Project - Invention! Force and Motion

Inside this curriculum packet you'll find several key features:

- **Curriculum Map** – Key for day-to-day plans and direction for instruction.
  - **"I can":** Student-friendly **learning** targets to focus learning for each week.
  - **Literature and Materials**: A list of materials either included in the trunk or with a link provided in the map.
  - **Products:** Student-created work products using a variety of methods.
  - **Description:** Includes links that are needed and/or helpful in the unit (also provided through links in the PowerPoint) as well as weekly ideas for instruction. Organized by primary and secondary (or "If you have time") instruction. Links with blue highlight are linked in the PowerPoint, links in yellow highlight are extra options that you'd have to type into the URL bar on your own.
  - **Closing Written/Oral Assessment:** Meant to be a way to assess weekly students' progress in attaining their learning goals – use in the manner that fits each child or your class – either through class instruction, written assessment, individual conferences, etc.
- **Weekly PowerPoint Presentation** – Includes the introduction to most of the people and activities, as well as links and visual cues for instruction
- **Force Questions:** Use these questions as the essential questions for your unit. Add them along the wall, attach them to poster paper and answer them as a class, or use in some other way that seems useful to you.
- **Pre- and Post- Test** – Helpful in evaluating prior knowledge and assessing learning growth – includes an individual and class scoring guide
- **Extra Cumulative Performance Assessment** – This unit is written as a four-week unit. However, if you choose, you can use the trunk beyond the 4-week period to extend students' learning with a culminating rocket project.

Standards Addressed:

S2P3. Students will demonstrate changes in speed and direction using pushes and pulls.

a. Demonstrate how pushing and pulling an object affects the motion of the object.

b. Demonstrate the effects of changes of speed on an object.

2.MD.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

2.MD.3 Estimate lengths using units of inches, feet, centimeters, and meters.

2.MD.4 Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

	Theme + "I Can"	Literature / Materials	Products	Description
Week 1	- I can identify several sources of energy. - I can explain the difference between a push and pull.	*Energy Makes Things Happen* *Motion: Push and Pull, Fast and Slow* - energy source cards - tug of war rope - push/pull game - Zoom Balls	- **Art:** Energy brainstorm - **Written/Art (Group):** Energy source graffiti - **Written:** Push and pull Venn diagram - **Art:** Create a cartoon explain how the Zoom Ball worked OR **Performance:** Explain to the class how push and pull worked together to make the Zoom Ball work.	- Put the word "energy" on several pieces of poster paper - have student share words that they associate with energy, using a black marker. Use the book *Energy Makes Things Happen* to introduce the concept of energy. Ask students to add to or revise their posters after reading the book, with another color marker. - Introduce the pictures of energy sources. Have students think-pair-share to describe either how that is a source of energy or what the energy is that it represents. Break students into groups, with one piece of poster paper and the source of energy pasted on it. Have groups rotate to write on the posters different things that use that source of energy. The "home" group shares the ideas they had. - Begin with a tug-of-war game. After the game, ask students to share what they were doing to win – *pulling*. Introduce the words "push" and "pull." Read the book *Motion: Push and Pull, Fast and Slow* and use an anchor chart to have students classify the types of pushing and pulling used in the book. - Distribute tools to different groups and have them identify for the group whether their tool uses pushing or pulling. Highlight for the kids that some tools use both pushing and pulling. - Then play the match-up game. Half of the students have a push/pull card, and half have activities. When you say "go," kids with push or pull have to find an activity that uses their force, and they have to explain what part of their card matched (i.e., shooting a ball uses pushing because you push a ball up and into the basket). - Complete the group Venn Diagram for items that use pushing/pulling. Have the group list things that you push (low), or have students work in partners or individually (high). If desired, use the cartoon framework to have students describe a situation in which there would be pushing and pulling doing on in real life. - Distribute the Zoom Balls to partners/groups, telling them that the Zoom Balls should move back and forth from one person to the next. Let students explore, and once a few students have begun to figure out how to make it move, ask them to explain how the push and pull work together by either completing a cartoon to answer the question, or to present and explanation to the class to answer the question – "How do the forces of push and pull work together to make the Zoom Balls move?"

Closing Written/Oral Assessment: a. List three different types of energy you use in your daily life. b. How can pushing and pulling work together? Give examples from your work.	*Level 1: Not Meeting Expectations* Is unable to answer or fails to support it with any details/reasons.	*Level 2: Inconsistently Meeting Expectations* a. Lists only two or fewer examples and/or answers that are inaccurate. b. Explains or describes a push not pull or vice versa, and/or does not give answers or gives inaccurate examples.	*Level 3: Meeting Expectations* a. Lists three correct and different examples. b. Explains that sometimes many machines use a push and a pull as the force that moves them, then lists three accurate examples.

