Mr. and Miss Big Feet

Science Standard IV

Objective 2

Connections

Standard IV:

Students will understand that objects near Earth are pulled toward Earth by gravity.

Objective 2:

Identify the effect of gravity on the motion of an object.

Intended Learning Outcomes:

1. Use Science Process and Thinking skills
2. Manifest Scientific Attitudes and Interests
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:

Math IV-2; Solve problems involving measurement.

Background Information

Gravity is affected by the magnitude or size of the gravitational force between two objects. It also depends on the masses and distance between them. A larger mass means a stronger gravity, and a shorter distance between objects also means stronger gravity. Gravity accelerates all objects at a constant rate. For example if a penny and a piano were dropped from a tall building at the same time, ignoring friction from the air, they would fall to earth at the same time.

- The force of gravity has an effect on all kinds of matter.
- The force of gravity acts from a distance.
- Gravity is only a one-way force.
- For us on Earth, gravity attracts all objects to at the center of Earth
- Inertia is the resistance to any change in motion.
- Gravity pulls in a path that is straight toward the center of the earth.

Information on *Weighty Wheels*, Ramp for the Matchbox cars—you can use several things to make your ramps, but whatever you choose to use, the track needs to have sides so the cars do not fall off. The track needs to be strong enough so it does not bend. Take a piece of posterboard and put a yard stick on the top of it, bend and then cut the ends so it is wrapped around the posterboard, and tape the edges down so it is securely around the yard stick. If you use this track, be careful not to put too much tape, you do not want bumps on the ramp where the car is going down. You can also buy wood, such as pine, cut into three to four feet lengths about a 3/4 to one inch thick and about

one inch wide approximately just wide enough to fit a Matchbox car. Another possibility is finding the Matchbox ramps that are designed for use with the cars. It is perfect because it fits the car snugly. Any one of these options work, it all depends on what you have available. Door screen trimming also works well for a ramp. It comes in approximately nine foot lengths and can be cut in half to use with students.

A few days before the activity, you want to ask the students to bring in a Matchbox car. Some students will bring them in but have some extras available for those students who do not have them.

Research Basis

Tobin, K. (1987) *the role of wait time in higher cognitive level learning, review of educational research.* JSTOR

Wait time is the duration of pauses separating utterances during oral interaction with the teacher and students. This article states the importance of the wait time. When wait time is greater than three seconds, changes in teacher and student discussions were observed and higher cognitive level achievement was obtained in elementary, middle, and high school science. Wait time appears to facilitate high cognitive level learning by providing teachers and student with additional time to think, thus allowing students to cognitively think about the processes asked of them by the teacher.

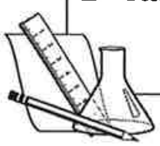
Huary, D. (1993). *Assessing student performance in science, ERIC source.* Retrieved January 27, 2007, from htttp://www.stemworks.org/digests/dse93-8.html

The article discusses how assessment is changing in science education. Assessment in this context must be inconspicuous. It needs to be tailored to measure specific learning outcomes. Assessment is more than testing, multiple choice, short answer, etc., it includes such techniques as systematic teacher observation and so-called "authentic" assessment, in which the tasks assessed more closely parallel the learning activities and outcomes that are desirable in the science classroom (Kober, 1993). Assessment should be context dependent; reflect the nature of the subject matter; and address the unique cultural aspects of class, school, and community among culturally diverse populations (Tippins & Dana, 1992). The article talks about the new assessment that many teachers are using. Among the most promising techniques is the use of scoring rubrics, and students knowing how to achieve the highest level of mastery. Another new assessment is the use of portfolios; these assemble evidence of skill attainment. Some other assessment tools are concept mapping, journal writing (techniques are used to document conceptual change among students), and student presentation and interview techniques (which allow learners to communicate their understanding in ways that rely less on reading and writing skills).

Invitation to Learn

Materials

- ❑ 12 oz plastic cup
- ❑ Science journal



Ask students to find a place in the classroom where they can stand with their backs up against a wall. If it is problem in your classroom, take them in the hall or somewhere where they can do this activity. Make sure each student has their heels back against the wall. Next set a plastic cup about 20 cm from one of the students' feet. Then ask the student to pick up the cup without bending their knees. Before they perform this activity have them predict, in their journals or orally, what they think will happen. Will they be able to pick up the cup? It is impossible to do. They almost want to fall over. Then have the students move away from the wall about a foot or so and try it again. This time the students should be able to pick up the cup without bending their knees. They can do this because as they push with their back sides away from the wall it keeps their center of gravity right in the center of their bodies.

