Name _____

Force and Gravity

What is a force? _____

What is an applied force? _____

Experiment 1: Balloon sent across room

Hypothesis:

IF...the balloon is filled with air and let go

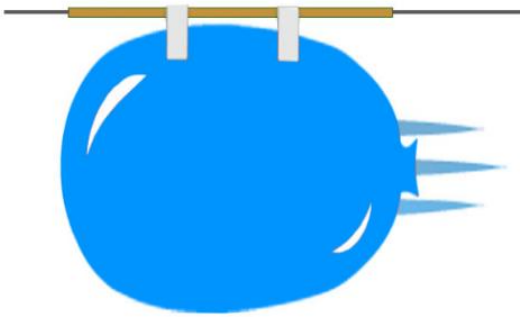
THEN..._____

BECAUSE..._____

_____

What "kind" of force "pushed" the balloon across the room? _____

How do we draw forces? _____



Experiment 2: Balloon sent up to ceiling

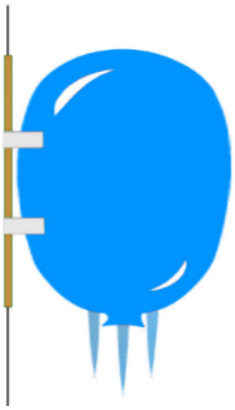
Write down everything that happened when the air was let out of the balloon?

_____

Why did the balloon fall to the ground?

_____

Draw force arrows on the balloon representing both the pushing of the air and the pulling of gravity.



What do you think?

- Is gravity a force? _____
- Why might you think it is a force? _____
- Is gravity an applied force? _____
- What kind of force is gravity? _____

Review:

- ✓ What *is* a force?
- ✓ What are the two *kinds* of forces?
- ✓ How do we draw forces?
- ✓ Which way does the force arrow point?

Force and Gravity

Teacher Notes

What is a force? A force is a "push" or a "pull." Teacher demonstrates force by pushing an object along the table and then pulling on the same object. Have students do the same thing to get them used to the concept. Students fill in the blank.

What is an "applied" force? There are different "kinds" of forces. When objects "push" or "pull" on other objects, then we call this an "applied" force. Since air molecules are objects, and since they are pushing on another object, the inside of the front of the balloon, then this is an applied force.

Experiment 1: Balloon sent across room

Set up a wire using fishing line about 20 feet apart. Thread wire through a straw and attach the blown-up balloon to the straw (as in video) using tape. Attach a peg to the end of the balloon.

Explanation

For now, best to keep this simple and just explain that gas inside the balloon is "pushing" on the front of the balloon when the peg is released. Since this is a "pushing," then it is a force.

Here is exactly what happens for those interested. But don't get into this with the students. We will discuss this later in the course. When the peg is released, there is more gas pushing on the front of the balloon than at the back of the balloon. That's because at the back of the balloon, the air is allowed to escape. Since more molecules of air are now able to push on the front of the balloon than on the back, the balloon moves forward.

An "Applied force" is what is pushing the balloon across the room.

Teach

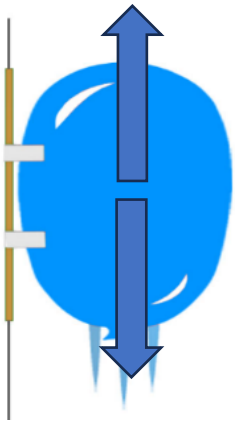
Have the students create a hypothesis using "if" and "then" and "because" in the sentence before doing the experiment. The hypothesis will want to say something like, "if" air is released from the balloon, "then" the balloon will move along the wire, "because" a force is pushing the balloon forward.

Explain that air molecules are pushing on the inside of the front of the balloon. It is these molecules that are creating a "pushing" force and so cause the balloon to move forward.

Forces are represented by an arrow that points in the direction of the force. The beginning of the force arrow usually starts in the middle of the object and is drawn such that it exits the object's exterior surface. Demonstrate this by first throwing an object in the air. Then draw it on the board and draw in the force arrow. In groups (and in pencil so it can be erased) have students decide where to draw the force arrow on the first balloon. Teacher then draws the balloon on the board, and draws in the force arrow (as per video).

Experiment 2: Balloon sent up to ceiling

Now anchor the wire somewhere on the ceiling and let the wire drop to the ground. Once again attach the balloon to the wire and put a peg on the end of the balloon. Make sure the wire is taut by having someone else pull on it.



Explanation

The "pushing" of the molecules on the front of the balloon makes the balloon go up the wire towards the ceiling (just like it did along the wire when horizontal). But eventually, the balloon gets low on gas (air molecules) and so the "pushing" becomes weaker and weaker until there is no more upward movement.

And this is important. What happens is that when the balloon starts going up the wire, the magnitude or size of the upward force is much bigger (has more power) than the magnitude or size of the downward gravity force.

Importantly, gravity has "always" been pulling down on the balloon, even before it started its trip up the wire. The students will most likely know that gravity is responsible for pulling the balloon to the ground. But ask them *when* gravity started to pull down on the balloon. This will get some interesting answers with some students even saying the gravity only started to work when the balloon stopped! Make sure to also ask them if gravity is "pushing" on the balloon or "pulling" the balloon to the ground. The latter is correct.

Gravity is called a "force-at-a-distance" because no objects, fingers, molecules, were actually touching the object.

Teach

- What happened when the air was let out of the balloon? *(The balloon went up, stopped, and then went down)*
- Why did the balloon go up? (*The air pushing on the FRONT of the balloon pushed it up*)
- Why did the balloon fall to the ground? (*Gravity pulled the balloon down to the ground.)*
- Student draws in force arrows on second balloon (see image).

Now draw the balloon on the board and draw in the correct arrows. Ask questions like, Where should I draw the force arrow that took the balloon to the ceiling? What about the gravity force arrow? What direction should it point? When did gravity start acting on the balloon? When the balloon stopped, what forces were acting on the balloon? At such and such a point, which force arrow was bigger?

Gravity is a force because it was "pulling" down the balloon. BUT, gravity is not an *applied* force because no molecules are involved! Gravity is called a "force at a distance." So, explain that there are "applied" forces and "forces at a distance."

What do you think?

- Is gravity a force? (*Yes)*
- Why might you think it is a force? (*Because it "pulled" the balloon down)*

- Is gravity an “applied” force? *(No)*
- What kind of force is gravity? (*A force at a distance)*

Review:

- What are the two *kinds* of forces? *(Applied and forces at a distance)*
- What *is* a force? (*There is a “pushing” or “pulling”)*
- How do we draw forces? (*By using an arrow)*
- Which way does the force arrow point? (*The same direction as the force)*