Predictions of Motion

Grade 3: Motion Probe

Aligned with National Standards

ward's science
Single Probes

overview

This is an interactive inquiry where students will participate in using force to create motion. Students will observe patterns of motion which will allow them to make predictions of future motion.

This activity uses the WARD's Single Motion Probe to collect data, allowing students to focus on the science discovery and leaves more time for learning and developing higher level thinking skills.

time requirement:

This activity can be completed in one session of 20 - 30 minutes.

materials required for the activity:

WARD'S Single Motion Probe
string (long enough to swing a soda bottle from the ceiling, about 1 meter)
soda bottle (filled 1/2 way with water)
meterstick
marker
masking tape
Instructions (this guide) and the student worksheet (page 9).

safety precautions

general safety:

- Read all instructions before starting the lab activity. Review the safety and lab procedures with the students and remind them to ask questions.
- Consider establishing a safety contract that students and their parents must read and sign. This is a good way to identify students with allergies (e.x. latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.

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DIMENSION 1 Science and Engineering Practices

	Asking questions (for science) and defining problems (for engineering)		Use mathematics and computational thinking
×	Developing and using models		Constructing explanations (for science) and designing solutions (for engineering)
×	Planning and carrying out investigations		Engaging in argument from evidence
×	Analyzing and interpreting data	×	Obtaining, evaluating, and communicating information

DIMENSION 2 Cross Cutting Concepts

×	Patterns		Energy and matter: Flows, cycles, and conservation
×	Cause and effect: Mechanism and explanation	×	Structure and function
	Scale, proportion, and quantity		Stability and change
	Systems and system models		

DIMENSION 3 Core Concepts

Discipline	Core Idea Focus
Physical Sciences	PS2.A: Forces and Motion

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NGSS STANDARDS

Elementary School Standards Covered
3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

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Content Standards (K-12)			
	Systems, order, and organization		Evolution and equilibrium
×	Evidence, models, and explanation	×	Form and function
×	Constancy, change, and measurement		

Physical Science Standards Elementary School	
×	Position and motion of objects

× Indicates standards covered in activity

prior to class

- Review the basic information about how to use the WARD's Single Motion Probe. The motion probe has three units that it can measure; the units can be changed by touching the "m" to the right of the motion icon and then touch the box showing one of the below units.

m

m	Measures distance in meters
m/s	Measures speed
m/s^2	Measures acceleration

It is recommended for this activity that the probe measure distance.

- Fill the soda bottle half way with water and hang it from the ceiling. Use a piece of string that is at least 1 meter long after it is tied to the bottle. Use a black marker to make a mark at 25 cm intervals from the neck of the bottle. This will make it easier for students to consistently change the length of the string during the activity.

- Make copies of the worksheet on page 9 if desired.
  Answers to the worksheet are: 1a, 2a, 3b, 4a, 5c, 6d, 7b.

objective

Students will learn to observe an object's motion to provide evidence that a pattern can be used to predict future motion.

background

Scientists have discovered several rules or laws that explain motion and the causes of changes in motion. The physics or science of motion is all about forces. A force needs to act upon an object to begin and maintain motion as well as to change an objects motion.

In the study of motion, there are simple movements and there are complex movements. When objects move in a straight line, with force acting on it in only one direction, it is a simple movement. Curved or circular movements, for example, the motion of a ball being thrown through the air, is a complex movement since there are forces "pushing" and "pulling" it in different directions.

Motion can also be repetitive and follow a pattern, most times when the object in motion is moving from or around a fixed location. The motion and forces acting on the object can then be measured and predictions can be made as to the future motion and the amount of force that would be required to keep the object in motion.

build upon prior knowledge:

- Ask the students to look at the pictures below and ask the students what are the repetitive patterns of motion in each. *(Student responses should be: The grandfather clock has a pendulum swinging in a repetitive back and forth motion. Jumping rope has a repetitive pattern that allows you to predict when to jump. A teeter-totter moves in a repetitive up and down motion.)*

- Ask the students to suggest more examples of repetitive motion or patterns of motion. (*Responses could include the Earth, moon, or satellites, windshield wipers, and hands on a traditional clock face.)*