After this activity ask the students what was happening. Have them answer this question in their science journals or orally.

Responses should be close to or equal to these: the more I lean the more I felt I was going to fall over. I couldn't bend because I was too close to the wall. When I was away from the wall I picked up the cup easily. Have them share their responses with the whole class.

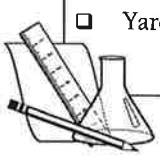
Background info for teacher: The reason this activity works is because the body's center of gravity.

This all has to do with the center of gravity. In order for us to pick something up, the legs and lower body have to move backwards. In order to stay balanced, the center of gravity of our body has to remain above our feet which is the pivot point supporting our body. So staying straight with your back against the wall made it impossible for you to move your lower part of your body backward, forward bending of the upper body shifts the body center of gravity toward the front of the pivot point and the whole body topples or moves forward.

Or in technical terms: center of gravity is the point where an object balances and where all the weight of an object appears to be located.

Materials

- ❑ Science journal
- ❑ Car ramp
- ❑ Matchbox cars
- ❑ Weights/washers
- ❑ Tape
- ❑ Scissors
- ❑ *Weighty Wheels*
- ❑ Tape measure
- ❑ Yard sticks



Instructional Procedures

Weighty Wheels

This activity needs to be done in an area where the cars can move forward freely, such as a gym, a hall or outside as long as the area is flat without any obstacles in the way. A classroom would probably be too small; you want the cars to move freely. Each team will have one car. You can choose how you want to make your groups.

1. Tell the students that they will be working with a group of other students. They will have a Matchbox car. They will take this car and run it on a ramp. Each time they take a run they will add more weight to the car. Then they will measure the distance their car went. Then each time they will add more weight. Then they will take the information from each run and record the distance traveled. They will use the recording page, *Weighty Wheels Record Sheet,* to write down the distance the car traveled and how much weight was added. Then they will take their information and make a bar graph with their data, following up with a class discussion on their findings. They will also take the median of all three of runs. Teach them how to get a median before you go ahead with the activity. You may have already taught this math concept so perhaps review with the students how to do this. Now model for the students the above, making sure they know how to load their car with weights. If you use any of the ramps above that need to be made, you will want to have them pre-made before you start this activity.
2. Put the students in teams of three to four and assign cooperative roles such as leader, scribe, reporter and materials manager. Give them the record sheet, *Weighty Wheels* and tape measure to measure the distance. Before they start their first run, tell them to write a prediction before each run of the weighted car. So they should have four predictions, first one with no weight, second with one washer, third with two washers, and third with three washers.
3. Have the students begin their task. Students should hold one end of their ramps at 30 cm off the floor. This can easily be accomplished by placing the end of ramp on the top of a 30 cm ruler. Walk around the room monitoring their activity. You can pose questions about some of their predictions, why they thought that, or how did they come up with that information, etc.

4. Once everyone has finished their task bring the students back as a whole class.

Make a large table like the one shown below on the board or chart, have each team report their median distance for each weight. Record their results on the table.

Team Number	No Washers	1 Washer	2 Washer	3 Washer
Median Distance				

5. Which team's car went the furthest? The one with no weight or the one with the most weight?

   Whose car went the shortest distance? Why? As you are going over the class graph, keep asking questions about the activity.
6. On the board or the overhead make a bar graph of the median distance for each weight for the whole class. Have students make the graph in their journals.
7. Lastly, have the students write a reflection about the activity. Also have them answer the questions that you asked earlier.

Assessment Suggestions

- Science Journals
- Discussion Questions
- Graphing Page, *Weighty Wheels*
- *Artificial Gravity Activity*

Curriculum Extensions/Adaptations/ Integration

- Take the same ramps, but use balls instead, use different types of balls and see which ball will roll the furthest distance, then graph the results.
- Pair special needs students with a student who can help them through the activity, as we call it in my classroom, Pair Buds, usually have the same students working together for several projects for assignments. That way the special needs students feel more comfortable with that person and they trust them, but

I switch after a few projects so the paired student can work with others and they do not feel like always being the leader.

