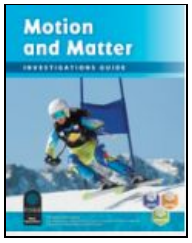
Investigation 1 - Forces



Students explore phenomena that can affect the motion of masses - the forces of magnetism and gravity. Through their investigations, students find that both magnetism and gravity can pull, and magnetism can sometimes push as well. Both forces can make things move even when not in direct contact with another object. Students refine their investigations and their abilities to use science practices and collect data regarding their observations of the interaction between paper clips and magnets. They use those data to predict how far the magnetic field extends. Building on their experience with magnetic force, students explore other pushes and pulls, considering strength and direction. Students are introduced to the effects of balanced and unbalanced forces.

Standards - 3-PS2-1, 3-PS2-2, 3-PS2-3

Investigation 1	Summary of Lesson	Priority
Part 1: Two Forces	Students explore the forces of magnetism and gravity. They bring two magnets close to each other and find that sometimes that magnets pull each other together and sometimes they push each other away. Students recognize that both magnetism and gravity can pull, and magnetism can sometimes push as well. Both forces can make things move even when not in direct contact with another object. *Read, "Magnetism and Gravity".* *Activity, "Magnetic Poles"* *FQ - What happens when magnets interact with other magnets and with paper clips?*	High Introduction to content vocabulary. Introduces anchor phenomenon as well as standards 3-PS2-1 and 3-PS2-3.
Part 2: Magnetic Force Investigation	Students build on the observations that made in Part 1 and look for patterns in data to predict how far the magnetic field extends around two magnets. Students collect data for one and three magnets, measuring the distance at which paper clips are attracted. They use those data to predict how far the magnetic field extends around two magnets. Students use and discuss science practices in the context of investigating magnetic fields. *Read, "What scientists do?"* *FQ - How is the magnetic field affected when more magnets are added?*	High Introduction to new content vocabulary and concepts. Standard 3-PS2-2 met and CCC, Cause and Effect
Part 3: More about Forces	Building on their experience with magnetic force, students explore other pushes and pulls. They expand their understanding of forces to include a force's strength and direction, and more about the effects of balanced and unbalanced forces. *Read, "Change of Motion".*	High This lesson reinforces the concept of balanced and unbalanced forces and gravity.

	Video, "All about Motion and Balance" and "All about Magnets". *FQ - What causes change of motion?*	
Assessment	i-Check	

Investigation 1 cont. - Forces

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Investigation 2 - Patterns of Motion

Students use variety of systems as phenomena to explore patterns of motion. They design wheel-and-axle systems and roll the systems down ramps to observe the pattern of motion. They extend their rolling investigations to systems with big and little wheels and use the predictable curved rolling path to meet challenges. Students make twirly birds (flying spinners) and explore the variables involved in the interaction between twirlying systems, gravity, and air. Students design tops and explore the variables that results in the best spinning top.

Standards - 3-PS2-1, 3-PS2-2, 3-PS2-3

Investigation 2	Summary of Lesson	Priority
Part 1: Wheel-and-Axle Systems	Students set up cardboard ramps down which they roll plastic disks. They put the disks on shafts to make wheel-and-axle systems that are driven by the phenomenon of gravity. Students try all kinds of configurations of wheel size, axle length, and axle position to meet a variety of challenges. *FQ - How can we change the motion of wheel-and-axle systems rolling down ramps?*	High Students are introduced to the concept of friction, pattern of motion, and systems.
Part 2: Predicting Motion of New Systems	Students roll paper cups down ramps and grapple with the different behaviors of rolling systems with two different-sized wheels. They observe the way cups roll and use the predictable curved rolling path to meet challenges. They put cups together to make them roll straight and weight them in various ways to see how weight affects rolling. *Read, "Patterns of Motion".* *Activity, "Roller Coaster Builder".* *FQ - What rules help predict where a rolling cup will end up?*	High Good example of SEP, Planning and Carrying out Investigations.
Part 3: Twirly Birds	Students make twirly birds (flying spinners) that create motion from the interaction of the forces of gravity and air friction (air resistance). First they create a standard twirly bird; then the class focuses on science practices as they investigate variables. Students take their twirly birds outdoors to find out if they fly the same. *FQ - Student-created questions, e.g., What happens to the motion of a twirly bird when the design changes?*	High Introduces the concept of standard and variable. A building block concept for later investigations. Nice examples of SEP - Asking Questions, Planning and Carrying out Investigations and Analyzing and Interpreting Data. Also, DCI PS2.A Forces and Motion.
Part 4: Tops	Students make tops from plastic disks and shafts, and spin them by applying a torque force to the shaft. After finding the arrangement of parts that produces the best top, they use the tops to look at different designs as they spin. Finally, they look at the path that a drawing top reveals as it spins. *Read, "What goes around".* *FQ - What is the best design for a top*	Low Although this activity meets standards 3-PS2-1 and 3-PS2-2, these standards have already been met in other Parts and this lesson could be skipped.
Assessment	i-Check	

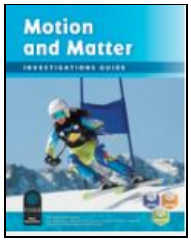
Investigation 2 cont. - Patterns of Motion

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Investigation 3 - Engineering



Students tackle an engineering design challenge in incremental steps. They first design a car that can roll “from here to there”, and then improve their designs to meet a specific distance challenge. Students continue with an investigation involving the phenomenon of gravity and explore how start position on a ramp affects the distance the cart travels. The final challenge incorporates students’ knowledge of magnetism into their cart design to meet new challenges. The investigation develops understanding of engineering design concepts and provides opportunities for students to engage in engineering practices.

