**Phenomenal Science Unit 3.1 *Let’s Move It!***

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| **Unit 3.1: Let’s Move It!****Unit GOALS** |
| **Established Goals:** | **Transfer:** |
| DCI:**PS2.A: Forces and Motion*** Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) **(3-PS2-1) (Balanced & Unbalanced forces)**
* The patterns of an object’s motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) **(3-PS2-2) (Predicting an Object’s Motion)**

**PS2.B Types of Interactions*** [Objects in contact exert forces on each other. **(3-PS2-1**) **(Balanced & Unbalanced Forces)**](http://www.nap.edu/openbook.php?record_id=13165&page=116)
* [Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. **(3-PS2-3),(3-PS2-4) (Electric and Magnetic relationships, Magnets)**](http://www.nap.edu/openbook.php?record_id=13165&page=116)

 [**ETS1.A: Defining and Delimiting Engineering Problems**](http://www.nap.edu/openbook.php?record_id=13165&page=204)* [Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.](http://www.nap.edu/openbook.php?record_id=13165&page=204)

 [**ETS1.B: Developing Possible Solutions**](http://www.nap.edu/openbook.php?record_id=13165&page=206)* [Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.](http://www.nap.edu/openbook.php?record_id=13165&page=206)

        | Performance Expectations: Students who demonstrate understanding can . . . **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. [Clarification Statement: For example,  an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.] **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. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]  **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. [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]  **3-PS2-4** Define a simple design problem that can be solved by applying scientific ideas about magnets.\* [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.] **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, and 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. \* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. |
| SEP: **1.   Asking questions  and defining problems**2.  Developing and using models**3. Planning and carrying out investigations**4.  Analyzing and interpreting data5.  Using mathematics and computational thinking6. Constructing explanations (for science) and designing solutions (for engineering)7.  Engaging in argument from evidence8. Obtaining, evaluating, and communicating information | CCC: 1. **Patterns**
2. **Cause and effect**
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
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| **Possible Naive Conceptions:** | **Meaning:** |
| * A charged object can only attract other charged objects.
* Energy is a thing. This is a fuzzy notion, probably because it is difficult to imagine an amount of an abstraction.
* An object at rest has no energy.
* The only “natural” motion is for an object to be at rest.
* If an object is at rest, no forces are acting on the object.
* Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting upon it.
* Large objects exert a greater force than small objects.
* A force is needed to keep an object moving with a constant speed.
* Large/heavier objects exert a greater force than small/lighter objects.
 | Essential Question(s): Students will consider . . . What makes objects move the way they do? | Understandings: Students will understand that observing the effects of balanced and unbalanced forces helps make predictions of future patterns of motion. Magnetic and electric fields cause the motion of certain objects because of their strength and/or relative distance.  |
| **Expected Prior Knowledge:** | **Acquisitions: (IC Level Performance Expectations)** |
| **K.PS2. A and B-** Students analyze how different strengths of pushes and pulls change the direction and speed of an object.**K.PS3.C-** Energy can transfer from one object to another object.**K.ETS1.A-** People want to change or create a design through questions, making observations, and gathering information.  A problem can be solved through engineering.**1.ESS1.A-** Patterns can be observed, described, and predicted. | **Students will know . . . (Key Concepts)*** You cannot see a force, yet you can see the effect of a force through the motion of an object.
* An object at rest is not moving.
* An object will move because of the effects of an unbalanced force.
* One object's motion will help you to predict another object's motion.
* Two objects that are not touching can force one or both objects to move.
* Two magnets (of the same magnitude) are stronger than one magnet (of the same magnitude). Therefore, two magnets will exert a greater force than one magnet acting alone.
* Opposite poles of a magnet will attract, or pull magnets together.
* Like poles of a magnet will repel, or push magnets apart.
* An electrical force will be observed through the movement of charged objects (positive and negative).
* Magnets have a force.

**Students will be able to . . .** * Construct an explanation of how a real world activity uses motion and force, by using pictures and words in a poster.
* Relate the data gathered from previous investigations of motion in order to predict the motion of two objects that are not touching.
* Argue and ask questions about the strength of a magnet and how to manipulate its strength.
* Design a model to compare the patterns of magnetic behavior with various materials and the magnetic field of Earth.
* Apply understanding of magnetism and electricity forces together to show how they can be used to solve simple problems.
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| **Focus Questions:** | **Conceptual Flow/Teacher Background** |
|  **Instructional Cycle 1:**Why do the dishes stay in place?* How can you win a tug-of-war against any opponent?
* Why do objects fall?  How much force is needed?
* Why does a pendulum move?

 **Instructional Cycle 2**What causes objects to move when they are not touching?* Why does this sock stick to the dryer sheet? How do magnets behave?
* How do magnets behave around other objects?
* How do magnets work?
* What allows a large object,  such as a car, to move?

  | A force is a push or a pull on an object.  Credit is given for most of our knowledge about force to Sir Isaac Newton, a famous scientist and mathematician. He developed three laws of motion, which are simplified as  1) When balanced forces occur, an object is not moving.  2) Gravity is the force from the Earth that pulls an object down. 3) Force causes change in the speed and direction of the motion of an object. The greater the force placed on an object, the greater the change in motion.  It is also important to understand that Static electricity is a form of electricity.  When two objects are rubbed together, the negative and the positive particles cause an attraction. Negative particles leave an object, causing it to become positively charged. Natural magnets are found in some rocks which contain iron. Magnets have two poles:  a north-seeking  and a south-seeking pole.  An electromagnet is made by constructing a battery, wire, and an axle (nail).  Each force acts on one particular object and has both a strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)  The patterns of an object’s motion in various situations can be observed and measured; when past motion exhibits a regular pattern, future motion can be predicted from it.   **Websites for Forces and Motion**     Balanced and Unbalanced Forces<https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html> Forces in Motion <http://www.bbc.co.uk/schools/scienceclips/ages/10_11/forces_action.shtml><http://studyjams.scholastic.com/studyjams/jams/science/forces-and-motion/force-and-motion.htm>  Magnets and Static Electricity [http://www.sciencekids.co.nz/sciencefacts/magnets.htm](http://www.sciencekids.co.nz/sciencefacts/magnets.html)l <http://www.physics4kids.com/files/elec_magneticfield.html> <http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/magnetism.htm><http://www.songsforteaching.com/science/physicalscience/musicwithmar-magnets.htm> |