

PowerPlay

PRE-VISIT

Gravity and Muscles

4

Students learn about the body's center of gravity, and how the body adjusts to the force of gravity to remain balanced.

TIME

10 minutes for set-up; 60 minutes to conduct activity

M A T E R I A L S

PER GROUP OF STUDENTS

- Light-weight chair or stool
- Copy of the "Balancing You" student sheet

Gravity places a heavy load on the human body. But good direction from the nervous system and coordination among muscles in the back, legs, ankles and feet enable us to counteract the downward pull of gravity and remain balanced and upright.

To balance itself, the body makes continual tiny corrections to maintain its center of gravity over the feet, an imaginary point within the body at which there is balance and from

where the weight on all sides is equal. Fortunately, the muscle adjustments necessary to maintain balance and posture are directed automatically by the nervous system.

The Children's Museum of Houston's PowerPlay exhibit is designed to reinforce healthy behaviors and help young people discover new ways to become more physically active. This activity will help students to begin understanding how one's "sense of balance" affects his/her ability to do physical

activities. It should be completed before students visit the Museum.

ENGAGE

1. Ask students, *Do you usually fall over when you're walking, riding a bicycle or standing on a bus? Why or why not?* Encourage students to think about how the body coordinates balance. Ask, *Do you need muscles to keep your balance? Would your skeletal system alone be able to keep you upright?*
2. Explain that students will investigate balance and stability while learning how living things use muscles and body position to maintain balance

EXPLORE

1. Ask students what our "center of gravity" is, and if it ever changes. Ask, *How do you keep yourself from falling when you trip? How do you maintain your balance when you're standing in a moving train or bus?* Tell students that they will be exploring their own centers of gravity in two different ways.
2. First, have students in each group take turns standing up from a seated position in their chairs, and then record the results on their data sheets. Ask, *How easy was it to stand up?* (very easy)
3. Have students try again to stand up from a seated position in a chair. This time, however, have them do so without leaning forward. Once again, students should record their results.
4. Next, instruct one student to stand with feet shoulder-width apart. Have a second student place a lightweight chair 15 cm in front of the first

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.

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

Students investigate the effects of gravity

HEALTH

3.1.A; 4.1.F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risks throughout their lifespan.

BCM
Baylor
College of
Medicine

- student. Instruct the first student to try to pick up the chair and then record his/her results. Then have students switch roles and repeat the process.
- Tell students to move to the periphery of the room and place their heels, hips, back and shoulders against the wall, and keep their feet flat on the floor. Have students take turns attempting to pick up the chair. They should record their results.

EXPLAIN

- Discuss students' results, and ask the class to identify the differences between the two trials of each experiment. Ask, *Why do you think it was not possible to stand up when you didn't move your shoulders? Why was it impossible to pick up the chair while you were standing against the wall?* Help students understand that in both cases, needed changes in balance could not be made because their body movements were limited.
- Discuss gravity again. Ask, *Does gravity affect people? Do people have a center of gravity? Have you ever observed changes in a person's center of gravity?*
- Have students think about where their centers of gravity are when they are sitting in chairs, and how things change when they begin to stand up. As their weight shifts from their seats to their feet, their centers of gravity must change also.
- Have students consider where their centers of gravity are when they lift a chair. The chair adds weight to the body, which must then compensate for that weight by moving the center of gravity.
- The body changes the center of gravity and achieves balance by moving the hips backward. This is why students were unable to pick up a chair when their backs were against a wall.

- Have students repeat these two experiments, this time paying close attention to their partners' body movements.

ELABORATE

- The body and muscles constantly adjust to compensate for the pull of gravity. Some of the adjustments are large, like those made when we pick up a chair, but many are very subtle, almost unnoticeable.
- Have students work in pairs. Each student should observe the movements of his or her partner as he/she performs certain tasks, such as moving from a two-footed stance to standing on one foot, walking heel-to-toe, squatting, or standing on tip-toes.

EVALUATE

- Tell students to imagine a person standing in the aisle of a subway or bus, with nothing to hold on to.
- Have student groups discuss and describe what would happen to the passenger when the vehicle begins to move, comes to a stop, or turns a right-hand corner. Without finding something to hold on to, how could the person keep from falling down?
- Students should realize that the passenger could spread his/her feet out to keep from falling over. Ask, *What does this movement accomplish?* (It widens the person's "base" and adjusts his/her center of gravity.)

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.



BALANCING YOU

Experiment 1: From a sitting position

1. Sit in a chair and try to rise to a standing position. Switch places so your partner also can try. Record your results in the box next to Question "A," right.
2. Again, sit in a chair and try to rise to a standing position, but this time, do not let your shoulders move forward. Switch places with your partner so he or she can try. Record your results in the box next to Question "B," above.

EXPERIMENT 1	RESULTS
A. Stand up from a seated position.	
B. Stand up from a seated position (without leaning forward).	

Experiment 2: From a standing position

3. Stand up straight and have your partner place a chair 15 cm in front of you. Try to pick up the chair. Switch places so your partner can try, and then record your results in the box next to Question "C," right.
4. Repeat Step 3, but this time, stand with your heels, hips, back and shoulders flat against a wall. Then let your partner try it. Record your results in the box next to Question "D," above.

EXPERIMENT 2	RESULTS
C. While standing, pick up a chair.	
D. While standing with heels, hips, back and shoulders flat against the wall, pick up a chair.	

5. What happened during parts B and D?
6. Did you expect this result? Why or why not?

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