Week	Theme + "I Can"	Literature / Materials	Products	Description
Week 2	**Theme:** Newton's First Law - I can explain that objects follow a path unless an outside force slows or stops them. - I can prove that the distance an object travels depends on the surface on which it travels	*Move It!: Motion, Forces and You* *The Magic School Bus and the Science Fair Expedition* - kicking balls - covered clipboards - toy cars - stopwatch	- **Performance:** Explain what force stopped the ball. - **Written:** Friction Experiment Sheet	- Read the book *Move It!: Motion, Forces and You* and introduce the word "force," as a push or pull that makes something move. - Ask students to give examples of forces they use in their day-to-day lives. Then introduce Isaac Newton and his three laws of motion. Use the link http://dsc.discovery.com/tv-shows/other-shows/videos/assignment-discovery-shorts-newtons-laws-of-motion.htm to watch a video introducing his laws of motion. Read the part of the book *The Magic School Bus and the Science Fair Expedition* that talks about Newton. - Tell students they are about to prove Newton's first law of motion, and review its content using the PowerPoint. Take the kicking balls outside, and ask students to kick them back and forth. - Introduce the word "inertia" using the PowerPoint presentation. - Ask them how they stopped the ball, what would happen if they hadn't stopped the ball. Then ask, "What was the force that acted on the ball to make it move? What was the force that acted on the ball to make it stop?" - Tell students that the experiment they're going to do will answer the question, "Does the surface that I roll an object affect the distance that it moves?" Ask them to make a hypothesis about how far the car will travel when it's traveling down the ramp . Group students into pairs, giving them a clipboard, car and stopwatch. Demonstrate how to set up the ramp so that the clip is facing downward. Place the car or tennis ball at the top of the ramp, and (without pushing), let gravity pull it down the ramp. Use the stopwatch to time how long it takes for that object to roll down each the surface. - After completing the experiment, pull students together and ask them which surface took the least amount of time. Tell them there's a vocabulary word that explains why – **friction**. Define friction, and ask which surface on the clipboard had the most friction, and which the least. Explain that students have just proved two different important notes about force and motion – 1. Objects follow a path unless an outside force slows or stops them. 2. The time it take for an object to move depends on the surface on which it travels. - Have students clap their hands and rub them together. Tell them the rubbing is friction, and that friction is building heat. List a few other things that might have friction. *For example: car tired on a road, the soles of shoes walking, using an eraser to erase.* - Have student reflect on the past two experiments by asking, "What was the force that stopped the ball?" and "What was the force that slowed down the race cars?" **If you have time:** - Use the link http://dsc.discovery.com/tv-shows/other-shows/videos/assignment-discovery-shorts-newtons-laws-of-motion.htm to watch a video that expands on Newton's first law. - Use the link http://vimeo.com/29612965 to watch a video from The Children's Museum of Houston that delves deeper into friction. - Use the link http://dsc.discovery.com/tv-shows/other-shows/videos/extreme-engineering-season-1-shorts-air-resistance.htm to explain air resistance. - Use the link http://www.sciencekids.co.nz/gamesactivities/detectivescience/friction.html to practice choosing surfaces and explore friction in a game format. - Use the link http://www.nbclearn.com/nfl/cuecard/50974 to watch the video on Newton's first law that relates Newton's Laws to football.

Closing Written/Oral Assessment: a. Give several examples of friction in your own life. b. Why are roads made of concrete not sand?	*Level 1: Not Meeting Expectations* Is unable to answer or fails to support it with any details/reasons.	*Level 2: Inconsistently Meeting Expectations* a. Lists only two or fewer examples and/or answers that are inaccurate or reflect an incomplete understanding. b. Give a reason, but explains ineffectively or inaccurately.	*Level 3: Meeting Expectations* a. Lists three correct and different examples. b. Explains effectively that sand has too much friction and concrete roads are more efficient.

	Theme + "I Can"	Literature / Materials	Products	Description
Week 3	**Theme:** Newton's Second Law - I can explain that more force will lead to a farther distance travelled. - I can explain that you need more force to move more mass. - I can use measurement to determine how far my objects moved.	*Forces Make Things Move* - marshmallow popper supplies - measuring tapes - scooters	- **Written:** Marshmallow Popper Experiment	- Using the book *Forces Make Things Move* review Newton's Second Law of motion. - Tell students that this week, they'll be proving Newton's second law of motion. Watch the video at http://www.youtube.com/watch? feature=player_embedded&v=iwP4heWDhvw to review and set up the second law of motion. - Introduce the experiment with the main question, "If I use more force, will the distance travelled increase or decrease?" - Review how to measure accurately. *For higher students, remind them how to convert inches to a measurements using feet AND inches (for example: 65 inches = 5 ft. 5 in.).* Use the poppers to compare how far marshmallow travels when pulling back just slightly on the balloon versus pulling back quite a bit on the balloon. When complete, pull students back together to discuss their findings, and relate it back to Newton's second law. - Answer the question on the class anchor chart. - Ask students to make a hypothesis about their answer to the question, "Do heavy objects need a strong or weak force to move?" AND "Do light objects or heavy objects need a strong or weak force to move?" Set up your classroom or an outside area with several spaces for groups to work, with pre-measured lengths of about 5 feet between the "starting line" and "finish line." Set up each station with two scooters. Each race will have two students – one will push a child on a scooter and one will push an empty scooter. The first one back to the start "wins." - When complete, pull students back together to discuss their findings. Ask them – "was it easier to push the person on the scooter or the empty scooter?" Then relate their findings back to Newton's second law. - Answer the question on the class anchor chart. **<u>If you have time:</u>** - Use the link *http://www.bbc.co.uk/schools/scienceclips/ages/6_7/forces_movement_fs.shtml and http://www.bbc.co.uk/schools/scienceclips/ages/5_6/pushes_pulls_fs.shtml* to see if the students' force experiment went the same way as the computer experiment. - Use the link http://www.nbclearn.com/nfl/cuecard/50974 to watch the video on Newton's second law that relates Newton's Laws to football.

