Instructional Approach for *Force and Motion*

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- Determine speed by finding the ratio of distance covered per unit of time, S=D/T.
- Explain that a force is a push or a pull that causes an object to change speed and/or direction in the direction of the force.
- Show how contact forces change the motion of an object.
- Show how non-contact forces change the motion of an object.
- Show how forces acting on an object in opposing directions of equal strength are balanced (zero net force).
- Show how forces acting on an object in opposing directions of unequal strength are unbalanced (non-zero net force).
- Explains when all forces are balanced an object that is moving will keep moving in a straight line at a constant speed, and if an object is at rest, not moving, it will stay at rest if all of the forces acting on it are balanced.
- Show how strength of an unbalanced force is the measurement of how strong (greater) or weak (lesser) the push or pull is that causes the change in motion. A weaker or lesser force causes a small change; a strong or greater force causes a larger change in the motion of objects.

Calendar Day	No.	Activity Label	Activity Description	Activity Functions* (Why this activity in this sequence?)
2/11/13 Monday 1	1	Sled Wipeouts	Show video of Top 10 Sledding Wipeouts (http://www.afv.com/top-10-sledding-wipeouts/) Ask the students questions about what they just saw. What just happened here? Why?	Establishing a question. "What happens when you sled down a hill?"
2/11/13 Monday 1	2	How Do We Measure Speed?	Lead students to thinking about speed: Why did the sled rider hit the wall? What made #10 different from #1? Guide students to "To figure out what happens when we sled, we need to know more about speed." Some students will know that speed is distance/time, in some way or another. Using the cart as a model, students will measure the speed in terms of distance/time.	Elicit student ideas about sledding down a hill. Refine question to, "What is the sled's speed?"
2/11/13-2/12/13 Monday	3	Measuring Speed	Students will have a discussions about their experiences in cars. How do you know how fast you are going? What do you look at? Lead into MPH. Ask the students the parts of what MPH mean. M	Explore Phenomena for Patterns. Students explore how height may affect the

Tuesday 2			for miles (distance), H for hour (time). Students will then be divided into groups of 3 or 4. Each group will be given a ramp, two tracks, a cart, and a science journal. They will conduct an investigation measuring speed and testing their ideas about speed. The students will record their procedures in their science journals, while recoding their observations. Available to them are different heights to release the cart from.	speed of a cart and how to measure the speed.
2/13/13 Wednesday 3	4	Talking About Speed	Groups will come together to share their ideas about the results of their experiments through a class discussion. What patterns did they notice when they let go of their cart at from a higher notch? What evidence do you have that shows this? Did all groups notice this? The students and teacher will take some notes to review after the long break.	Explore Ideas for Patterns. Students share that they noticed the higher the cart is released the faster it will go.
2/19/13 Tuesday 4	5	Review Speed	Because of the long break from science, we will have a short review the Ideas for Patterns.	Explore Ideas for Patterns Students share that they noticed the higher the cart is released the faster it will go. (answer questions about mass and speed: https://www.youtube.com/watch?v=Z789eth4lFU)
2/19/13 Tuesday 4	6	Asking "Why?"	Students will now have the chance to explain their patterns. Students will have about 5-7 minutes to talk it over in their groups to have an explanation for their patterns. We will come together as a group to hear each other's explanations. Ask "Why do these patterns happen?"; "What about speed causes these patterns to happen?"	Students Explain Patterns They will answer "Why?" Based on their pre-assessment, most students will say that the force of gravity is what makes the cart go faster from the higher notch.

