Cornell Institute for Biology Teachers

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Title: **Metric Measurement**

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Appropriate Level: Grades 2-7

NYS Standards: Elementary (K-4): STANDARD 1 Scientific Inquiry- Key Ideas 1 (S1.1-1.3), 2 (S2.3a-b), 3 (S3.1-3.4); STANDARD 4 Living Environment- Key Ideas 1 (PI1.1), 3 (PI3.1a, c); STANDARD 6 Interconnectedness- Models: Key Idea 2; Magnitude & Scale: Key Idea 3; Patterns of Change: Key Idea 5
Intermediate (5-8): STANDARD 1 Scientific Inquiry- Key Idea 1 (S1.2-1.3); STANDARD 4 Living Environment- Key Idea 1 (PI 1.1g, 1.2g); STANDARD 6 Interconnectedness- Models: Key Idea 2 (2.2)

Abstract: Students will learn how to measure length in SI units (the metric system), and practice measurements on human and orangutan hands and feet. Students may practice conversion of metric units, as well as inferring a subject's height from the length of their humerus.

Time Required: 2 or more class periods

Teacher Section Contents

Background Information

Often measurements are made to learn more about biological problems. The international system of units, or SI system, is a system of measurements that students will become more familiar with throughout this exercise. The SI system is the "universal language of measurement" for all countries, and the only system used in science. All the measurements in this lab are SI length measurements.

The basic unit of length is the meter. The meter is divided into one hundred smaller units called centimeters. Smaller measurements are made with millimeters. Ten millimeters equal one centimeter. When measurements are made, students will write them down. The data will be written in a table to help them stay organized. They will be measuring lengths of hand and feet bones, and comparing measurements between humans and orangutans in the second part of the lab.

Metric System Practice, Inferring Height From Humerus Length, and the Metric Scavenger Hunt activities are practice exercises for the skills learned in Parts 1-2 of the lab. Feel free to use the activities in any order that works for you and your students.

Time Required

2 or more class periods.

Materials (provided in CIBT kit)

- 1 orangutan hand model
- 3 human hands models
- 3 human feet models
- 1 human arm model
- 12 metric yellow rulers
- 12 blue laminated foot Guides
- 12 green laminated hand Guides
- 12 laminated orangutan disarticulated and handprints handouts
- 12 laminated disarticulated human hands handouts
- Laminated pieces of colored paper of different lengths

Required for portions of the lab but NOT included in the kit:

- Meter sticks or tape measures
- Calculators
- Thermometers
- Mass scale
- Graduated cylinder (for measuring volume in ml)
- Disposable cups

Sources

- Part 1 of this lab was modified from an SI Measurements lab first brought to CIBT by Megan Wieboldt found at: http://www.cnusd.k12.ca.us/cms/lib/CA01001152/Centricity/ModuleInstance/16072/Lab-SI%20Length%20Measurements.pdf
- http://animals.nationalgeographic.com/animals/mammals/giraffe/
- http://www.giraffeconservation.org/giraffe_facts.php?pgid=2
- http://home.cogeco.ca/~parksidescienceq/SNC%2014/Measurement.htm
- http://kids.nationalgeographic.com/kids/animals/creaturefeature/orangutan/
- http://www.orangutans-sos.org/
- http://orthoanswer.org/hand-wrist/fracture-wrist-hand/definition.html

- http://www.pbs.org/saf/1203/teaching/teaching2.htm
- http://theadvancedapes.com/201328great-ape-and-human-genetic-diversity/

NYS LEARNING STANDARDS

Elementary Science Core Curriculum—*Grades K-4*

Standard 1—Analysis, Inquiry, and Design
Scientific Inquiry

Key Idea 1. The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process. Students:

S1.1 Ask "why" questions in attempts to seek greater understanding concerning objects and events they have observed and heard about.

S1.1a Observe and discuss objects and events and record observations

S1.1b Articulate appropriate questions based on observations

S1.2 Question the explanations they hear from others and read about, seeking clarification and comparing them with their own observations and understandings.

S1.2a Identify similarities and differences between explanations received from others or in print and personal observations or understandings.

S1.3 Develop relationships among observations to construct descriptions of objects and events and to form their own tentative explanations of what they have observed.

