Children's Museum of Houston

Pre/Post Classroom Activities

Water Pressure Blaster

Rationale

FlowWorks gives visitors a chance to experiment with the power and properties of water. Through various inquiry-based explorations, visitors have the opportunity to examine transformations of energy (ex. potential to kinetic or even kinetic to electrical). Water's natural physical and chemical properties come to life as the exhibit simulates a variety of natural phenomena, such as vortices and rapids, as well as allows visitors to harness water's power through lock systems, boat building, and dams.

TEKS Objectives (Science)

3.1: The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices.
3.2: The student uses scientific inquiry methods during field and laboratory investigations.
3.3A: Justify an explanation, argument, or conclusion using student generated data.
3.4A: Collect, record, and analyze information using tools including meter sticks, metric rulers.
3.5B: Demonstrate liquids take the shape of their container.
3.6B: Demonstrate and observe that position and motion can be changed by pushing and pulling objects.

TEKS Objectives (Math)

3.1A: Use place value to compare and order whole numbers.
3.7: The student uses lists, tables, and charts to express patterns and relationships.
3.11A: Use linear measurement tools to estimate and measure lengths.
3.14: The student applies Grade 3 mathematics to solve problems connected to everyday experiences and activities in and outside of school.
3.15A: Explain and record observations.
3.16B: Justify why an answer is reasonable and explain the solution process.

Background

In this experiment, we are going to apply pressure to a water bottle (i.e. "push" on the water) to determine how the area of a hole affects the force of the water (which will be observed by measuring the distance the water sprays). Children will become familiar with the concept of pressure, its relationship to width/diameter of a stream or pipe and the associated force/rate of flow. This lesson relates to several areas of the *FlowWorks* exhibit where similar phenomena can be observed either as an introduction to the concept or as a follow-up exploration based on this experiment.

Vocabulary

Pressure – the amount of force being applied over an area or Pressure = Force ÷ Area.
Force-

Area-
Diameter-

Materials (per group of students)

- Three plastic water bottles with caps
- Meter stick and metric rulers
- Chalk
- Paper/pencil

For Teacher Only: a permanent marker, three different sized nails (with hammer) or drill bits

Procedure

Set Up: *Prior to experiment*: for each group, label their bottles A, B, and C using the permanent marker. Then, use the smallest nail (or drill bit) to punch a hole in the caps of all the "A" bottles. Use the middle-sized nail (or drill bit) to punch a hole in the "B" bottle caps and the largest on the "C" bottle caps.

1. Introduce the basic concept of pressure to students). Explain that they are going to apply this idea towards the creation of a water squirter.
2. Divide the class into groups and hand out the empty bottles. Have each group write down a prediction of which of the bottles they think will squirt the water the furthest and explain their hypothesis.
3. Have each group use a metric ruler to measure the size of each of the holes on their bottles. Ideally, every group should find the same sizes for each of their bottles.
4. As a class, develop a table to record all the data
5. Explain that the class is going to go outside and each group is going to test their bottles to see how far each spray goes. Remind everyone that it is very important they all do the experiment the same way so the data gathered is similar. Depending on resources, there are two recommended methods:
    a. From a table: lay a bottle on the table with the cap right at the edge of the table (no overhang).
    b. On the ground: using the chalk, each team should mark a "starting line" on the ground. They should line up the cap with the mark.
6. In either case, one team member presses or steps down on the bottle with all their weight (NO BOUNCING) while another uses chalk to mark the furthest distance the stream reaches.
7. Once marked, stop pressing on the bottle and measure the distance from the starting line to the mark using centimeters. Record.
8. Repeat for the other two bottles. Note that the person who sprayed the first bottle should do the spraying for all three bottles (consistency). For fairness, you may want to have each team do multiple trials so that everyone gets a chance to spray water.
9. When done, have the class work together to share their data (ex. create a large data table where each team can record their distances) and analyze.