Standards - 3-PS2-1, 3-PS2-2, 3-PS2-4, 3-5-ETS1-1, 3-5 ETS1-2, 3-5 ETS1-3

Investigation 3	Summary of Lesson	Priority
Part 1: From Here to There	Students tackle an engineering challenge. The only criterion given is that whatever is created must be able to roll from one place to another with a small push or a pull. The two constraints are a restricted set of materials and a time limit. The challenge provides the foundation for science learning and engineering activities throughout the rest of the investigation. *Read, “What Engineers do” and “Science Practices” and “Engineering Practices”.* *FQ - What are some important features of a car that will roll from here to there?*	Low This lesson is an engineering challenge, SEP, Planning and Carrying out Investigations. This lesson could be skipped if pressed for time as this SEP has been met in other areas. The important piece is the reading and discussing the science and engineering practices.
Part 2: Distance Challenge	Students get a second chance to build carts and improve their designs. Once they have a new working cart, students are challenged to make it roll farther or stop shorter than the initial trial distances that they recorded. The meter (m_ and centimeter (cm) are reviewed as the measurement units used by scientists to measure distance. *Read, “Soap Box Derby” and “The Metric System”.* *Activity, “Measuring Length” and “Measuring Logic”.* *FQ - How can you improve the design of your cart?*	Low This lesson is an engineering challenge, SEP, Planning and Carrying out Investigations. This lesson could be skipped if pressed for time as this SEP has been met in other areas.
Part 3: Investigation Start Position	Students measure equal amounts of water into four containers with different surface areas. After 4 days, students measure the amount of water remaining in each container to discover that the greater the surface area exposed to air, the greater the amount of evaporation. *Read, “How Engineers and Scientists work together”.* *FQ - Student-created questions, e.g., How does start position affect how far a cart rolls?*	Low This lesson is an engineering challenge, SEP, Planning and Carrying out Investigations. This lesson could be skipped if pressed for time as this SEP has been met in other areas. The important piece is the reading.
Part 4: Cart Tricks	Students modify their systems (carts) to meet new challenges. They use their knowledge of magnets to resolve new engineering challenges. *Read, “Magnets at Work”.* *FQ - How can you use magnets to do cart tricks?*	Low This lesson is an engineering challenge, SEP, Planning and Carrying out Investigations. This lesson could be skipped if pressed for time.

Assessment	i-Check	

Investigation 3 cont. - Engineering

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.

3-5 ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5 ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5 ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Investigation 4 - Mixtures

Students extend grade two experiences with matter by using tools to quantify data to develop evidence for the phenomenon of conservation of mass. They determine the mass of the materials prior to mixing and after mixing. In one mixture, salt dissolves (disappears), resulting in a solution. Students confirm that the mass of the solution is equal to the starting masses of the water and salt. They mix vinegar and baking soda and observe a bubbling reaction. Students determine that the mass of the ending mixtures is less than the mass of the original materials, which challenges students to infer that carbon dioxide gas, which escaped, has mass. The investigation and module ends with students designing and conducting a metric field day to creatively apply their understanding of standards of measurement.

Standards - 3-PS2-1, 3-PS2-2, 3-PS2-3, 3-PS2-4

Investigation 4	Summary of Lesson	Priority
Part 1: Mixing Solids and Liquids	This investigation provides students with an opportunity to develop proficiency with metric measurement tools that will be important tools for collecting experimental data going forward. Students make four different mixtures, one that includes two solids and three that use 50 mL of water and one of three solids (sand, chalk, or salt). In one mixture, the solid salt dissolves resulting in a solution. Students determine the mass of the salt and water and compare the sum to the mass of the solution to observe that the salt is still present, even though it is not visible. *Read, "Mixtures"* *Activity, "Measuring Mass", "Conservation of Mass" and "Measuring Volume"* *FQ - What happens when you mix two materials?*	Low This lesson could be skipped.
Part 2: Reactions	Students determine the mass of a volume of vinegar and baking soda before mixing them. They observe bubbling and fizzing, evidence that a new material - carbon dioxide gas - formed. The new material is evidence that a chemical reaction occurred. Students determine that the mass of the mixture after the bubbling stops is less than the mass of the original materials. This change in mass pushes students to infer that carbon dioxide has mass, which went into the air. *Read, "Reactions".* *FQ - What happens when you mix two materials?*	Low This lesson could be skipped.
Part 3: Metric Field Day	Students plan and participate in an outdoor field day featuring metric measurement. The events can call for estimation, speed, accuracy, or problem solving, and they all deal with the skill of metric measurement. It is a day of fun, enrichment with light-hearted competition. Students evaluate the events and suggest ways to redesign them for future competitions.	Low This lesson could be skipped.

	Read, "Careers you can count on". *FQ- What is the importance of accurate measurements for a metric field day?*	
Assessment		

Investigation 4 cont. - Mixtures

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.