical formulas that illustrate the relationships between bone lengths and a person's height.

Males (Height in Inches):

Height = (length of radius x 3.3) + 34
Height = (length of humerus x 2.9) + 27.8

Females (Height in Inches):

Height = (length of radius x 3.3) + 32
Height = (length of humerus x 2.8) + 28.1

Activity: 14. Inferring A person's Height From The Length of One Bone:

The following activity from the Scientific American Frontiers, has been adapted to fit the needs of the integration of math, science, and social studies in elementary school level.

1. Give a pair of students a meter stick, a copy of table 5, a diagram of the human skeleton, and the two mathematical formulae for calculating the height of males and females from one bone.
2. Place a skeleton in front of the class, then ask students to come forward and identify the different major bones in the human skeleton in front of the class. Teachers should make sure that the humerus and radius are mentioned, either by the students or themselves. This is important because every student must be able to identify these two bones. The radius "is one of the two bones found in the forearm and extends from the base of the wrist to just beneath the elbow hinge. The humerus is the bone that extends from the shoulder socket to just above the

elbow hinge.

3. Ask each pair to label on the diagram of the human skeleton as many bones as they can remember and underline the radius and the humerus After they finish, collect all the papers.
4. Ask one student in each group to measure the length of his or her partner's radius, and to record this length on table # 5.
5. Then ask the same student to measure his or her partner's actual height and to record it in the table.
5. Ask the other student in each group to measure the length of his or her partner's humerus, and to record this length in the table. Then ask the same student to measure his or her partner's actual height and to record it in the table.
6. Ask each group to use the mathematical formulae for calculating the height based on the length of humerus and radius and to record the calculated heights on the table. Then ask them to compare the measured height with the calculated height, and to make inference and conclusion.
7. Ask each student to measure the sole of his/her foot and compare it to the length of the radius and the humerus.
8. Ask the students to gather around the skeleton and figure out if any other bone could be used to find out the height of the individual. This part is important because this helps the students to realize that all the bones are proportionate to the height and therefore to one another.

Table # 5

	Bone Length	Calculated Length	Measured Length	Measured Foot
Radius				
Humerus				

For more advanced students, this activity could be modified by not giving them the conversion factor, letting the students do the measurement of selected bones (humerus, radius or femur). They could develop a chart and find out if there is a correlation factor between the lengths of the bone and the height of the individual.

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Appendix 1

The Scientific System of Measurement

The metric system of measurement is used by scientists throughout the world. It is based on units of ten. Each unit is ten times larger or ten times smaller than the next unit.

Length

The Distance From One Point to Another

The basic unit: a "meter" (m) is slightly longer than a yard.

1 kilometer (km) = 1000 meters
1 meter (m) = 100 centimeters
1 centimeter (cm) = 10 millimeters (mm)

Volume

The Amount of Space An Object Takes Up

A liter (L) is slightly more than a quart.
1 liter = 1000 milliliters (mL)

Mass

The Amount of Matter in an Object.

A gram (g) has a mass equal to about one paper clip

1000 grams = 1 kilogram (kg).
500 grams = 1/2 kilogram (kg)

Temperature

The Measure of Hotness or Coldness

degrees O C = freezing point of water
Celsius (C)100 C = boiling point of water

Metric-English Equivalents:

2.54 centimeters (cm) = i inch (in.)	1 meter (m) = 39.37 inches (in.)
1 kilometer (km) = 0.62 miles (mi)	1 liter (L) = 1.06 quarts (qt)
250 milliliters (mL) = 1 cup (c)	1 kilogram (kg) = 2.2 pounds (Ib)
28.3 gram (g) = ounce (oz)	C = 5/9 x (F -32).

How well do you know your body?

1. Every day, blinking causes the eye to close for
   a) 45 seconds
   b) 12 minutes
   c) 30 minutes

2. The iris of the eye can adjust to light intensities up to
   a) 500 times
   b) 1000 times
   c) 2000 times

3. The average human circulatory system is
   a) 50 to 60 miles long
   b) 5,000 to 10,000 miles long
   c) 60,000 to 100,000 miles long

4. The body's largest organ is
   a) the heart
   b) the liver
   c) the skin

5. What percentage of your body weight is represented by muscle?
   a) 50% in both men and women
   b) 20% in men, 10% in women
   c) 40% in men, 30% in women

