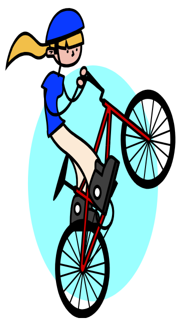
SOARING WITH NEWTON

Guiding Question 5 Activities



Purpose: **To explore and discover Newton's three laws of motion**

Note: **The following activities are used in class by the teacher to demonstrate Newton's laws. Later students are given an opportunity to experience Newton's laws during a whole class activity called "Soaring With Newton". This activity can be done on a smaller scale in the classroom or on a larger scale in the gym. One activity must be done outdoors. The teacher should select the activities that would best suit her/his situation.**

Procedure:

1. **Select the activities that best suit your classroom.**
2. **Arrange your room in a way that will allow students to move about from station to station with ease.**
3. **At each station, set up a demonstration for one of Newton's laws. Provide all of the equipment needed and in addition be certain to include lesson sheets for each student.**

4, Students will perform the experiment, fill in the lesson sheet and continue on to the next station. Once the students have completed all lessons they turn them in to the teacher.

NEWTON'S FIRST LAW OF MOTION

Demonstrating Inertia

Station a:

Step 1: Place an 8 ounce glass on the table

Step 2: Lay a flat playing card on top of the glass. Place a coin in the center of the card.

Step 3: Using either a flicking motion or a pulling motion of your fingers, quickly remove the card so it flies out from under the coin. Can you remove the card fast enough so the coin lands in the glass?

Questions:

1. How does this activity demonstrate inertia?
2. What happens to the coin if you remove the card slowly?

Station b:

Step 1: Place a narrow necked bottle or vase on the table. Be certain the opening is wide enough to allow a 1 inch piece of chalk to pass through.

Step 2: Balance a wooden hoop (12 inches in diameter and 3/4 inches wide) upright on top of the bottle. The size of the hoop can be changed. In fact you might have several hoops for students to try.

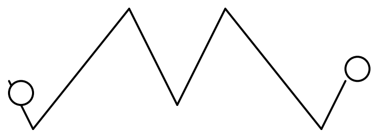
Step 3: Carefully balance a small piece of chalk on the top of the hoop. Be certain the chalk lies directly above the opening of the bottle.

Step 4: Using a quick sweeping motion pull or push the hoop from the top of the bottle. (If this is done quickly the chalk should fall straight down into the bottle.)

Questions:

1. How does this activity demonstrate inertia?
2. What happens to the chalk when you removed the hoop?

Station c:



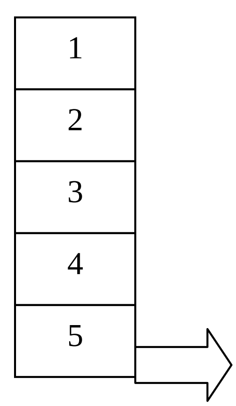
Step 1: Bend a stiff piece of wire into the shape seen above.
Step 2: Using two sticks of modeling clay, fashion two spheres of clay around each end of the wire.
Step 3: Balance the center point of the wire on the top of your head. Make sure only the center point touches the head. Spin around. What happens?
Questions:

1. **What happens to the wire and clay as you spin around?**
2. **What holds the wire and clay in one spot as you spin around?**
3. **What happens when you spin slowly?**

Station d:

Step 1. Stack 5 blocks one upon the other on a table.
Step 2. Using a ruler strike the lowest block abruptly. What happens to the remaining blocks?
Step 3. Continue striking the blocks until only one remains.
Step 4. Restack the blocks and then exert a slow, steady push of the ruler against the bottom block.
Questions:

1. **What happened to the blocks in step 2?**
2. **What happened to the blocks in step 4?**
3. **Explain the difference in the motion.**



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NEWTON'S SECOND LAW OF MOTION

Demonstrating that force is a push or pull on an object. In equation form: force equals mass times acceleration (F=ma).

Station e:

Equipment required for this activity includes:

- **1 cart on wheels (possibly a cart used to transport equipment such as a television or a wheel barrow)**
- **1 pair of adjustable roller skates (the type clamped onto the shoes) or a skateboard. This can be excluded if needed.**
- **Mass (Possibly a box of computer paper)**
- **Open space to roll the cart**
- **Scale for weighing student, mass, and cart**

Procedure:

1. **Weigh and record the weight of the cart on your activity sheet.**
2. **Weigh and record the weight of the mass on your activity sheet.**
3. **Weigh and record the weight of the student on your activity sheet.**
4. **Place the mass on the cart.**
5. **If using skates, put on the skates.**
6. **Student should push on the cart and record what happens to the cart on the activity sheet.**
7. **Remove the mass from the cart and student should again push on the cart. Record what happens to the cart.**