- Sing the Song "Gravity" sung to the tune "London Bridges Falling Down."
- Students write a story explaining what would happen if there wasn't any gravity on earth.
- Have students go to http://www.pbs.org/wgbh/nova/pisa/galileo.html where they can do activities like Galileo did when he was learning about gravity.
- Go to http://www.sunblock99.org.uk/sb99/people/RWalsh/gravity/grav1.html and find out what your weight is on other planets.

Family Connections

- Students do the invitation to learn activity with their families, explaining what they learned about gravity.

Additional Resources

Books

101 Science Poems & Songs for Young Learners, by Meish Goldish

The Science Book of Gravity, by Neil Ardley; ISBN 01520062104

Physics for Every Kid, by Janice Van Cleave; ISBN 0471542849

Media

Gravity is Attractive, by Science FUNdamentals Item #70962902524

Squibs DVD In Force, Gravity and Friction ASIN: B000BJNUKM

Web sites

http://en.wikipedia.org/wiki/Gravity

http://www.uen.org/3-6interactives/science.shtml

http://www.bbc.co.uk/schools/gcsebitesize/physics/earthbeyond/universerev2.shtml

http://www.sunblock99.org.uk/sb99/people/RWalsh/gravity/grav1.html

Weighty Wheels Recording Sheet

Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Weighty Wheels Recording Sheet

Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Artificial Gravity

What You Need

2 paper plates	1 ruler	1 large bead
1 stick	1 scissors	8 pieces of tape

What You Do

1. First, build your space station. Mark the center of both paper plates. Poke a hole with the stick through the center of each plate.
2. Mark a circle on one paper plate about one inch from the edge. Also draw two lines

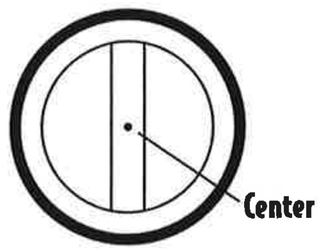


Figure 1

through the middle of that plate about one inch apart as shown in Figure 1.

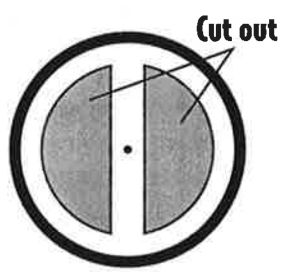


Figure 2

3. Cut out the shaded areas shown above in Figure 2 on just one plate.
4. Put one paper plate upside down on top of the other plate. Tape the edges together in

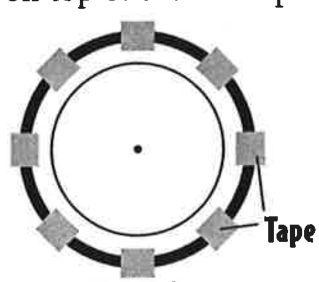


Figure 3

eight places as shown in Figure 3.

5. Put the stick through the two holes in the center and practice spinning your space station while your partner holds the stick.

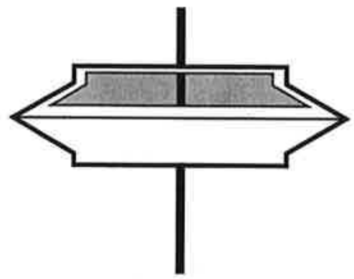


Figure 4

6. Hold your space station so the cut open part of it is facing up. Put the bead in near the middle. We will pretend the bead is an astronaut.

7. Spin your space station and write down what happens to the astronaut. (If the astronaut falls out, put her or him back in and try again. Try spinning a little slower.)

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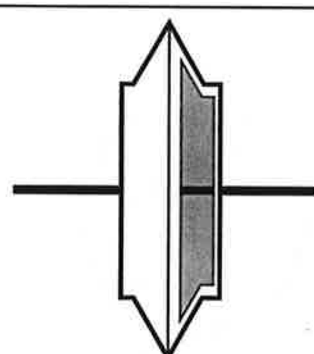

Figure 5

8. What do you think will happen to the astronaut if you tip the space station like in Figure 5 while it is spinning?

9. Try spinning the space station again. While one partner keeps the space station spinning, the other partner should tip the stick. What happens to the astronaut?

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Think About It

When the space station was spinning, we created artificial gravity that kept the astronaut from falling out. Which direction is "down" for your astronaut?

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