

PowerPlay

POST-VISIT

Human Body Ratios

6

Students practice estimating and measuring in metric units, and investigate the concepts of ratio and proportion as they relate to features of the human body.

TIME

One or two 45-minute class periods

M A T E R I A L S

PER STUDENT

- Student worksheets
- Metric tape measure
- Small mirror

Measuring, an essential skill for all students, is the focus of this Children's Museum of Houston's PowerPlay station (www.cmhouston.org/powerplay), which allows individuals to measure their height and weight. In addition to completing the station, students are encouraged to track changes in their height and weight over time by logging into their own private, web-based PowerPlay accounts (www.powerplay-houston.org).

Have you ever heard the sayings, "Once around the waist, twice around the neck," or "Once around the neck, twice

around the wrist?" In this activity, students will investigate simple proportional relationships among the measurements of various body parts. For example, consider the following correlations for an average adult (may vary somewhat for children).

- Total height is equivalent to 7 to 7.5 heads tall
- Nose length is equivalent to first two digits of index/pointer finger

- Head is approximately four to five eyes wide
- Length of face is equal to length of hand
- Eyes are separated by one eye's width
- Bottom of nose to outside corner of eye is equal to length of ear
- Length of foot is equal to length of forearm
- Waist to neck ratio is 1 to 2 (waist is twice the circumference of the neck)
- Neck to wrist ratio is 1 to 2 (neck is twice the circumference of the wrist)

ENGAGE

1. Ask students, *How long is your foot? Did you know there is a way to estimate this length without even looking at your foot? Does anyone know the secret?*
2. Call a volunteer student to the front of the room. Measure the length of that student's forearm. Then instruct each student measure his/her own forearm in the same way.
3. Have students compare their forearm measurements to the heel-to-toe length of one of their feet. The two measurements should be very close.
4. Ask students if they think other body parts might have similar sizes, or if there might be other predictable ratios between the sizes of different body parts. Mention that students will investigate a number of body measurements and determine some possible relationships among them.

EXPLORE

1. Before beginning, review with the class how to use a tape measure.
2. Distribute the "Estimates and Measures" student sheet. Have each



BCM
Baylor
College of
Medicine

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

3.2.B; 4.2.B; 5.2.B

Students collect data by observing and measuring using the metric system and recognize differences between observed and measured data.

- student estimate his or her height in centimeters and record that number on the first line in the “Estimate” column. Next, instruct students use a tape measure to measure their height accurately and record that number on the appropriate line in the “Actual” column.
- Have students estimate, then measure the next body dimension (arm span) listed on the student data sheet. Students should continue in this manner until all measurements are completed.
 - Direct students to look for patterns and relationships among their measurements. For instance, ask, *How does the length of your nose compare with the width of the first two digits of your pointer finger?*

EXPLAIN

- Ask, *Did the estimates you recorded for the size of each body part become more accurate as you continued making measurements? Why might this be the case?*
- Ask students if any of their measurements are equal, half, double, or 1.5 times the length of any of the other measurements. (For example, the length of most people’s foot is equal to the length of their forearm.) *If so, what are they?*
- Have the class form student groups of 4. Have each group calculate and record the average measurement of each body part for their group in the “Group Average” column and then compare the team average to individual measurements.

ELABORATE

- Distribute the “Human Body Ratios” student sheet. Have students use information from the “Actual” column in the “Estimates and Measures” student sheet to complete column one.
- Ask students if they notice measurement patterns and relationships that are common to all groups.

EVALUATE

- At 2.72 meters (8 ft, 11 in.) in height, Robert Pershing Wadlow was the tallest man in recorded history. Ask students, *Based on the relationship of one body part to another on your completed “Human Body Ratios” sheet, what would his estimated arm span and head size be?*
- Ask students if they ever have heard the old saying, “Once around the waist, twice around the neck; once around the neck, twice around the wrist.” Have them determine if this statement is true for themselves and other members of their groups.