S1.3a Clearly express a tentative explanation or description which can be tested.

Key Idea 2. Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity. Students:

S2.3 Carry out their plans for exploring phenomena through direct observation and through the use of simple instruments that permit measurements of quantities (e.g., length, mass, volume, temperature, and time).

S2.3a Use appropriate "inquiry and process skills" to collect data.

S2.3b Record observations accurately and concisely.

Key Idea 3. The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena. Students:

S3.1 Organize observations and measurements of objects and events through classification and the preparation of simple charts and tables.

S3.2 Interpret organized observations and measurements, recognizing simple patterns, sequences, and relationships.

S3.3 Share their findings with others and actively seek their interpretations and ideas.

S3.4 Adjust their explanations and understandings of objects and events based on their findings and new ideas.

Standard 4—The Living Environment

Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Key Idea 1. Living things are both similar to and different from each other and nonliving things. Students:

- Describe the characteristics of and variations between living and nonliving things.

PI 1.1 Major understandings: Animals need air, water, and food in order to live and thrive.

Key Idea 3. Individual organisms and species change over time. Students:

- Describe how the structures of plants and animals complement the environment of the plant or animal.

PI 3.1a Major understandings: Each animal has different structures that serve different functions in growth, survival, and reproduction.

PI 3.1c In order to survive in their environment, plants and animals must be adapted to that environment.

Standard 6—Interconnectedness: Common Themes

Models

Key Idea 2. Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design. Students:

- Analyze, construct, and operate models in order to discover attributes of the real thing.
- Discover that a model of something is different from the real thing but can be used to study the real thing.
- Use different types of models, such as graphs, sketches, diagrams, and maps, to represent various aspects of the real world.

Magnitude and Scale

Key Idea 3. The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems. Students:

- Observe that things in nature and things that people make have very different sizes, weights, and ages.
- Recognize that almost anything has limits on how big or small it can be.

Patterns of Change

Key Idea 5. Identifying patterns of change is necessary for making predictions about future behavior and conditions. Students:

- Use simple instruments to measure such quantities as distance, size, and weight and look for patterns in the data.
- Analyze data by making tables and graphs and looking for patterns of change.

<u>Intermediate Level Science Core Curriculum—*Grades 5-8*</u>

Standard 1—Analysis, Inquiry, and Design

Scientific Inquiry

Key Idea 1. The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process. Students:

S1.2 Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.

S1.3 Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

Standard 4—The Living Environment

Key Idea 1. Living things are both similar to and different from each other and nonliving things. Students:

PI 1.1 Compare and contrast the parts of plants, animals, and one-celled organisms.

1.1g Multicellular animals often have similar organs and specialized systems for carrying out major life activities.

PI1.2 Explain the functioning of the major human organ systems and their interactions.

1.2g Locomotion, necessary to escape danger, obtain food and shelter, and reproduce, is accomplished by the interaction of the skeletal and muscular systems, and coordinated by the nervous system.

Standard 6—Interconnectedness: Common Themes

Models

Key Idea 2. Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design. Students:

2.2 Use models to study processes that cannot be studied directly (e.g. when the real process is too slow, too fast, or too dangerous for direct observations).

Procedure

Part 1: Hands and Feet

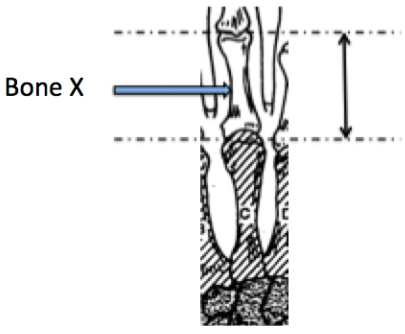
1. Hand out one copy of the student section to each student. Have them read the introduction and answer the first question independently.
2. Explain to students that in Part 1 of this lab, they will be comparing the measurements of human hands to human feet. Ask which they think is longer: a hand or a foot? And which one do they think has more bones? This question may be discussed as a class, but students must write down individual answers on their worksheet.
3. Divide class into pairs. Each group will receive one of 12 laminated handouts, included in the CIBT Kit. Pass out one **green** handout to each pair, and one **blue** handout to each pair.
4. Instruct students to look at the hand on the **green** handout. They will count the number of bones present in the thumb, fingers, palm and wrist (they are shaded in different ways in the diagram). Counts will be recorded on Table #1, on Page 2 of the Student Section.
5. Instruct students to look at the foot on the **blue** handout. They will count the number of bones present in the big toe, other toes, center of the foot, ankle, and heel. Counts will be recorded on Table #1.
6. Have students count *all* of the bones in the hand and the foot, and enter these numbers in Table #1, or add the numbers they have already recorded in the table.

