



Apple On a Desk

Boys and Girls Club After School Science
NSF Center for Chemical Innovation
Chemistry at the Space Time Limit (CaSTL)
<https://www.castl.uci.edu/>

National Science Education Standard(s) Addressed:

- K – 4 The position and motion of objects can be changed by pushing or pulling.
5 – 8 If more than one force acts on an object along a straight line, then the forces will reinforce or cancel each other.

Lesson Objective: Children will be able to identify the forces acting on a static object and will be able to state whether the forces are balanced or unbalanced by using manipulatives while in cooperative groups and by making observations and talking to their partners to notice patterns.

Materials Used: apple, sponge, 5 bricks, 9 oz plastic cup, index card, penny, empty glass bottle (ex. Snapple with large mouth), roll of masking tape, penny, flexible meter sticks, images of people engaging in sports

Student Talk Strategies: *Numbered Heads, Revoicing*

Classroom Management: CHAMPs

Conversation: Children may talk with inside voice to their partners only. **Help:** If children need help, one of the group will raise a hand to let the teacher know. **Activity:** Children will use manipulatives, make observations, and draw the materials and forces. **Movement:** Children will stay at their place. **Participation:** All children in the group are expected to take turns and handle the manipulatives.

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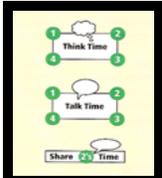
ENGAGE: <i>Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary</i> Estimated time: 10 minutes		
Teacher's Role	Teacher Questions	Children's Role
<p>1. Teacher places an apple on the teacher's desk then administers Probe 8: <i>Apple on a Desk</i> to determine what children know about forces. Teacher walks around the room and reads student responses quietly without talking to children. In particular, teacher looks at children's drawings for insight into student thinking.</p>	<p>1. From probe: Which student do you most agree with? Explain your thinking.</p>	<p>1. Children respond individually without talking to an elbow partner.</p> <p>Naïve conception: Some children think that if an object is not moving, there is no force acting on it.</p> <p>Naïve conception: Children have difficulty understanding that all interactions involve equal forces acting in opposite directions on the separate, interacting objects.</p>
EXPLORE: <i>Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding</i> Estimated time: 30 minutes		
Teacher's Role	Teacher Questions	Children's Role
<p>1. Teacher asks the children to get into groups of 2 or 3. Teacher may select these groups or may have the children self-select.</p> <p>2. Teacher models how to use the materials at each station without moving the objects so as not to spoil the surprise.</p> <p>See attached worksheet and directions pages.</p> <p>3. Teacher walks around the room and listens to conversations or asks children questions. Teacher chooses a different group to describe the forces at each station in preparation for the Explain.</p>	<p>1. You will now observe different objects and will investigate forces using the materials at each station.</p> <p>2. Follow the directions and make your observations. Perform the next investigation.</p>	<p>2. Children investigate the materials, talk to their partners, and write their observations.</p>

EXPLAIN: <i>Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding</i>		
		Estimated time: 20 minutes
Teacher's Role	Teacher Questions	Children's Role
<p>1. Teacher tells groups to share their observations and findings.</p> <p>2. Teacher listens to groups' reports and repeats or Revoices (one of the five productive talk moves) what they say to be sure that the class is noticing patterns and the learning is addressing the standards.</p>	<p>1. Each group will now tell us a. what they observed at each station and b. what forces they think were acting on the objects at their station.</p> <p>2. What evidence do you have to make that statement?</p> <p>3. Do you think the forces are balanced or unbalanced? How do you know?</p>	<p>1. Children in their groups tell the whole class what they observed and what forces they think were acting on the objects.</p> <p><i>Answers vary depending on the station.</i></p> <p>3. <i>If the object did not move, the forces were balanced. If the object moved, the forces were unbalanced.</i></p>
EVALUATE: <i>Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding</i>		
		Estimated time: 10 minutes
Teacher's Role	Teacher Questions	Children's Role
<p>1. Teacher checks for understanding by asking questions, looking at responses, and looking at student responses.</p> <p>2. Teacher distributes the pictures to the groups and walks around the room listening to the conversations.</p> <p>3. Teacher uses Numbered Heads to call on certain members of each group.</p>	<p>1. Take out your probes now and look at the answer you gave earlier. Do you want to change your answer? If you do, cross out your answer. DO NOT ERASE!</p> <p>2. I am going to give each group a few pictures. Your task is to look at the pictures and compare and contrast them with respect to the forces that are acting on the people or objects in the pictures.</p> <p>3. Now what do you think that word "force" means? Talk to your partners.</p> <p>4. What can you say about the forces acting on the people</p>	<p>1. Children revisit their probes and decide whether they want to change their answer. They cross out any incorrect responses. DO NOT ERASE.</p> <p>2. Children get into cooperative groups and discuss the pictures before answering the teacher's question.</p> <p>3. <i>A force is a push or a pull from an interaction between 2 objects.</i></p> <p>4. Children talk to their partners while looking at the</p>

<p>5. Teacher then stops the group conversations and asks each group what forces they identified. Teacher scripts what children say.</p> <p>6. Teacher helps children to complete the Farmer in the Dell. Teacher scripts children's words.</p>	<p>and objects in the pictures?</p> <p>5. What forces were acting on the people and object?</p> <p>6. Let's fill out the Farmer in the Dell then we will sing our sentences.</p>	<p>pictures and try to decide what forces are acting on the people or objects in the images.</p> <p>5. Each group reports out to the whole class.</p> <p>5. Examples of possible answers: <i>gravity, foot pushing on the ball, bat pushing on the ball, hammer pushing on the nail, hand pulling on the paper, bodies pushing against each other, foot pushing down on the ground</i></p> <p>6. Children provide the words for the Farmer in the Dell then sing the sentences.</p>
<p>EXTEND: <i>Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas</i> Estimated time: 5 minutes</p>		
<p>Teacher's Role</p>	<p>Teacher Questions</p>	<p>Children's Role</p>
<p>1. Teacher connects the lesson to the real world.</p>	<p>1. When you leave the classroom, notice the objects and people around you. What forces are acting on them?</p> <p>Are the forces balanced or unbalanced?</p>	<p>1. Children notice objects and people around them. They note the forces they think are acting on these.</p>

Student Talk Strategies

Adapted from *Avenues* (2007). Hampton Brown.

