

Pre-Assessment
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Fifth Grade
Force & Motion

Reiteration of Primary Learning Goals

- Every force is part of an interaction between two objects.
- Forces are pushes and pulls that can be contact or non-contact forces.
- Motion is described as relative to something else (point of reference).
- A change in motion is due to unbalanced forces.
- No change in motion and an object at rest are due to unbalanced forces.

Student Ideas and Reasoning

Task Label: Write a Story About... Motion

Task Description:

Each student will have the choice to write a story on three different topics. They can choose to write about riding their favorite roller coaster, a world without gravity, or what it would be like if the sidewalks were icy year-round. They will have to use the following key terms in their writings; motion, speed, position, direction, gravity, friction, force

Rationale:

I want the students to think about the forces that they have noticed in their own lives. Opening it up to fiction allows the students to write about what they perceive to be true (their pre-conceptions) in an authentic and fun way. There is no “wrong” answer in this assessment. To differentiate, I will also let them draw a labeled picture to go along with their story, because some students’ strengths are in drawing rather in writing.

Example of student responses:

Student #1 Response:

“When I ride roller coasters, my favorite ones are when you go to the top and there’s no more of the track and then the gravity pulls you down. When it changes direction like that you start to feel heavy against the back of your seat. When the track starts to curve side to side and the position of the cart starts to tilt, I sometimes get butterflies on my stomach, also when the force of gravity starts to pull you down the hill. But eventually the friction between the tracks and the brakes stop the cart so they can get off and others can start the journey.”

Interpretation #1:

This student can explain the “what” of what is happening when they are on the rollercoaster, and a lot of the “why”. She knows how gravity is the force that pulls the cart down and how the brakes use friction to stop the cart. She also recognized how she felt heavy against the back of her seat. This shows that she has experience with something wanting to continue in its motion (herself) and needing another force to act on it (the force of the cart moving down the hill). Because of the stronger knowledge in the force of gravity and friction, I might want to spend more time explaining concepts like inertia, which can be harder to understand.

Student #2 Response:

“When you are on a rollercoaster and going up the first incline, your back is all the way against the seat... One your way down, you pick up speed because of gravity. You kind of fly out of your seat, but there is a bar that holds your position. When you go one direction, like for an example, left, really fast it throws your body to the right and visa-versa. When you get to the area where you first started, it stops really fast and you kind of lurch forward.”

Interpretation #2

Something that stood out to me in this response was when he said that “you pick up speed because of gravity.” He didn’t say that you speed. The “picking up speed” is important because it shows that he understands that the rollercoaster isn’t always going at a constant speed, but that it accelerates. Acceleration will be important when we talk about balanced and unbalanced forces, so it is good that a student can describe how that might look in the real world.

This student also has a lot to say about inertia without using that term. He noticed that when the cart moves to the left, your body will go to the right. He noticed when the cart stops suddenly that you lurch forward. This student has a lot of prior experience that I can use when talking about inertia.

Student #3 Response:

“One day we went to Michigan’s Adventure. The first ride we went on was a rollercoaster called Mad Mouse. When we got up the first hill and went around the first corner I felt like I was going to fling out of my seat. After the first corner it felt like we were traveling at the speed of lightning, When we went down the hills so fast I felt like I was motion sickness. When we went up the hills I felt like a elephant was sitting on me. It was a lot of friction between us in the rollercoaster, that’s why it was going so fast. I think the forces of the rollercoaster is gravity.”

Interpretation #3:

Like many of the responses, this response also highlights what the student is feeling when she is on the rollercoaster. the elephant that is sitting on her is her body continuing to move in its speed and direction while the cart is pulling her back up. Inertia might be easier to explain when many students have experiences like this.

One misconception that she has is that more friction will make you go faster. She knew that friction was the force between the cart and the rollercoaster, she just didn’t know if friction speeds you up or slows you down. Not a lot of students used friction in their responses, so that could also be an indicator that they aren’t as familiar with it as they are with gravity.

Student #4 Response:

“Roller coasters are very fun to ride. But riding a roller coaster has to do with the force of gravity. Without gravity there wouldn’t be no down, there would be only up. When you’re going a certain direction you will go a certain speed.”

Interpretation #4:

This student knows that gravity pulls things down, but thinks that without gravity everything would go up. Although he has the first part right, the second part of that statement isn’t necessarily correct. He also writes that direction and speed are correlated. This may be somewhat true when going up and down a hill because the forces of gravity, but he needs to know that speed has to do with the FORCE of gravity (and other forces) , not just the direction.

Task Label: What Just Happened? - Force

Task Description: I will demonstrate to a small group (4-5) of students a pencil rolling down a ramp. I will then have the students write what they saw using words such as motion, speed, position, direction, gravity, friction, force. They can also draw a diagram using arrows to show the direction of movement or force. They will be expected to caption their diagrams. After they have recorded what they saw, I will ask debriefing question to encourage a brief discussion.

Rationale:

I want the students to look at a seemingly simple demonstration and try to deconstruct it. Their pencils roll on their desks on a daily basis, so asking them questions about why and how will help me see how they can articulate their understandings of force and motion.

Questions:

1. What did you just see?
2. Why did the pencil roll down the ramp?
3. How come the pencil didn't move when it was on the table? When did it start moving?
4. How come the pencil did move UP the ramp?