Questions to ask

- Did everyone have the same numbers for each distance? Why or why not?
- Did everyone have the same results? Why or why not?
- Which bottle went the furthest? Why? How did it compare to their prediction?

Extensions

- Run similar tests with 1 liter and/or 2 liter bottles. Does it change the results?
- Have the students determine the maximum sized hole before the distance begins to drop (i.e. the pressure can no longer build to maximum).

Resources

http://www.instructables.com/id/Super-easy-water-bottle-water-gun!/ - this website contains instructions on how to construct a similar sprayer to what is described here

http://en.wikipedia.org/wiki/Fluid_pressure - this website discussed the concept of fluid pressure in more detail

http://en.wikipedia.org/wiki/Super_soaker - this website describes the super soaker water gun, which uses compressed air pressure to spray water, and the physics at work with this gun.

Children's Museum of Houston

Pre/Post Classroom Activities

Clay Float: Exploring Archimedes' Principle

Rationale

FlowWorks gives visitors a chance to experiment with the power and properties of water. Water's natural physical and chemical properties come to life as the exhibit simulates a variety of natural phenomena, such as vortices and rapids, as well as human-created devices such as sprays and pumps. Visitors harness water's power through lock systems, boat building, and dams and, through various inquiry-based explorations, visitors have the opportunity to examine transformations of energy (ex. potential to kinetic or even kinetic to electrical) using water as a medium.

TEKS Objectives (Science)

5.2: The student uses scientific methods during field and laboratory investigations.

5.3: The student uses critical thinking and scientific problem solving to make informed decisions.

5.4A: Collect and analyze information using tools including calculators, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, compasses, balances, hot plates, meter sticks, timing devices, magnets, collecting nets, and safety goggles.

5.7D: Observe and measure characteristic properties of substances that remain constant such as boiling points and melting points

Background

In this lesson plan, children become familiar with the concept of Archimedes' Principle (buoyancy) and how this concept relates to building a boat that will float. Archimedes' Principle states that the buoyant force on a submerged object is equal to the weight of the fluid that is displaced by the object. In order for an object to float, it must displace enough water to equal its weight, before it is fully submerged. An object will float if it weighs less than the amount of water it displaces. It will sink if it weighs more than the water it displaces. Differently shaped objects displace water differently, even if they are of the same material and have equal weight. This explains why huge steel ships float even though a ball of steel sinks. While in the exhibit, visitors will be able to test out their new found knowledge about buoyancy at the Currents' Boat Race Course by building boats and racing them.

Vocabulary

Buoyancy – the ability to float.

Density – the measurement of how much matter is in a given amount of space.

Mass-

Volume-

Archimedes Principal-

Materials (per group of students)

- One small plastic container (bottom half of 2-liter soda bottle or similar container)
- Modeling clay
- Masking tape
- Ruler
- Balance
- Paper and pencil

Procedure

Set Up: Discuss Archimedes' Principle. After an introduction to Archimedes' Principle, students will be ready to explore the phenomenon through this activity.

1. Fill the clear plastic container with water.
2. Attach a piece of masking tape to the container vertically, running from the top of the container to the bottom. Mark the starting water level on the tape.
3. Using modeling clay and a balance, create two balls of equal mass.
4. Drop the first ball into the water. Observe and record whether it sinks or floats. Mark the resulting water level on the masking tape and use a ruler to measure the total change in water level. Record this measurement.
5. Remove the clay ball and put it aside. Check to make sure your water level still matches what is was when you started. If not, add more water.
6. Take the second clay ball and think about how you might shape it so that it will float. Shape the clay accordingly and place it in the water.
7. Observe and record whether the clay sinks or floats. Keep trying until you get a shape that floats.
8. Mark the resulting water level on the masking tape. Measure and record the total change in water level.

Questions to ask

- Why did one shape sink and the other float? Remember that the two pieces of clay are of equal mass.
- How did the shape of the clay effect the change in water level?
- How does this demonstration relate to Archimedes' Principle?