6. Blood serum is almost identical in chemical content to
   a) sea water
   b) maple syrup
   c) pure glucose

7. Every day, bone manufactures how many red blood cells?
   a) 500
   b) 10,000
   c) 1,000,000,000

8. The largest blood vessels in your body are
   a) 1/2 inch wide
   b) 1 inch wide
   c) 2 inches wide

9. In an average lifetime, the hair on the head grows about
   a) 5 feet
   b) 25 feet
   c) 150 feet

10. Without the pituitary gland at the base of your brain, you wouldn't
   a) walk
   b) talk
   c) grow

11. Every night, the average person has three to four dreams, each lasting
   a) 2 minutes
   b) 5 minutes
   c) 10 minutes or more

12. When we touch something, the impulse travels along our nerve network to the brain at the rate of
   a) 10 feet per second
   b) 100 feet per second
   c) 350 feet per second

13. The human skull is
   a) one solid bone
   b) two bones joined together at the center
   c) made up of 29 different bones

14. The main mineral in bone is
   a) calcium
   b) potassium
   c) magnesium

15. For reasons unknown to science, color blindness
   a) affects more women than men
   b) affects more men than women
   c) affects only men

16. Human eye can distinguish
   a) nearly 8 hundreds differences in colors.
   b) nearly 8 thousands differences in colors.
   c) nearly 8 million differences in colors.

17. Human eye and brain "Build" color
    a) from waves of energy.
    b) from waves of matter.
    c) from waves of anti-matter.

18. If all 600 muscles in your body pulled in one direction,
    a) you could lift 15 tons.
    b) you could lift 25 tons.
    c) you could lift 35 tons.

18. Human ears can discriminate among
    a) more than 10,000 tones.
    b) more than 100,000 tones.
    c) more than 300,000 tones.

19. The surface area of your lungs is 1,000 square feet or
    a) 10 times greater than the surface area of your skin.
    b) 20 times greater than the surface area of your skin.
    c) 30 times greater than the surface area of your skin.

20. Your heart pumps more than 5 quarts of blood every minute, or
    a) 2,00 gallons a day.
    a) 2,000 gallons a day.
    a) 20,000 gallons a day.

21. Your body produces
    a) one billion red blood cells every day.
    b) one million red blood cells every day.
    c) one thousand red blood cells every day.

22. Every pound of excess fat you carry requires
    a) an extra 2 miles of capillaries.
    b) an extra 20 miles of capillaries.
    c) an extra 200 miles of capillaries.

23. Your digestive tract is
    a) 10 feet long.

b) 20 feet long.
c) 30 feet long.

24. More than half of your body's 208 bones are
a) in your hands and your feet.
b) in your skull and your backbone.
c) in your ribs and your neck.

25. The human adult backbone contains a total of about
a) 19 vertebrae.
b) 29 vertebrae.
c) 39 vertebrae.

26. The human skull is made up of
a) about 14 smooth bones.
b) about 24 smooth bones.
c) about 44 smooth bones

27. In relation to all the bones in the entire body, the hands
a) contain more than 100 bones (about 1/4 of all the bones).
b) contain more than 50 bones (about 1/4 of all the bones).
c) contain more than 25 bones (about 1/4 of all the bones).

28. In relation to all the bones in the entire body, the feet
a) contain more than 100 bones (about 1/4 of all the bones).
b) contain more than 50 bones (about 1/4 of all the bones).
c) contain more than 25 bones (about 1/4 of all the bones).

29. The total number of bones in adult human body
a) is about 106 bones.
b) is about 206 bones
c) is about 406 bones.

30. One cubic inch of bone can withstand
a) a two-ton force.
b) a four-ton force.
c) an eight-ton force.

Did you know...

Your eye can distinguish nearly 8 million differences in colors.

Your eye and brain "Build" color from waves of energy

If all 600 muscles in your body pulled in one direction, you could lift 25 tons.

Your ears can discriminate among more than 300,000 tones.

The surface area of your lungs is 1,000 square feet- 20 times greater than the surface area of your skin.

Your heart pumps more than 5 quarts of blood every minute, 2,000 gallons a day.

You have skin cells in your stomach, eyes and lungs,

Your body produces one billion red blood cells every day

Every pound of excess fat you carry requires an extra 200 miles of capillaries,

Your digestive tract is 30 feet long,

More than half of your body's 208 bones are in your hands and your feet.

One cubic inch of bone can withstand a two-ton force.