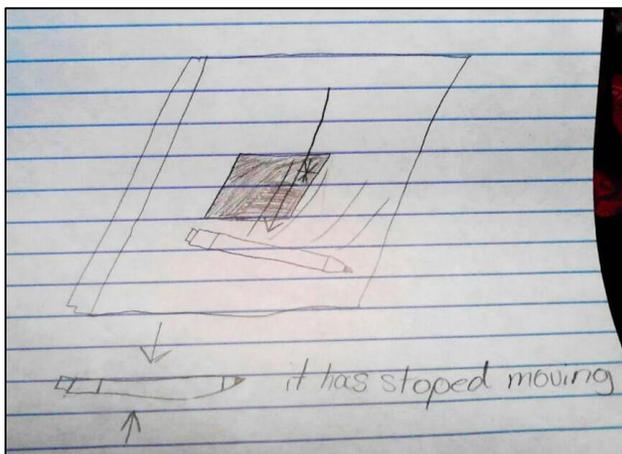
Example of student responses:

Student #1 Response:

“Miss H is keeping the pencil in one position because the gravity is not as strong.

Gravity is forcing the pencil to fall in motion.

The pencil came down off the folder and gravity pulled harder. Because of the position it was in, it gained more speed”



Interpretation #1:

This student showed knowledge of gravity. The first sentence, where she says, “keeping the pencil in one position because the gravity is not as strong” could mean that the force of gravity is not as strong as the force my hand is using to keep the pencil in place. However, later on she says that gravity pulls harder, but we know that gravity is pretty much constant. This is a common misconception that I will need to address.

In the drawing, an arrow points in the direction that the pencil was moving, and also in the other direction when it “stopped moving”. I think this is a very strong indicator that this student thinks about force in an abstract way. It is something that she can’t see, but knows it is there.

Student #2 Response:

“The hard pencil went slower than the smooth pencil because somebody make it more down when is push it. Gravity is more slow.”

Interpretation #2

This student has special education support for math and language arts. After talking to her about this response, she said that when I pushed the first pencil down the folder (ramp) it went faster than the second pencil when I just let it go. She noticed the result of my using more force on the first pencil. Even though she didn’t say that there were more forces being used than just gravity, she could put the cause and the effect together of why one pencil went faster. This will be beneficial when we begin looking at acceleration and balanced and unbalanced forces.

Student #3 Response:

“The gravity is not that strong. The pencil rolled and came to a slow stop. The pencil rolled off the table because of speed. I think the pencil rode down the ramp because of gravity and force, and gravity is only pulling down.”

Interpretation #3:

What sticks out from this student response is that the pencil came to a “slow stop.” This highlights that the student is thinking about deceleration. He doesn’t do a lot of explaining, but he can describe that the speed is changing. Another thing that showed what he knows is when he specifies that gravity only pulls down. Some students may think that gravity is pushing the pencil forward. He knows that gravity pulls down, but still knows that it still caused it to roll down the hill.

Student Cultural Ways of Knowing

Funds of Knowledge Focus:

Like my other pre-assessment, I will interview 3 of my students asking questions relating to their experiences at home, with family or friends. Instead of asking them questions about a specific event (like watching the pencil roll), I am going to ask them questions about experiences in their lives.

Small Group Talk Guiding Questions:

- What do you like to do for fun? Sports? Hobbies? Riding bikes? Skateboarding? Sledding?
- What are some activities that your parents do? Do you ever watch or go with them?
- What movies or TV shows do you like to watch?
- Are there any chores that you have to do at home?
- What kind of vacations do you go on? Have you been to an amusement park?

Summary of Small Group Talk & Observations of Students:

We started off our discussion talking about rollercoasters. It was still fresh in their mind from the stories that they were writing. PHB said that she could feel gravity pulling on her when she was going up the hill. The students in the discussion group reacted by trying to correct her. She defended her statement by saying, “gravity was pulling ME down in my seat while the rollercoaster was going up.” This rephrasing helped the students connect their own experiences of feeling forces on the rollercoaster. “The gravity made my stomach hurt when I went on a roller coaster. I can still imagine I’m on one when I am on a swing and close my eyes,” said TLE. “When we stop it makes me fly out of my seat,” JTH said. I asked the students if they ever felt like that when they were in a car. RD said, “gravity pulled me to the front even though I was wearing a seatbelt.” No one corrected his use of gravity.

I wanted to get them thinking about other forces that they might be able to feel. I asked if any of them had chores at home. JTH said that he has to vacuum. I asked if he had to move any furniture to vacuum under it. He said no, but PHB said that sometimes she had to. “Is it easy to move the furniture?” I asked. “The chairs are made out of wood...like a basket so I can move it.” She was talking about wicker chairs so I asked if she could move a bigger couch. She said, “No! That weighs too much!” . Then RD added that his dad could move the couch. I asked if they would be able to move the couch if they all tried together. They agreed that they could. No one mentioned force, so I asked if one 5th grader would have more or less force than five 5th graders. They said that five 5th graders would have more.

Interpretations and Implications for your Teaching:

Like the other pre-assessment, this discussion really shows what the students know from their lives. Most of their observations come from being able to physically feel forces. There are still some misconceptions. For example, RD said that gravity pulled him to the front if the car. He was using “force” and “gravity” interchangeably. Since gravity is something that pulls us toward Earth, there might be confusion as to whether gravity is a force that just pulls. I was surprised by this because students learned about gravity at the beginning of the year. However, they didn’t really compare that force to others.

When talking about moving furniture, it shows that they know about unbalanced forces, even if they weren’t using those terms. It is something that I can refer back to that is simple and can be used as a type of anchor throughout the unit. This unit has many components that can connect to their real life. They have shown that they notice forces around them, even if they can’t always explain how or why forces work, they definitely can answer what happens when they do.