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Discrepant Event

GRADING CRITERIA	
Grade Level (4th or 5th)	5th Grade
Title of Discrepant Event	"Balloon in a Bottle"
Next Generation Science	5.Structure and Properties of Matter ● 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]
Student Learning Objectives	● After successful completion of the lesson, the student will demonstrate understanding of air pressure by successfully inflating the balloon inside of a bottle without touching it. ● After successful completion of the lesson, the student will demonstrate understanding that air takes up space through written/visual responses on their worksheet.
Summary of Science Concept/Content	Atmospheric pressure, also called barometric pressure, is the force or pressure exerted by the weight of air in the atmosphere on objects located within it. The higher the pressure the stronger the force will be, or the harder the atmosphere will push against objects.
Materials	*Each student will need:* ● 1 Balloon ● 1 Bottle and cap ● 1 Worksheet ● 1 Pencil
Discrepant Event Procedures	● The teacher will introduce the materials the students will be using. 1. Latex balloon 2. Bottle and a cap ● The teacher will display the materials on a table for students to explore. ● The teacher will allow time for students spend some time exploring their materials, if they choose (e.g blowing up the balloon). ● The teacher will then explain their first challenge: Try to fully blow up the balloon inside the bottle. ○ The teacher will introduce the one and only rule: The balloon must be wrapped around the top of

Discrepant Event Procedures	the bottle opening. ○ During this phase of exploration, only students who have a pre-poked hole in their bottle will be able to successfully inflate the balloon inside the bottle. The students who do not have a hole in their bottle will be unable to inflate the balloon inside the bottle. ○ The teacher will use the following prompts to guide the students. ■ Maybe you can make sure the materials all work. ■ Can you try it a different way? ■ Can you change the way you are blowing? ■ If no students are coming to the conclusion teacher may prompt to look at students who did succeed for help. ○ The teacher will then add holes to every student's bottles and let them know that their bottles are all the same. ○ The students will be instructed to try inflating the balloon again with the hole in the bottle. Once all students succeed the teacher will move on. ● The teacher will regain attention of the class and give the students a second challenge: Try to keep the balloon inflated without touching the balloon. ○ The teacher will use the following prompts to guide the students. ■ Can you change the way you are blowing? ■ Can you do anything to the bottle? ■ If no students are coming to the conclusion teacher may prompt to think about the hole in their bottle. ● The teacher will regain attention of the class and give the students a third challenge: Try to inflate the balloon without touching the balloon. ○ The teacher will use the following prompts to guide the students. ■ What are other ways you can not touch the balloon? ■ How else can you get air inside the balloon? ■ If no students are coming to the conclusion

Discrepant Event Procedures	teacher may prompt to think about the hole they created. ● The teacher will regain attention of the classroom and begin to start a discussion about challenge 1. ○ The teacher will provide students with prompting questions about their results. ■ Why do you think your balloon inflated? ■ What did you do to get your balloon to inflate? ● The teacher will end the discussion after students have spent time discussing their thoughts and explain and show that the hole helped them blow up the balloon. ○ The teacher will ask students if they know how the hole helped blow up the balloon in the bottle and use the following questions to guide their discussion. ■ Is the bottle empty? ■ What is inside the bottle? ■ What do we know about air? ○ The teacher will introduce the concept of air is matter. ■ Air takes up space. ■ The bottle isn't empty. ■ Air needs a place to escape to. ● The teacher will regain attention of the class and begin the next discussion about challenge 2. ○ The teacher will provide students with prompting questions about their results. ■ Who was able to keep their balloon inflated? ■ How did you keep the balloon inflated? ● The teacher will end the discussion after students have spent time discussing their thoughts and explain and show that the way to keep the balloon inflated is to cover the hole. ○ The teacher will ask students if they know how covering the hole helped keep the balloon inflated and use the following questions to guide the discussion. ■ When the hole is uncovered what is the air doing? ■ What happens to the air when we cover the hole?

Discrepant Event Procedures	■ Why doesn't the air escape the top of the balloon? ○ The teacher will introduce the concept of air pressure. ■ Air pressure - air is pushing on everything. ■ Explain the balance of air pressure in bottle. ● Air is creating pressure inside pushing up on the balloon. Air is creating pressure outside pushing down on the balloon. Keeping the balloon inflated. ● The teacher will regain attention of the class and begin the next discussion about challenge 3. ○ The teacher will provide students with prompting questions about their results. ■ Who was able to inflate the balloon without touching it? ■ How did you inflate the balloon without touching it? ● The teacher will end the discussion after students have spent time discussing their thoughts and explain and show that sucking air out of the hole in the bottle can inflate the balloon without touching it. ○ The teacher will ask students if they know why sucking the air out of the hole inflates the balloon in the bottle and use the following questions to guide their discussion. ■ What happens to the air inside of the bottle when you suck out of the bottle? ■ What is happening to the air inside of the balloon? ■ Where is the air coming from inside of the balloon? ○ The teacher will introduce the concept of air pressure. ■ Air takes up space. ■ The bottle isn't empty. ■ Air needs a place to escape to. ■ Air escapes to our lungs lowering the air pressure inside the bottle. ■ Air from outside gets pushed into the balloon.
Questions to Ask Students Before (Hooking Students),	*Before:* 1. Explain the positive properties of air.