   Answers for Table #1 are shown below:

TABLE #1. Bone count comparison between a human hand and a foot.

BONE COUNTS				
Hand	**Number of bones in…**		**Foot**	**Number of bones in…**
The thumb	2		**The big toe**	2
All other fingers	3		**All other toes**	3
Palm of hand	5		**Center of foot**	5
Wrist	8		**Ankle and heel**	8
TOTAL	18		**TOTAL**	18

7. Pass out metric rulers to each group, explaining that from now on, students will be taking measurements on the blue and green handouts. Instruct them to round numbers to the nearest 10^{th}, or millimeter. Explain to students how the measurements are to be taken, to and from which part of the bone (s). See the diagram at right. One idea is to find the farthest two points in the bone, and measure, using a straight line, the distance between these two points. Make sure everyone understands



how to take the measurements before proceeding.

8. Tell students to measure, in millimeters, the lengths of the bones marked A, B, C, D, and E on the **green** hand diagram. Counts will be recorded on Table #2, on Page 3 of the Student Section.
9. Tell students to measure, in millimeters, the lengths of the bones marked A, B, C, D, and E on the **blue** foot diagram. Counts will be recorded on Table #2.
10. Have them measure the lengths of the thumb and the big toe, and record these on Table #2.
11. Have them measure the lengths of the smallest finger and the smallest toe, and record these on Table #2 as well.
12. Help students change all of their millimeter measurements to centimeter measurements on Table #2, in the space provided. Since there are 10 millimeters in one centimeter, students can simply move the decimal point over one space to the left. Answers for Table #2 are shown below:

TABLE #2. Bone length comparison between fingers and toes.

BONE LENGTHS				
BONE	**HAND**		**FOOT**	
	MILLIMETERS	**CENTIMETERS**	**MILLIMETERS**	**CENTIMETERS**
Bone A	35	3.5	64	6.4
Bone B	54	5.4	78	7.8
Bone C	53	5.3	72	7.2
Bone D	48	4.8	72	7.2
Bone E	43	4.3	76	7.6
Length of thumb or big toe	78	7.8	123	12.3
Length of smallest finger or toe	95	9.5	119	11.9

13. Instruct students to fill out the Venn diagram on Page 4 of the Student Section. The top circle requires them to brainstorm characteristics unique to the bones of the hand, while the bottom circle requires foot bone characteristics. The middle space allows students to brainstorm similarities between the bones of the hands and feet.
14. Have students answer Questions 2-3 (Page 5) on their own. Refer them to the data they collected in Tables #1-2, especially for the first question.

Part 2: Humans and Another Species

1. Have students return **green** and **blue** handouts, in exchange for the two **yellow** handouts. They will be working in the same pairs for this part of the lab, and they will keep the same metric rulers.
2. Help students locate **Side A** of the large yellow handout, which is a disarticulated orangutan hand, as well as **Side B**, a print of an orangutan hand. They must also locate the **half-page yellow** handout, which shows a disarticulated human hand.

3. Instruct students to use **Side A** of the large yellow handout to fill in the first half of Table #3 (Page 6 of the Student Section).
4. Instruct students to use the **half-page yellow** handout to fill in the second half of Table #3.
5. Before finding the total numbers of bones, students should predict which hand has more bones: the human or orangutan. Answers for Table #3 are shown below:

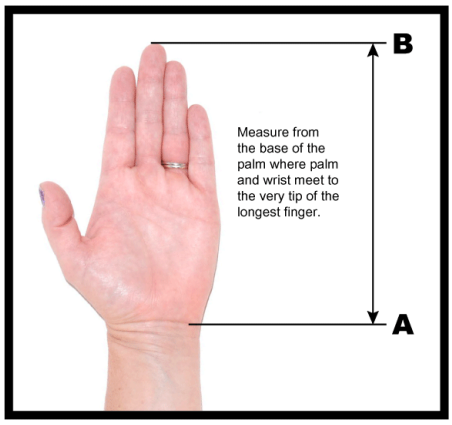
TABLE #3. Comparison of a human and orangutan hand.