Questions:

1. **Which had more mass, the cart with its load or the student?**

2. **Why should the student be on wheels? Why should the cart be on wheels?**
3. **How did the change in mass affect the acceleration of the cart?**
4. **What would you change so that the student, not the cart, would move?**
5. **Do you think wheels would help SuitSat2?**

NEWTON'S THIRD LAW OF MOTION

Demonstrating that for every action, there is an equal and opposite reaction. During the launch of a rocket the fuel is ignited, pressure builds up, and the thrust from the escaping fuel leads to an imbalance of forces which cause an action. The burnt fuel pushes out toward the ground and the reaction is the rocket being pushed in the opposite direction.

Station f:

Materials needed:

- **Several long balloons (8 inch size works)**
- **Fishing line or thin string**
- **Large straws**
- **Masking tape**

Procedure:

Step 1: Tie one end of the string to a pole or a chair. Slip the straw through the string. Pull the string tight and tie it to a second pole or chair. The distance between the poles should measure at least six feet.

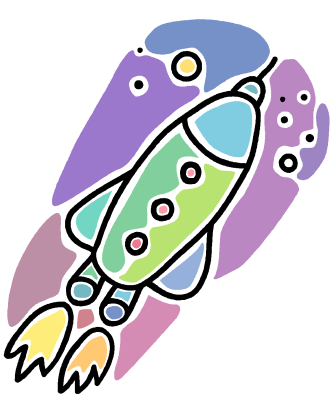
Step 2: Place two pieces of masking tape to the bottom of the straw and pull the straw to the starting point (close to one of the poles).

Step 3: Blow up one balloon and without tying it, use the masking tape to attach it to the straw while being careful not to allow air to escape from the balloon.
Step 4: Launch the rocket by releasing the balloon. Which way did the balloon go?

Note: At this point students could experiment with other balloons of various sizes. They could then determine if the size or shape of the balloon makes any difference in the distance the balloon travels. They might also try taping two balloons together in such a way that the balloon nearest the pole is positioned in such a way that it holds the next balloon closed keeping the air in it. Upon releasing one balloon it pushes both along the line and when it deflates it releases the air in the second balloon carrying it further down the line. This is an example of staging rockets.

Questions:

1. **Which way did your rocket balloon travel?**
2. **Did the size or shape of the balloon make any difference in the distance the balloon traveled?**
3. **If you tried the balloon staging, what happened when you released the first balloon?**
4. **How would SuitSat2 move differently if she were larger or smaller than she actually is?**



OUTDOOR ACTIVITIES:

Carbon Dioxide Rockets

Purpose: This activity will demonstrate Newton's Third Law of Motion through carbon dioxide powered rockets. Due to the nature of this activity, the building can be done in class however the launching of the rocket should be done outside. You can create the altitude tracking devices and measure the altitude the rocket reaches.

Materials
Plastic 35 mm film canister (with lids that attach on the inside of the canister-such as Fuji canisters)
½ effervescing antacid tablet per rocket launch
Paper rocket template
Paper (computer paper or notebook paper)
Scissors
Tape
Water
Paper towels
Eye protection (safety glasses)

Procedure:

1. **Cut out all the pieces for your rocket.**
2. **Wrap the paper around the film canister.**
   Important! Place the lid end of the canister down.
   Tape the paper rocket together
3. **Tape fins to your rocket body with the right angle of the fin perpendicular with the base of the rocket.**
4. **Roll the circle (with a wedge cut out) into a cone and tape it to the rocket's top.**
5. **Tape ½ effervescent tablet to top of film canister.**

6. **Fill film canister ½ full with water and place in the bottom of the rocket. Fit the lid on the canister and flip it over, standing the rocket on the base, with the top of the canister facing the floor. This will allow for the water and antacid to mix, creating carbon dioxide. The carbon dioxide will create pressure inside the tube and shoot the rocket.**
7. **Repeat steps 5 and 6 launching your rocket and measuring the altitude reached.**

This project should be done with another student. As the rocket is launched the second student will measure the altitude the rocket reaches.

Questions:

1. **Explain how the rocket worked.**
2. **Which of Newton's laws does the rocket demonstrate? Explain.**
3. **Tell us:**
   a. What was the highest altitude your rocket reached?
   b. How much fuel did you use for your rocket?
   c. What would you do to improve your rocket's performance?
4. **Explain why SuitSat2 didn't need a rocket to be launched from the International Space Station?**

STUDENT WORK SHEET

Name: ____________________ Date: __________

Class: ________

Station # ________

Name of activity: ________________________________

Observations:

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Data collected (if any):

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Answers to questions:

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