Funded by a Science Education Partnership Award (SEPA) R25RR022697, from the National Center for Research Resources, a component of the National Institutes of Health.

The activities described herein are intended for school-age children under direct supervision of adults. The authors, Baylor College of Medicine, the Children’s Museum of Houston and funders cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.



ESTIMATES AND MEASURES

Name: _____

Individual Estimates and Measures (in centimeters)

1. Estimate the measurements of different parts of your body and record them in the "Estimate" column below.
2. Use a tape measure to determine the actual measurements of the same body parts. Record the numbers in the "Actual" column.

ITEM	ESTIMATE (in cm)	ACTUAL (in cm)	GROUP AVERAGE (in cm)
Total height			
Arm span			
Length of head (from crown to base)			
Length of nose			
Length of first two digits of pointer finger			
Width of eye			
Width of head			
Distance between eyes			
Distance from bottom of nose to outside corner of eye			
Length of ear			
Length of foot			
Length of face (from hairline to chin)			
Length of hand			
Waist circumference (distance around)			
Neck circumference			
Wrist circumference			

Group Averages (in centimeters)

Calculate the average measurement of each body part for your entire group. Record your results in the "Group Average" column. Do you see any common measurement patterns or relationships?

MEASURING BODY PARTS

Total height: Have a partner measure from the bottom of the foot to the top of the head.

Arm span: With arms spread out, measure the distance between the fingertips.

Height of head: Measure from the bottom of the chin to the top of the head.

Length of top two digits index/pointer finger: Measure from the fingertip to the second line (joint).

Eye width: Measure from corner to corner.

Head width: Measure across from ear to ear (not the distance around the head).

Distance between eyes: Measure from the inside corner of both eyes.

Length of hand: Measure from the top of the wrist to the fingertips.

Circumference: Measure the distance around a circular object, such as a person's waist, neck or wrist.



HUMAN BODY RATIOS

Name: _____

- Use the actual measurements from your “Estimates and Measures” page to complete the list below. The value for each item listed in the left column below is equal to “1.” The answer given for the first item is “2,” because the circumference of the neck is twice the circumference of the wrist (or a ratio of 1 to 2).

Neck circumference = 2 **Wrist circumference**

Total height = _____ Length of head (from crown to base)

Total height = _____ Arm span

Length of nose = _____ Length of first two digits of pointer finger

Width of head = _____ Width of eye

Length of face = _____ Length of hand

Width of eye = _____ Distance between eyes

Length of ear = _____ Distance from bottom of nose to outside corner of an eye

Length of foot = _____ Length of face (from hairline to chin)

Waist circumference = _____ Neck circumference

- Do you notice any patterns or relationships between each pair of measurements?

Teacher Tips

Follow these guidelines when your students visit the PowerPlay exhibit at the Children's Museum of Houston (CMH).

- Students must wear tennis shoes.
 - The CMH's PowerPlay exhibit is on three levels, connected by the Power Tower. Level 2 of the Power Tower is on the main entry level of the Museum. It is suggested that teachers have a chaperone on each level of the Power Tower or have a chaperone accompany each group.
 - An elevator for handicapped children is available (CMH guide will have key). It is suggested that you inform CMH officials about any special needs your students may have before you arrive at the museum.
 - Before your visit, help students understand the difference between heart rate while resting and after exertion, (see "Activity 3. Heart Rate and Exercise").
 - Also before your visit, explain to students that they will rate (on a 1–10 scale) the amount of effort they expend during some of the activities in the exhibit. This is known as "perceived exertion rate."
 - Ask the CMH guide for a "Kid Card" (Power Tracker) for each student. To set up a card, each student will need the information below before visiting the Museum (see "Kid Card" video). Please make sure your students are ready to enter the following information (or have a chaperone assist).
 - Username (numbers and letters only)
 - Password
 - Male or female
 - Birthday (numerical date)
 - E-mail (optional)
- As a final step, have students measure their baseline heart rates.