How many fingers are in the orangutan hand? ___5___

How many fingers are in the human hand? ___5___

ORANGUTAN HAND		HUMAN HAND	
Number of bones in the thumb	2	**Number of bones in the thumb**	2
Number of bones in the other fingers	3	**Number of bones in the other fingers**	3
Number of bones in the rest of the hand	13	**Number of bones in the rest of the hand**	13
Total number of bones in the hand	27	**Total number of bones in the hand**	27

6. Have students measure the length of their hand, *in centimeters*, from the base of the palm to the tip of the longest finger (typically the middle finger), and enter it in the space below the question. Use the diagram at right as a guide.



7. Have students measure the length of the orangutan handprint on **Side B** of the large yellow handout, using the same procedure as the did for their own hand. They will enter it in the space below the question, and also perform simple subtraction to find out how many centimeters *longer* the orangutan hand is than their own.
8. Have students answer Questions 4-9 (Pages 7-8) on their own. Refer them to the data on Table #3 and their measurements for Question 4. Possible answers are shown below:

Question #4. How do the hands of humans and orangutans compare to each other?

Human and orangutan hands are very similar- they have approximately the same structure and number of bones. The major difference is the length of the bones. Orangutan fingers are much longer than human fingers.

Question #5. Which of these findings surprised you and why?

This answer is up to individual interpretation.

Question #6. The number of bones in the foot of a gorilla is the same as in humans and chimpanzees. Suggest why species that seem so different could share these similarities.

The number of bones might be similar because the gorilla, humans, and chimpanzees are all "great apes," in the family *Hominidae*.

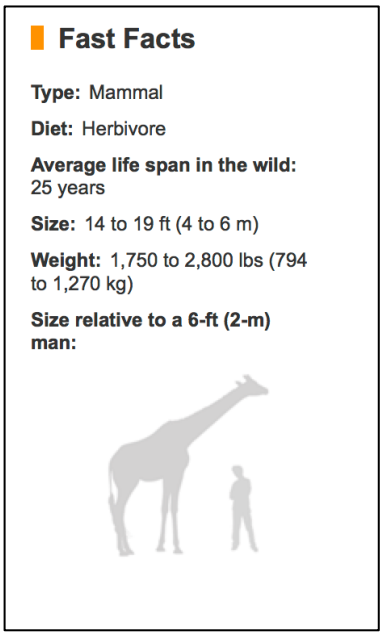
Question #7. The number of bones in the neck of a giraffe is the same as the number of bones in the neck of a human: each one has 7 vertebrae. Yet the giraffe is so much taller than a man. The average length of **each** of the giraffe neck vertebrae is about 25 cm. The **total** length of the human neck is about 11 cm. How much longer than the average human neck is the neck of the giraffe? Show your work and use the proper unit.

25 cm × 7 vertebrae = 175 cm total length (giraffe neck)

175 cm (giraffe) − 11 cm (human) = **164 cm** longer!

What is the average length of the vertebrae in the human neck?

11 cm total length ÷ 7 vertebrae = **1.6 cm** each



Question #8. Look at this chart of Fast Facts with general information about the giraffe. What is one characteristic we share with giraffes that could explain why both species have the same number of vertebrae in the neck? Use a complete sentence to answer this question.

Both humans and giraffes are mammals.

Question #9. The length of a human hand with all fingers extended is exactly the same as the length of the person's face. How long is your face?

Students' faces will range in length from approximately 13-23 cm long.

Orangutan Article

You may want to do this activity before starting to measure the orangutan hands, as an introduction.

1. Read through the article on Page 8 as a class, or instruct students to read through it individually.
2. Discuss the question at the end of the article as a class: *What advantage do long arms and hands give orangutans?*

   Possible answers include: easier to climb and swing from trees, easier to hold offspring while tree-climbing, longer reach for finding food and water sources, etc.