2/19/13 Tuesday 4	7	Answering "Why?"	Review gravity from their Space Bodies Unit from the fall. Gravity is the force of attraction. In this case, gravity is the force that pulls the cart toward Earth, down the ramp. When you go down a taller hill, you will go faster than if you go down a shorter hill. What other activities do see this pattern? Do you think it is true for most of them?	Introduce Scientific Ideas, Compare Student & Scientific Ideas
2/19/13 Tuesday 4	8	Speed… so what?!	When we sled, what is so important about this speed? Think about times you've been sledding. Show the video again. Ask the students leading questions to get them thinking about speed and wipeouts. Tell them that tomorrow they will be conducting an investigation about speed and wipeouts. Have students work in their groups to come up with their predictions about the relation to the speed and collisions.	Elicit Student Ideas about speed. Refine question to, "What does speed have to do with the wipeouts?"
2/19/13 Tuesday 4	9	Introducing The Laws of Motion	Hand out the "Student Anticipation Guide" and have the students complete it individually. It asks students if they agree or disagree with statements that are based upon the Laws of Motion. At the end of the Unit, students will be able to reflect on what they have learned and what misconceptions were cleared up.	Elicit Student Ideas, Students will be asked to answer questions about the Laws of Motion (pre-assess)
2/20/13 Wednesday 5	10	Speed and Collisions	Ask the students what happens when sleds wipeout. Lead students to thinking about what is needed for a collision, at least two objects. If they want to test what happens when a sled collides with something, what will they need besides a cart? Introduce the tools that the students can use to conduct their investigation: ramp, two tracks, cart, wooden block. Students will get into their groups to figure out the relationship between speed and collisions. They will use their science journals to record their findings in a chart, diagram, and words.	Explore Phenomena for Patterns to see that the faster the cart goes, when it hits the wooden block, the wooden block will move farther. This shows that force is related to speed.
2/20/13 Wednesday 5	11	Exploring Mass with Silver Cylinders	Let students know that as they finish, they will be allowed to move on to the next activity. As groups finish up their investigation, hand out the cylinder weights and have them "see what happens." They can use the block, the cart, the ramp, and tracks. Tell the	Explore Phenomena for Patterns to see that the more massive an object is, when it hits the wooden

			groups to use them and "see what happens." Have the recorder keeps notes of what they did while playing and what they saw. NOTE: this is an extension, and not all groups will get to do this activity on this day.	block, the wooden block will move farther. This shows that force is related to mass.
2/20/13 Wednesday 5	12	Speed and Collisions Discussion	The groups will come together to discuss the patterns they saw and will try to explain them. Ask questions like, "What did you notice?"; "When did the wooden block move the farthest?"; "How did you know?"; "Were there any differences that didn't make sense?"; "What do these differences mean?" "What did you notice about this experiment and what you saw in the video?", "What other connections can you make to the carts and the sledding?"	Explore Ideas About Patterns, Students Explain Patterns that they noticed about speed and force being related.
2/21/13 Thursday 6	13	Adults versus Kids	Introduce the investigation by showing the students the video of the Sled Wipeouts again. Have them compare the wipeouts with the children versus the adults. Have students predict what would happen to the wooden blocks if they added weight to their carts.	Establish a Question Elicit Student Ideas about mass. "What does mass have to do with the wipeouts?"
2/21/13 Thursday 6	14	Mass and Collisions	Students will get into their groups to figure out the relationship between Mass and collisions. Yesterday they watched how far the wooden blocks moved when the cart was moving at different speeds. Give them the same materials as yesterday, plus the cylinders. They will use their science journals to record their findings through a chart, diagram, and/or words. Before they begin, ask if the students will be able to change the speed and the weight of the carts. Ask if the information will be accurate if they change the speeds and the weight to make sure they know which variables they are controlling.	Explore Phenomena for Patterns to see that the more massive an object is, when it hits the wooden block, the wooden block will move farther. This shows that force is related to mass.
2/21/13 Thursday 6	15	Mass and Collisions Discussion	The groups will come together to discuss the patterns they saw and will try to explain them. Ask questions like, "What did you notice?", "When did the wooden block move the farthest?", "What did you notice about this experiment and what you saw in	Explore Ideas About Patterns, Students Explain Patterns that they noticed about

			the video?", "What other connections can you make to the carts and the sledding?", "What other connections can you make to your life about weight and wipeouts or collisions?"	mass and force being related.
2/22/13 Friday 7	16	Introduce Inertia	Show the Sled Wipeout video, focusing on #8 and #6. For #8, ask, "What happened to the rider when the sled hit the deck?" (they kept on going). For #6, "When the adult started to push the sled, but then stopped, what happened to the kid on the sled?" (they slid forward).	Elicit student ideas about what makes an object keep moving
2/22/13 2/25/13 Friday 8	17	Exploring Inertia	Tell the students that they will be doing tests to watch the motion of objects. "It seems that those moving objects don't like to stop or change direction." They will be doing activity "Around a Curve". The materials will be a glass marble, a metal marble, a circular track, and poster board. The students will be predicting and tracking the direction a marble goes in after released from its circular track. Students should notice that as soon as the marble exits the circular track, it will move in a straight line. Each time they change the shape of the track, the marble still moves in a straight line.	Explore Phenomena, Explore Ideas about Patterns, Students Explain Patterns in their small groups
2/25/13 Monday 8	18	Inertia Discussion	As a whole class, discuss the activity from Friday. "What happened to the marbles?" "Why did you think that the marbles would end up where you thought they would?" "Did your predictions match what happened?" "Are there any other times you have experienced something like this before?" Explain to the students that the reason the marble continued in the direction that it did, and the riders kept on moving even after their sleds stopped is because of Inertia. Ask the students if they have heard of this word before. (Some students have because of Insights) Let any students share their explanations. Define inertia as an objects resistance to motion.	Students Explain Patterns to the whole group. Teacher Introduces Scientific Ideas about inertia.
2/25/13 Monday 8	19	The First Law of Motion	For background, tell the students about the First Law of Motion. If something is moving at a certain speed, it will keep on moving at that speed forever. It will not slow down and stop unless	Compare Student & Scientific Ideas about inertia and their personal