Closing Written/Oral Assessment: a. What factors will make an object move farther? b. What factors will keep it from moving very far?	*Level 1: Not Meeting Expectations* Is unable to answer or fails to support it with any details/reasons.	*Level 2: Inconsistently Meeting Expectations* a. Lists only one example, or explains inaccurately. b. Lists only one example, or explains inaccurately.	*Level 3: Meeting Expectations* a. Lists two correct and different examples, like more mass and a smooth surface (less friction). b. Lists two correct and different examples, like less mass and a rough surface (more friction), or obstacles in the way.

	Theme + "I Can"	Literature / Materials	Products	Description
Week 4	**Theme:** Gravity + Newton's Third Law - I can explain the force of gravity and its effect on objects on Earth. - I can explain that for every action there is an equal and opposite reaction.	*Gravity Is a Mystery* - Clipboard - Toy Car - Soda Bottle - Tissue Paper - Paper Cup	- **Written/Art:** Gravity Drawings	- Put a car/ball on clipboard as a ramp. Tell students this experiment is going to answer the question, "Is there a force that moves things without me touching is?" Then, without touching the car, place it on the plain section of the ramp and let it roll downward. Ask students how it moved if you didn't touch it. Introduce the vocabulary – "gravity." Read the book *Gravity is a Mystery*, and create a class definition of gravity. Then watch the video http://dsc.discovery.com/tv-shows/other-shows/videos/assignment-discovery-shorts-newtons-explanation-of-gravity.htm. - Have students create a drawing of other things that are affected by gravity, and have them share by arranging students into two circles – an inner and outer circle. The inner circle turns toward the outer circle, and partners share. Then the inner circle rotates to the next partner and they share their ideas of the effects of gravity. - Review Newton's third law, and watch this video to review http://www.youtube.com/watch?feature=player_embedded&v=_sr3hBxu614 - Ask students to make a hypothesis about their answer to the question, "What will happen when forces are unbalanced, or one is stronger than the other?" Complete the soda bottle experiment (directions attached) to show that every action has an opposite and equal reaction. - Explain that forces can be balanced, which make inertia continue or unbalanced, which make things move. - Pull students together and ask, "What was the equal and opposite reaction that we experienced when we pushed the soda bottle?" **<u>If you have time:</u>** - Use the link http://www.nbclearn.com/nfl/cuecard/50974 to watch the video on Newton's third law that relates Newton's Laws to football.

Closing Written/Oral Assessment: a. What is gravity? b. If you ran into someone (for example, tackling on a football field), how would the effect of that tackle illustrate Newton's third law?	*Level 1: Not Meeting Expectations* Is unable to answer or fails to support it with any details/reasons.	*Level 2: Inconsistently Meeting Expectations* a. Lists only one example, or explains inaccurately. b. Explains that they will move with the force, but doesn't explain that it will be equal to the force you had while moving, or has other inaccuracies.	*Level 3: Meeting Expectations* a. Lists two correct and different examples, like more mass and a smooth surface (less friction). b. Explains that when you run into someone or something, they will move or have a reaction that is equal to the force that you use to run into them. So, in football they'll fall down or be hit with the same force you used to run.

Week 5	Theme + "I Can"	Materials	Description
	<u>If you have time: Culminating Project</u> I can design, build and explain a rocket that blasts off into space.	- water bottles - baking soda - cling wrap - vinegar - balloon - rubber band - cardstock - dowel - tape	Set students up to build and discuss the rocket. Invite friends and family to the "rocket launch." Afterward, students will complete the reflection of the rocket based on their understanding of force.

<u>Culminating Project: Rocket</u>	*Level 1: Not Meeting Expectations* Is unable to answer or fails to support it with any details/reasons.	*Level 2: Inconsistently Meeting Expectations* Incompletely or inaccurately answers some of the questions.	*Level 3: Meeting Expectations* Answers questions accurately, rocket launches.