Metric System Practice

1. Give each pair of students six pieces of laminated, colored paper of various lengths (included in CIBT Kit).
2. Have students put them in order according to the numbered instructions, duplicated below:
   1) 34 cm length
   2) 29 cm length
   3) 290 mm length
   4) 21 cm length
   5) 100 mm length
   6) 9 cm length
3. Help students make the conversions listed on Page 9. Again, when going from millimeters to centimeters, they can move the decimal one place to the *left*. When going from centimeters to millimeters, they can move the decimal one place to the *right*. Answers are given below:

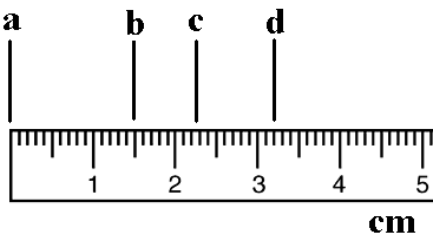
1 m = <u>100 cm</u>	1 cm = <u>10 mm</u>	1 m = <u>1000 mm</u>
99 cm = <u>990 mm</u>	25 mm = <u>2.5 cm</u>	4.9 cm = <u>49 mm</u>
21 cm = <u>210 mm</u>	80 mm = <u>8 cm</u>	5.7 cm = <u>57 mm</u>
320 cm = <u>3200 mm</u>	100 mm = <u>10 cm</u>	140 mm = <u>14 cm</u>

4. Instruct students to record measurements B-D from the ruler pictured at right, with the correct units specified. Answers are given below:

   B = <u>1.5 cm</u>

   C = <u>2.3 cm</u>

   D = <u>32 mm</u>



Inferring Height From Humerus Length

1. If not already paired, put students into groups of two. Give each pair a meter stick or tape measure, and a calculator.
2. Instruct students to measure each other's height in centimeters, and record their partner's height in the space on Page 10. Alternatively, students could work in pairs but record their own data instead of a partner's throughout the activity.
3. Help students identify each other's humerus bone. This is the single, large bone that extends from the elbow to the shoulder socket. Make sure students confirm that it's okay with their partners before touching!
4. Instruct students to measure their partner's humerus with the meter stick or tape measure, in centimeters, and write it down in the space provided.
5. Tell students that if their partner is a girl, they will move on to Step 3. If their partner is a boy, they will skip directly to Step 4.
6. Students will now use calculators to multiply the measured humerus length by 3.06 (for females) or 3.27 (for males), and then add 64.26 (for females) or 59.41 (for males). They will record the result– their partner's estimated height– on the correct line.
7. Have students compare their partner's actual height to the estimated height (using humerus measurements), and explain why there may be differences. Remind them to include units (in this case, centimeters) in their answers.
8. Set up the arm model (included in CIBT Kit) and have groups take turns measuring the humerus, and then estimating the person's original height using the formulas from the last question. For the purposes of this lab, we will assume that the person was male.

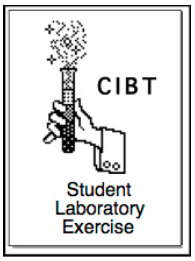
Metric Scavenger Hunt

1. Divide the class into small groups (between 2 and 4 students). DO NOT provide any measuring equipment…yet!
2. Instruct groups to find all of the items listed on the page in a given amount of time (try 15 minutes). This activity is best done outdoors, but it is possible to modify for the classroom. Use a stopwatch to keep exact time for students, if desired. They must *estimate* all of the quantities—measuring is not allowed until the end. Give each group a disposable cup for collecting water. They will be looking for:

    - Blade of grass that is 6 cm long
    - Coin with a diameter of 24 mm
    - Piece of paper that is 28 cm long
    - Pine cone with a mass of 14 g
    - Stick with a mass of 1.5 g
    - 20 ml of water
    - Rock with a volume of 5 ml
    - Water with a temperature of 23˚C

3. Prepare measuring instruments (metric rulers, thermometers, mass scale, graduated cylinders for measuring liquids) for student use.
4. At the end of 15 minutes, have groups measure all of their specimens and record the actual quantity for each one. Instruct students to compare the estimates with the actual numbers. The most accurate group wins.

Metric Measurement



Name: _____ Date: _____

The Metric System, also called the International System of Units, or SI system, has basic units that you might have heard about:

- Meter (m) for length
- Gram (g) for mass
- Second (s) for time
- Liter (l) for volume
- Celsius (°C) for temperature

Which of these units have you heard about before and where?