			something pulls or pushes on it. The idea also applies to an object that is not moving. It will remain motionless until a force acts on it. Students should be able to explain it in their owns words. They will compare their ideas from this experiment with their answers from the "Student Anticipation Guide" from activity #9.	experiences.
2/25/13 8 Monday	20	The "Problem" with the First Law of Motion	Ask, "What example have you seen of this in your life? I've read your stories from the pre-assessment. I know you've seen this…" Give students an example: Have students put a pencil flat on their desks. Ask them to watch the pencil. Ask, "why isn't it moving?" Next have the students give the pencil a little push. Ask, "why did it stop?" According to the First Law of Motion it shouldn't stop. In my classroom, there will be a student who will mention friction. Have the students write down what they think friction is and what they think would happen if we were to sled down a hill without snow, but only grass.	Students will apply to near contexts by doing the quick pencil activity with teacher support. That leads into introducing a question and eliciting their ideas.
2/26/13 9 Tuesday	21	The Importance of Friction	Show the video of grass sledding: http://www.youtube.com/watch?v=Hgck8wQ_Hy0&t=3m33s Ask the students why the boy is having a hard time going down the hill. Use the students' prior knowledge to think about patterns. Ask what they think it would be like to have icy sidewalks year-round. What would that be like?	Compare student and scientific ideas about friction and their personal experiences and observations.
2/26/13 Tuesday 9	22	Friction in Action	Ask students how they might test the effects of friction. Tell them that they will get into their groups to demonstrate friction working on the carts. They will be using the ramps, tracks, and a piece of fabric for this investigation. Have them answer the questions in their small groups.	Students will apply to near contexts by experimenting with friction using fabric and ramps and carts.
2/27/13 10 Wednesday	23	The Net-Force Challenge	After looking and working with different types of forces (gravity, friction) students are expected to interpret forces using force diagrams. Thinking back to Speed and Collisions, ask "Which force was stronger, the force of the cart when it hit the block and made the block move, or the force of the block on the cart that	Explore Phenomena for Patterns, Explore Ideas About Patterns

			made it stop?" Working in their groups, the students will complete the "Net-Force Challenge" from their science journals. They will need wooden blocks and force meters. This activity has them answering questions about the patterns that they are experiencing.	
2/27/13 10 Wednesday	24	Net-Force Challenge Discussion	Students gather as a whole class and make connections between "Feeling Force" and the "Net-Force Challenge". They also explain the patterns that they noticed. The teacher explains that the greater the mass of an object the greater the force is required to change the motion of the object.	Students Explain Patterns, Introduce Scientific Ideas
2/28/13 11 Thursday	25	Talking about the Three Laws of Motion	The teacher will use the activities that the students participated in the past two weeks as examples of the Three Laws of Motion. The students will share their ideas about how the past activities explain what happens when they sled through a class discussion. Make sure to connect it to other experiences besides sledding. Give examples from their pre-assessment (roller-coasters, riding in cars).	Introduce Scientific Ideas Compare Student & Scientific Ideas
2/28/13	26	Writing About Sledding	After the discussion, the students will be allowed to write a step-by-step explanation of what happens when they sled. They will get to use this explanation on their final assessment.	Apply To Near & Distant Contexts With Support. Students will apply what they learned about the cart and its motion to the experience of riding a sled down a hill.
3/1/13	27	Final Assessment	Students will take the final summative assessment. The will be allowed to use their written explanation from the previous day as an anchor for the test.	

* Describe the activity functions using I-AIM.