Extensions

Add weights (ex. washers) to the boat shaped clay, one at a time. See how many weights your "boat" can hold before it sinks. Describe what you observe using Archimedes' Principle.

NOTE: Build a Boat is an excellent follow-up activity for this activity post-visit.

Resources

http://www.instructables.com/id/Pop-pop-or-put-put-steamboat-made-easy-for-childre/ - this is a site with instructions on how to build a very simple steam-powered boat
http://pbskids.org/zoom/activities/sci/sodabottleboat.html - this website has a chemically powered (very safe) water bottle boat
http://pbskids.org/zoom/activities/sci/survivalraft.html - this challenge is a fun way to take this activity up yet another step
http://en.wikipedia.org/wiki/Buoyancy - more in-depth understanding of buoyancy and Archimedes' principle

Children's Museum of Houston

Pre/Post Classroom Activities

Student Boat Building

Rationale

FlowWorks gives visitors a chance to experiment with the power and properties of water. Water's natural physical and chemical properties come to life as the exhibit simulates a variety of natural phenomena, such as vortices and rapids, as well as human-created devices such as sprays and pumps. Visitors harness water's power through lock systems, boat building, and dams and, through various inquiry-based explorations, visitors have the opportunity to examine transformations of energy (ex. potential to kinetic or even kinetic to electrical) using water as a medium.

TEKS Objectives (Science)

5.2: The student uses scientific methods during field and laboratory investigations.

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5.7D: Observe and measure characteristic properties of substances that remain constant such as boiling points and melting points

Background

In this lesson plan, children become familiar with the concept of Archimedes' Principle (buoyancy) and how this concept relates to building a boat that will float. Archimedes' Principle states that the buoyant force on a submerged object is equal to the weight of the fluid that is displaced by the object. In order for an object to float, it must displace enough water to equal its weight, before it is fully submerged. An object will float if it weighs less than the amount of water it displaces. It will sink if it weighs more than the water it displaces. Differently shaped objects displace water differently, even if they are of the same material and have equal weight. This explains why huge steel ships float even though a ball of steel sinks. While in the exhibit, visitors will be able to test out their new found knowledge about buoyancy at the Currents' Boat Race Course by building boats and racing them. Back in the classroom they can use all of this knowledge to build and test out their own boats made out of recycled materials.

Vocabulary

Buoyancy – the ability to float.
Density – the measurement of how much matter is in a given amount of space.
Mass-
Volume-
Archimedes Principal-
Bow-
Stern-

Hull-
Keel-

Materials

- Tape
- Glue
- Thumb tacks
- Craft sticks
- Aluminum foil
- Yarn or string
- Variety of recycled materials that students can bring from home such as plastic bottles, margarine and other plastic containers, milk jugs, egg cartons, juice cartons, ice cream containers, etc. Be sure to remind students that they are not to bring glass, sharp metal, or any other possibly dangerous or hazardous material.

Procedure

Set Up: Review the Archimedes' Principle with your students.

1. Challenge your students to design a boat out of recycled materials (either individually or as a partner/team challenge).
2. Once their design is complete, have them create their own boats out of the recycled materials.
3. Next, test them out to see which ones float.
4. Let your students have time to build and modify their creations, then have a class-wide contest.

Questions to ask

- What did you notice about the shape of the boats that floated?
- What did you notice about the shape of the boat that sunk?

Extensions

Test the boats to see which can hold the most weight by adding one washer (weight) at a time. Record how many washers each boat can hold on a class chart. Allow time for students to make modifications and retest.

Resources

http://www.instructables.com/id/Pop-pop-or-put-put-steamboat-made-easy-for-childre/ - this is a site with instructions on how to build a very simple steam-powered boat
http://pbskids.org/zoom/activities/sci/sodabottleboat.html - this website has a chemically powered (very safe) water bottle boat
http://pbskids.org/zoom/activities/sci/survivalraft.html - this challenge is a fun way to take this activity up yet another step
http://en.wikipedia.org/wiki/Buoyancy - more in-depth understanding of buoyancy and Archimedes' principle