_____

_____

_____

_____

_____

This is the "universal language of measurement" for all countries, and the only system used in science. All the measurements that you will be required to make on this lab will be SI measurements. You will be measuring length of hands and feet and even comparing different species. The results might surprise you!

Materials

- Several printouts or models that your teacher will provide
- Metric ruler

Procedure

Part 1: Hands and Feet

In the first part of this lab you will compare human hands to human feet.

In humans, what is longer: a hand or a foot? _____.

Which one do you think has more bones than the other? _____.

What makes you think this? _____

_____

_____

1. Look at the diagram of the hand in the **green** print out. Count the number of bones present in the thumb, fingers, palm and wrist (they are shaded in different ways in the diagram to help you.) Record your counts on Table #1.
2. Look at the diagram of the foot on the **blue** print out. Count the number of bones present in the big toe, other toes, center of the foot, ankle and heel. Record data in Table #1.
3. Count all the bones in the hand and all the bones in the foot and enter these numbers in Table #1.

TABLE #1. Bone count comparison between a human hand and a foot.

BONE COUNTS				
Hand	**Number of bones in…**		**Foot**	**Number of bones in…**
The thumb			**The big toe**	
All other fingers			**All other toes**	
Palm of hand			**Center of foot**	
Wrist			**Ankle and heel**	
TOTAL			**TOTAL**	

For the following measurements, round numbers to the nearest 10^{th}, or millimeter. All these results will be recorded on Table #2.

4. Measure in millimeters the lengths of the bones marked A, B, C, D, and E on the **hand** diagram. Record your measurements in Table #2.

5. Measure in millimeters the lengths of the bones marked A, B, C, D, and E on the **foot** diagram. Record your measurements in Table #2.

6. Measure the length of the thumb and record the number in Table #2.

7. Measure the length of the big toe and record the number in Table #2.

8. Measure the lengths of the smallest finger and toe and record the number in Table #2.

9. Change all the millimeter measurements to centimeter measurements in Table #2. Remember: there are ten millimeters in one centimeter (1 cm = 10 mm).

TABLE #2. Bone length comparison between fingers and toes.

BONE LENGTHS				
BONE	**HAND**		**FOOT**	
	MILLIMETERS	**CENTIMETERS**	**MILLIMETERS**	**CENTIMETERS**
Bone A				
Bone B				
Bone C				
Bone D				
Bone E				
Length of thumb or big toe				
Length of smallest finger or toe				

Question #1. Complete the Venn diagram below. Find some characteristics that are *unique* to the hand and foot, and others that they have in common.

1. _____
2. _____
3. _____
4. _____
5. _____

1. _____
2. _____
3. _____
4. _____
5. _____

1. _____
2. _____
3. _____
4. _____
5. _____

Question #2. Using the information in your data tables, describe the main differences between the lengths of the bones in the hand and the foot.

_____

_____

_____

_____

_____

Question #3. Why do you think feet are larger than hands in humans?

_____

_____

_____

_____

_____

Part 2. Humans and Another Species

In Biology, 'the great apes' include orangutans, bonobos, gorillas, chimpanzees and humans. They are all in the family *Hominidae* because in the distant past they all shared an ancestor. We all still have many features in common in spite of the obvious differences among us.

http://theadvancedapes.com/201328great-ape-and-human-genetic-diversity/

For this part of the Lab you will need to use the **yellow** handouts. Return the green and blue handouts to your teacher. Exchange them for the two yellow pages. Locate the 3 diagrams that you will be working with at about the same time (the large yellow handout is double sided):

a. Large size yellow handout. Side A: Disarticulated orangutan hand
   Side B: Print of an orangutan hand
b. Half-page yellow handout. Disarticulated human hand

1. Look at **Side A** in the long, yellow handout. You will use this printout to complete the information requested in Table #3.
2. Fill out the rest of Table #3 using the small yellow handout with the disarticulated human hand.

   Predict: Which hand do you think is made up of more bones: the human hand or the orangutan's hand?

   _____

TABLE #3. Comparison of a human and orangutan hand.