Numbered Heads		
	<ul style="list-style-type: none">• Students number off within each group.• Teacher prompts or gives a directive.• Students think individually about the topic.• Groups discuss the topic so that any member of the group can report for the group.• Teacher calls a number and the student from each group with that number reports for the group.	<ul style="list-style-type: none">• Group discussion of topics provides each student with language and concept understanding.• Random recitation provides an opportunity for evaluation of both individual and group progress.

Teacher Background Information

from Keeley, P. , Eberle, F., & Dorsey, C. (2008). *Uncovering Student Ideas in Science* (Vol 3). Arlington, VA: NSTA Press.

Forces come in pairs. The force of gravity acting on the apple is the result of the matter in the Earth pulling on the matter in the apple. When the apple is set on the table, the table exerts a force upward on the apple equal to the force exerted downward, which is the pull on the apple. At a microscopic level, when the apple is placed on the table, the individual molecules of the table's surface adjust their position in much the same way that the individual springs in a bedspring mattress change position to support a sleeping person. This force on the apple exists because the apple is in contact with the surface of the table. When the apple is removed, the molecules of the table return to their original positions, as happens when a sleeping person rises from the bed in the morning.

The fact that the apple is not moving indicates that another force besides gravity must be present. In order for any object's motion to remain unchanged, all of the forces on that object must balance. In the case of the motionless apple, the downward gravitational force is balanced by an upward force supplied by the only other object in contact with the apple—the table.

Air pressure also creates a force on the apple, but since air pushes on the apple almost equally in all directions, the effects of the air's force are not noticeable in this case.



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CaSTL program at UC Irvine

Student Response Sheet

Data Table to record observations in the investigations.

Tasks	Observations	Drawing
bricks on a sponge		
brick in hands		
penny and card on a cup		
penny on ring on bottle		
bricks on meter sticks		

Task 1. Bricks on a Sponge

Put one brick on the sponge and notice what happens to the sponge. Continue to put more bricks on top of the first brick and notice the sponge each time. Discuss with your partners what is happening. Record your observations on the data table and draw what happened to the sponge as it pushed up on the bricks.

Task 2. Brick in Hands

Take turns holding the brick in your hands. What do you need to do to keep the brick steady and not moving? What happens if you push harder on the brick? What happens if you relax your muscles a little bit? Discuss these questions with your partners and record your observations in the data table.

Task 3. Penny and Card on a Cup

Cover the cup with the paper card and put the coin on top of the card. Is the penny moving? What do you think is happening?

Get the penny into the cup without lifting the card by “flicking” the card with your finger. Observe what happens to the penny and the card and discuss this with your partners. Write your observations in the data table.

Task 4. Penny on Ring on Bottle

Place the masking tape on the bottle so that it is supported vertically by the bottle. Put the penny on the top surface of the masking tape. Is the penny moving? What do you think is happening?

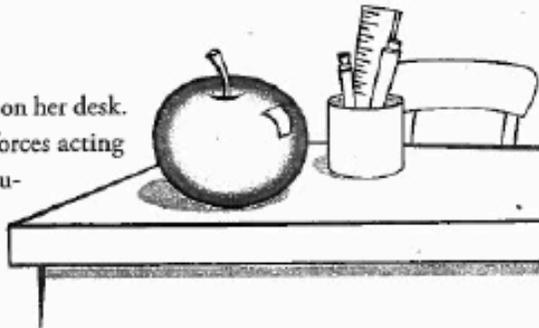
Without touching the penny or the bottle, quickly move the masking tape aside to get the penny into the bottle. Observe what happens to the penny and discuss this with your partners. Write your observations in the data table. Draw what happened to the penny when you removed the ring that was supporting it.

Task 5. Bricks on Meter sticks

Put the two meter sticks side by side resting on 2 chairs. Put one brick on the meter sticks and notice what happens to the meter sticks. Continue to put more bricks on top of the first brick and notice the meter sticks each time. Discuss with your partners what is happening. Record your observations on the data table and draw what happened to the meter sticks as they pushed up on the bricks.

Apple on a Desk

Mrs. Canales pointed to an apple sitting on her desk. She asked her students to describe any forces acting on the apple. This is what some of her students said.



Archie: "The only force acting on the apple is air pressure."

Sam: "There is one force acting on the apple. Gravity is the force that pulls on the apple."

Soledad: "There are two forces: the desk pushes up on the apple and gravity pulls downward on the apple."

Misha: "There are many forces acting on the apple; but, it is the holding force in the apple that keeps it on the desk."

Tess: "There are no forces acting on the apple because the desk stops any forces from acting on it."

Which student do you most agree with? _____

Explain your thinking. What rule or reasoning did you use to decide if there were any forces acting on the apple?