During, and After the Event	2. Explain the negative properties of air. 3. Explain what problems you think you will encounter when blowing up the balloon. 4. How will you know that your balloon works properly? 5. Explain what do you know about balloons. *During:* 1. Why are some balloons inflating while others aren't? 2. Explain what needs to happen in order for the balloon to inflate. 3. Explain what forces are working or working against your ability to blow up your balloon. 4. How would you be able to keep it inflated? 5. Explain any other ways to inflate the balloon? *After:* 1. Why does putting a hole in the bottle allow the balloon to inflate? 2. Explain why the balloon stayed inflated. 3. Why did sucking inflate the balloon? 4. Apply your knowledge of air pressure to explain what how the balloon inflated in each way. 5. How does this relate to anything you have seen in your life?
Explanation of the Science Concept	It is important to first remember that air takes up space, meaning that the bottle is not empty but instead filled with air. When first attempting to inflate the balloon, it will not inflate inside of the bottle. Due to the fact that the bottle is already filled with air particles that have nowhere to escape to.The air inside the bottle may compress a small amount but not enough to permit the balloon to fully inflate. When you puncture a hole in the bottle you create an exit path for the air molecules in the bottle to become released to the outside environment. When attempting to inflate the balloon the air is pushed out of the bottle through the punctured hole resulting in room for the balloon to inflate. In order for the balloon to stay inflated after the student's mouth is removed, the hole must remain plugged. The high pressure air in the balloon pushes outward harder than the low pressure air in the bottle keeping the balloon inflated. When the hole is unplugged, air flows back into the bottle. The air pressure in the bottle increases and collapses the balloon.
Possible Student Misconceptions Regarding	1. Air is only outside of the bottle, the bottle is "empty" 2. Air does not take up space

the Science Content	3. Some balloons were defective 4. Bottle openings are different sizes. 5. Others may be better at blowing than others
Assessment Plan to Determine Student Understanding	Formative Assessment: Students will be asked a series of questions at the start of the lesson to activate their prior knowledge and help the teacher understand what the students know. (eg, explain the positive properties of air). Progress Monitoring Assessment: The teacher will walk around the classroom while students explore, and ask questions. The teacher will stop by desks of any students who are struggling, or frustrated, and will pose guiding questions, but not provide the answers. Summative Assessment: Students will be given a worksheet at the end of the lesson and will be given the following prompts from the teacher. 1. Students are able to use drawings, words, or both to explain their thinking. 2. Ensure all drawings include labels, arrows, and other markings to show your thought process. 3. Ensure all written work is clear and in full sentences. 4. Students will also need to add in one example of air pressure in real life, if possible. Students will demonstrate understanding of air pressure by writing or drawing what they learned from their explorations. *Exceeds:* Students Demonstrate understanding of air pressure and the concept that air occupies space by completing an accurate drawing of the discrepant event and writing a rationale describing the event. Student will also be able to describe these concepts in a real world applications. *Meets:* Students Demonstrate understanding of air pressure and the concept that air occupies space by completing an accurate drawing of the discrepant event and writing a rationale describing the event. *Approaching:* Students are able to draw the representation of the discrepant event, but unable to provide a rationale for the event.
Teaching Tips for the DE	1. Utilize misdirection: have students test the balloons to make sure they will work prior to beginning the experiment 2. Do not explicitly tell students how to blow up the balloon,

	simply lead them with questioning and prompting. 3. Have materials ready prior to the lesson ● Holes poked in the bottom of some the bottles ● Balloons ready ● Bottles must made of a thick plastic material (sports drinks work best).
Possible Extension Activity of Discrepant Event	**Kissing Balloons.** Blow up two balloons and attach a piece of string to each. Hold one balloon by the string in each hand and position the two balloons so that they are at your nose level and 6 inches apart. Blow hard into the space between the balloons. This lowers the air pressure. The pressure of the surrounding air is now higher and it will push the balloons together.

Science Content Background

Air is matter. It has mass/weight and volume, meaning it takes up space. Being that it takes up space, once an object has filled with air, no more air can enter unless there is a way the air already inside can escape.

Multiple gases make up air; including nitrogen, carbon dioxide, water vapor, oxygen, and others. All of these gasses are composed of molecules, which are all in constant motion. As the molecules move, they come in contact with the surfaces of objects; these molecules push and press on the surfaces, exerting pressure.

There are both positive and negatives of air. One positive property is that air occupies space. There are many negative properties of air, such as being odorless, colorless, tasteless, and can not be seen.

Air exerts pressure. Air pressure affects people, animals and the weather. Clear sunny weather generally accompanies high-pressure systems, while low pressure can result in thunderstorms and other weather disturbances. The pressure of air is very strong, but we are not crushed by it because the pressure pushing down on us is equal to the pressure within our bodies pushing outward. The pressure of air pushes in all directions.

Air pressure is never felt, except in rare cases when the pressures outside are not equal to the pressure inside our bodies pushing out. This can be felt in instances where elevation level is changed, because air pressure varies with elevation. An example of this is the ear popping sensation that many people get when flying in an airplane.

Air pressure can be measured in a myriad of ways. Some of these are pounds per square inch, millimeters of mercury, atmospheres, and pascals. Air pressure is measured by an instrument called a barometer. Barometers were first developed in the 1600s. The original instrument had mercury in the small basin with an upside down glass tube placed in the mercury. As air pressure increased, the mercury would be forced into the tube. On the other hand, when pressure decreased, the mercury in the tube would go down. This type of barometer is known as a mercurial barometer. The glass tube has markings indicating different temperatures. As the mercury rises and falls, the temperature can be read.

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