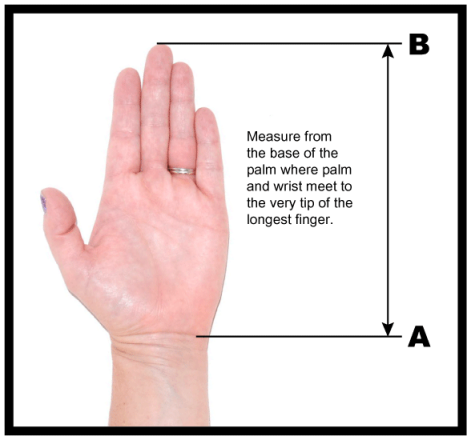
How many fingers are in the orangutan hand?_____

How many fingers are in the human hand? _____

ORANGUTAN HAND		HUMAN HAND	
Number of bones in the thumb		**Number of bones in the thumb**	
Number of bones in the other fingers		**Number of bones in the other fingers**	
Number of bones in the rest of the hand		**Number of bones in the rest of the hand**	
Total number of bones in the hand		**Total number of bones in the hand**	

3. Using centimeters, measure the length of your own hand from the base of your palm, to the tip of the longest finger. See the picture on the side for reference. Enter this information in the space below.

   Length of your hand: _____



4. Locate the print of the orangutan hand on **Side B** in the long yellow handout. Using centimeters and following the same procedure you did for #3, measure the length of the orangutan hand. Enter this information in the space below.

   Length of the orangutan hand: _____

   How many centimeters *longer* is the orangutan hand? _____

Question #4. How do the hands of humans and orangutans compare to each other?

_____

_____

_____

_____

_____

Question #5. Which of these findings surprised you and why?

_____

_____

_____

_____

Question #6. The number of bones in the foot of a gorilla is the same as in humans and chimpanzees. Suggest why species that seem so different could share these similarities.

_____

_____

_____

_____

Question #7. The number of bones in the neck of a giraffe is the same as the number of bones in the neck of a human: each one has 7 vertebrae. Yet the giraffe is so much taller than a man. The average length of **each** the giraffe neck vertebrae is about 25 cm. The **total** length of the human neck is about 11 cm. How much longer than the average human neck is the neck of the giraffe? Show your work and use the proper unit.

_____

What is the average length of the vertebrae in the human neck?

_____

Question #8. Look at this chart of Fast Facts with general information about the giraffe. What is one characteristic we share with giraffes that could explain why both species have the same number of vertebrae in the neck? Use a complete sentence to answer this question.

Fast Facts

Type: Mammal

Diet: Herbivore

Average life span in the wild: 25 years

Size: 14 to 19 ft (4 to 6 m)

Weight: 1,750 to 2,800 lbs (794 to 1,270 kg)

Size relative to a 6-ft (2-m) man:

_____

_____

_____

Question #9. The length of a human hand with all fingers extended is exactly the same as the length of the person's face. How long is your face?

_____

ORANGUTANS

Once widespread throughout the forests of Asia, orangutans are now found on just two islands, Sumatra and Borneo. They are now highly endangered due to habitat loss and poaching.

Orangutans are the largest of all arboreal (tree-dwelling) animals. The males can reach 1.5 m and the females about 1.06 m. Males can weigh up to 140 kg, but the females only reach about half of that. Equipped with very long, powerful arms and hook-shaped hands and feet, these apes climb and swing from tree to tree with ease.

They reach from one tree to the next with their long arms, grasping the next branch with long hands or feet, and swing their bodies across the gap. If a baby following its mother reaches a gap between trees that is too wide for it to navigate, its mother makes a living bridge for the baby to scamper across. An orangutan's arm span can reach more than 2.5 m!

Orangutans find their food in the trees where they live. More than half their diet consists of fruit. They also eat nuts, bark, and other parts of plants and trees. Every once in a while they eat insects such as ants and termites, as well as bird eggs. Orangutans even find the water they need for drinking up in the trees—in hollows, on leaves, or even on their own fur after a rain.

Trees are essential to every aspect of the orangutans' world. The cutting down of trees—*deforestation*—has landed this species on the endangered species list.

(adapted from **National Geographic Kids** and **SOS – Sumatran Orangutan Society.**)

What advantages do long arms and hands give orangutans?