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guiding questions

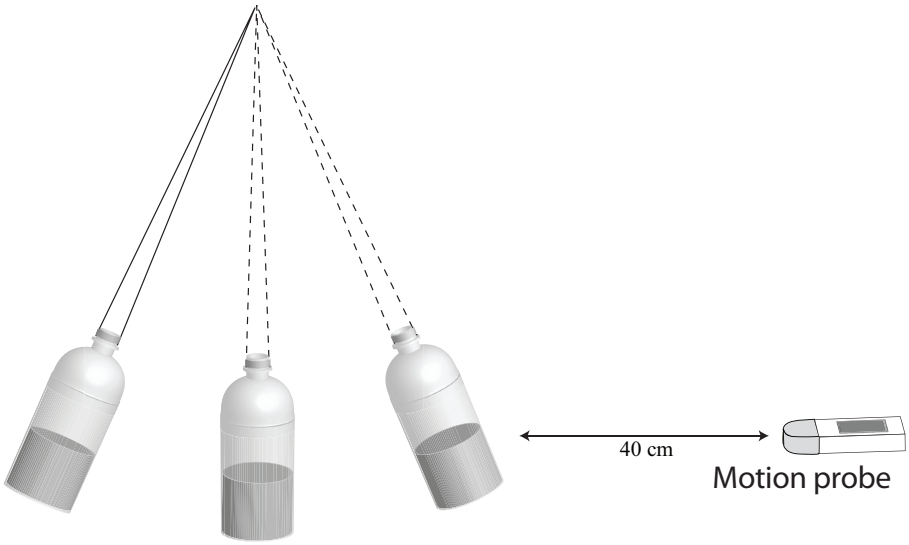
- What do you think will happen? (Hypothesis)
- What do you expect to learn?
- What tools are needed?
- How can we record our findings?

procedure

1. Ask two students to assist with the experiment.

   One student will pull the soda bottle back to their position and then release it to swing towards the other student who will hold the Ward's Single Motion Probe.

   Use tape to mark the position for the student releasing the bottle to stand for consistent trials. Measure this position from the center point (where the bottle is at rest). Mark another position directly across from the first position but 40 cm further away from the center position. This will allow the student holding the motion probe to stand about 40 cm from where the bottle will swing at its highest point.



2. Unless the string is 1 meter from ceiling to bottle, hold the string at the 1 meter length. Stay to the side of the swinging motion and try to remain out of the probes focus.

3. When the bottle is released, have the student with the probe observe the graph of the bottle's motion and announce the distance every time the bottle swings closest to them. It would be helpful to have another student record the distances unless you will be viewing all the graphs from the different trials at the end. It could also be noted how many times the bottle swings until it returns to rest.

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4. Have the students repeat the experiment while the string is held at the 75 cm mark.

5. Have the students compare the two trials and have them make predictions of what the distances and pattern of motion will be when the string is held at the 50 cm mark. Write down the predictions.

	Predictions for third trial	Actual results for third trial
distance of highest swing		
number of swings until the bottle returns to rest		
other		

6. Have the students repeat the experiment while the string is held at the 50 cm mark. Record the actual results of this trial and compare the data to the predictions.

7. If time permits, repeat the procedure (including predictions first) while the string is held at the 25 cm mark.

summarize

Ask the students what they learned about the pattern of motion they observed with the soda bottle. (*Student responses may include: the longer the string, the bigger and slower the motion was. As the string got shorter, the motion got smaller and faster.)*

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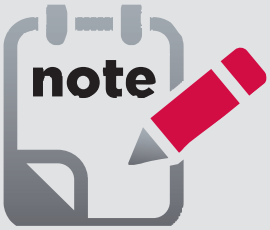

teacher notes

- The Ward's Single Motion Probe sends out a sonic cone that it uses to determine the distance of an object. The probe will yield better results if held clear of any surface.
- Connecting the probe to a computer either through the USB or WiFi may make the graph easier to see. Printing out the graph for each experiment may also be useful.
- Since the motion probe emits a high frequency sound, it is an excellent way to demonstrate to the students how sound waves reflect off different objects. Point the probe at a hard tiled floor and then at a carpet, the carpet will absorb the sound waves.

extension

This experiment could be conducted while using the probe to read the speed of the motion. It could also be conducted with varying amounts of water in the bottle to test how mass affects the motion of the bottle.

Worksheet

1. An object in motion will continue to move in a straight line at a constant speed unless a force acts on it.
   a. True
   b. False

2. A force can change the direction of a moving object.
   a. True
   b. False

3. The greater the force, the less the change in the position of the object.
   a. True
   b. False

4. If an object is at rest, it will remain at rest until a force (a push or a pull) is applied to it.
   a. True
   b. False

5. The force that pulls objects to the center of the Earth is called?
   a. motion
   b. friction
   c. gravity
   d. acceleration
   e. force

6. This is required to move an object.
   a. motion
   b. friction
   c. gravity
   d. force
   e. acceleration

7. A force is _____
   a. a very loud noise.
   b. a push or pull upon an object.
   c. a strong pull on an object.

5100 West Henrietta Rd • PO Box 92912 • Rochester, NY 14692-9012 • p: 800 962-2660 • f: 800 635-8439 • wardsci.com