IDEAS FOR TEACHERS WITHOUT ACCESS TO THE CHILDREN'S MUSEUM OF HOUSTON

- Incorporate any of the lessons into your regular curriculum.
- Plan a special "field day" at your school. Prior to the event, conduct the Pre-visit lessons. After the event, use the Post-visit lessons.
- Create a classroom fitness plan that provides one month of activities. Help students plan a calendar with different fitness activities for each day.
- Participate in the President's Challenge for fitness (www.presidentschallenge.org).

Exhibit Key

	Cardiovascular	Strength	Flexibility	Balance
Power Tower: Climb, leap and jump in a 3-story climbing structure that takes you to other parts of PowerPlay.				
Dance Mania: Listen to music and follow along with different dance moves. Record your heart rate after you play.				
Match My Moves: Capture images of your own body in action and follow the poses you've set through a sequence of quick movements, testing your endurance and raising your heart rate.				
Light Chase: Race around an interactive game board, while increasing your speed and raising your heart rate.				
Jump It Up: Get your heart pumping as you jump over a glowing, virtual rope, which gets faster and faster the more you jump!				
Blast Off: Crank hand pedals as fast as you can to race flying superheroes across the exhibit.				
Adventure Course: Run through a course of climbing and crawling activities along padded, sloping surfaces! Slap each hand whacker along the way and record the level you achieve.				
Mt. Boulder: Face three challenges on a climbing wall and measure how far you've climbed, your grip strength, reach, flexibility and coordination.				
Grip It: Measure your grip strength and record this measurement using your Kid Card.				
Power Course: Grab a scoot and use your upper body strength to push or pull yourself along this wheelchair accessible course.				

© 2013 by Baylor College of Medicine
All rights reserved.
Printed in the United States of America.

ISBN: 978-1-888997-85-9

BioEdSM

**TEACHER RESOURCES FROM THE CENTER FOR EDUCATIONAL OUTREACH
AT BAYLOR COLLEGE OF MEDICINE**

CCIT The Center for Collaborative
and Interactive Technologies

The mark “BioEd” is a service mark of Baylor College of Medicine. The information contained in this publication is for educational purposes only and should in no way be taken to be the provision or practice of medical, nursing or professional healthcare advice or services. The information should not be considered complete and should not be used in place of a visit, call, consultation or advice of a physician or other health care provider. Call or see a physician or other health care provider promptly for any health care-related questions.

Development of PowerPlay educational materials was made possible by a Science Education Partnership Award (R25RR022697) from the National Center for Research Resources, National Institutes of Health. The activities described in this book are intended for school-age children under direct supervision of adults. The authors, Baylor College of Medicine (BCM), the Children’s Museum of Houston and the funding agency cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text. The opinions, findings and conclusions expressed in this publication are solely those of the authors and do not necessarily reflect the views of BCM, image contributors or the sponsoring agencies.

Cover photos and illustrations courtesy of the Children’s Museum of Houston.

Authors: Nancy P. Moreno, PhD, Barbara Z. Tharp, MS, and Sonia Rahmati Clayton, PhD

Designer: Martha S. Young, BFA

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support and guidance of William A. Thomson, PhD, BCM Center for Educational Outreach, and C. Michael Fordis, Jr., MD, BCM Center for Collaborative and Interactive Technologies.

No part of this book may be reproduced by any mechanical, photographic or electronic process, or in the form of an audio recording; nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use without prior written permission of the publisher. Black-line masters reproduced for classroom use are excepted.

Center for Educational Outreach, Baylor College of Medicine
One Baylor Plaza, BCM411, Houston, Texas 77030
713-798-8200 | 800-798-8244 | edoutreach@bcm.edu
<http://www.bioedonline.org> | <http://www.superstaar.org>

BCM[®]
Baylor College of Medicine



SEPA SCIENCE EDUCATION
PARTNERSHIP AWARD
Supported by the National Institutes of Health