Sophia, a 27 year-old Bornean orangutan, holds her newborn in her enclosure at Brookfield Zoo in Illinois, on October 23, 2008. The female infant was one of only two orangutan births expected in North American zoos that year. There are an estimated 61,000 orangutans remaining in the wild, a 50 percent decline since 1990. (www.zimbio.com).

Metric System Practice

Obtain the laminated pieces of paper from various lengths from your teacher. You need to have 6 pieces all together. Organize them in the following order, writing the color of the corresponding piece next to the right length. You do NOT need to use a ruler for this part. Each color represents a letter. Record the color and the corresponding letter below. What does it spell?

_____

	Color:	Letter:
1. The piece with a length of 34 cm	_____	_____
2. The piece with a length of 29 cm	_____	_____
3. The piece with a length of 290 mm	_____	_____
4. The piece with a length of 21 cm	_____	_____
5. The piece with a length of 100 mm	_____	_____
6. The piece with a length of 9 cm	_____	_____

Make the conversions below:

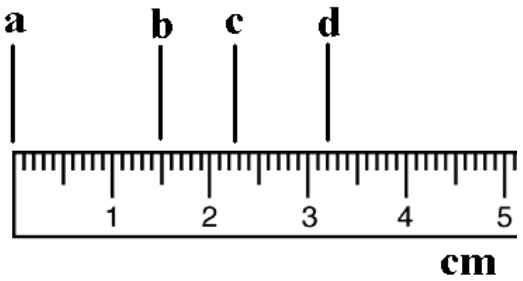
1 m = _____ cm	**1 cm = _____ mm**	**1 m = _____ mm**
99 cm = _____ mm	25 mm=_____ cm	4.9 cm=_____ mm
21 cm =_____ mm	80 mm=_____ cm	5.7 cm=_____ mm
320 cm=_____ mm	100 mm=_____ cm	140 mm =_____cm

On the sample ruler below, what measurements are represented by the letters b, c and d? BE CAREFUL WITH THE UNITS REQUIRED!

b = _____ cm

c = _____ cm

d = _____ mm



Inferring Height from Humerus Length

Work with a partner. Measure each other using meter sticks, and write your partner's height here:

_____ cm.

1. Identify the placement of your partner's humerus bone. It is the single large bone that extends from the elbow to the shoulder socket.
2. Use a meter stick or measuring tape to determine the approximate length of this bone (in centimeters). Write it down here:

   _____ cm.

   If the bone comes from a **female** subject, go to **Step 3**. If the bone comes from a **male** subject, go to **Step 4**.
3. If the bone comes from a **female**, multiply the measured length in centimeters by 3.06.

   Add 64.26 to this number. This final number is the approximate height of the female based upon her humerus length. If your partner is female, enter her estimated height here:

   _____ cm.
4. If the bone comes from a **male** subject, multiply the measured length in centimeters by 3.27.

   Add 59.41 to this number. This final number is the approximate height of the male based upon his humerus length. If your partner is male, enter his estimated height here:

   _____ cm.
5. Compare your partner's actual height (the number you wrote at the beginning) with their estimated height (the number that you wrote on #3 if female; or #4 if male).

Partner's actual height: _____ Partner's estimated height: _____

Explain why there might be differences between these two numbers.

_____

_____

_____

_____

_____

Next, your teacher will have different groups measure the humerus of the arm model in this lab.

Obtain the length and write it here: _____.

Assuming that this was a male, what was the height of the original person? _____.
REMEMBER TO WRITE THE CORRECT UNIT!

Metric Scavenger Hunt

1. Find the items listed below, checking them off as you go. Do NOT use any measuring equipment! Do your best to estimate. You will not lose points if you are off. Ask your team members if you are in doubt!

2. When you are done collecting these items, measure all your specimens and write down their actual size. How close were you?

☐ Blade of grass that is 6 cm long	Actual length?_____
☐ Coin with a diameter of 24 mm	Actual diameter?_____
☐ Piece of paper that is 28 cm long	Actual length?_____
☐ Pine cone with a mass of 14 g	Actual mass?_____
☐ Stick with a mass of 1.5 g	Actual mass?_____
☐ 20 ml of water	Actual volume?_____
☐ Rock with a volume of 5 ml	Actual volume?_____
☐ Water with a temperature of 23˚C	Actual temperature?_____