<table>
<tr><th colspan="3">Readorium Alignment to FOSS Kit: Electromagnetic Force</th></tr>
<tr><th>Readorium Books
By Standard</th><th>Magazine Articles (A) and Science Alive Videos (V) By Standard</th><th>Teacher Resource Center Classroom Strategy Lessons (CL) with Articles (A) by Standard</th></tr>
<tr><td colspan="3">NGSS: MS-PS2: Motion and Stability: Forces and Interactions—How can one explain and predict interactions between objects and within systems of objects?</td></tr>
<tr><td colspan="3">PS2.A Forces and Motion: How can one predict an object’s continued motion, changes in motion, or stability? [For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first but in the opposite direction (Newton’s third law). The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. Forces on an object can also change its shape or orientation. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.]</td></tr>
<tr><td>• Newton’s Laws
• Scientists who Changed the World
• Sports Physics</td><td>• A Titanic Collision: The Science Behind the Sunken Ship (A)</td><td></td></tr>
<tr><td colspan="3">PS2.B: Types of interactions: What underlying forces explain the variety of interactions observed? [Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
Forces that act at a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object (a ball, a charged object, or a magnet, respectively).]</td></tr>
<tr><td>•</td><td>•</td><td></td></tr>
<tr><td colspan="3">NGSS: MS-PS2-2: Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.</td></tr>
<tr><td>• Newton’s Laws
• Scientists who Changed the World
• Space Rocks!</td><td>• A Titanic Collision: The Science Behind the Sunken Ship (A)</td><td>•</td></tr>
<tr><td colspan="3">NGSS: MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</td></tr>
<tr><td>• Sea Floor Spreading</td><td>• The Many Uses of Submarines (A)</td><td>•</td></tr>
<tr><td colspan="3">NGSS: MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</td></tr>
<tr><td>• Sea Floor Spreading
• Total Lunacy
• Scientific Method</td><td>•</td><td>•</td></tr>
<tr><td colspan="3">NGSS: MS-PS3: Energy- How is energy transferred and conserved?</td></tr>
<tr><td colspan="3">NGSS: MS-PS3.A: Definitions of energy?
What is energy? [Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. A system of objects may also contain stored (potential) energy, depending on their relative positions. For example, energy is stored-in gravitational interaction with Earth-when an object is raised, and energy is realesd when the object falls or is lowered. Energy is also stored in the electric fields between charged particles and the magnetic fields between magnets, and it changes when these objects are moved relative to one another. Stored energy is decreased in some chemical reactions and increased in others.]</td></tr>
<tr><td>• Lights Sound Action
• Sports Physics</td><td>•</td><td>•</td></tr>
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• Newton's Laws		
NGSS: MS-PS3.B: Conservation of energy and energy transfer What is meant by conservation of energy? How is energy transferred between objects or systems? [When the motion energy of an object changes, there is inevitably some other change in energy at the same time. For example, the friction that causes a moving object to stop also results in an increase, in the thermal energy in both surfaces; eventually heat energy is transferred to the surrounding environment as the surfaces cool. Similarly, to make an object start moving or to keep it moving when friction forces transfer energy away from it, energy must be provided from, say, chemical (e.g.burning fuel) or electrical (e.g. an electric motor and a battery) processes.		
• Sports Physics	• Weapons Older than Dirt: The History of Some of the World's Most Ancient Weapons (A) • Things That Go BOOM!: The History and Chemistry of Explosives (A)	•
NGSS: MS-PS3.C: Relationship between energy and forces How are forces related to energy? [When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. For example, when energy is transferred to an Earth-object system as an object is raised, the gravitational field energy of the system increases. This energy is released as the object falls; the mechanism of this release is the gravitational force. Likewise, two magnetic and electrically charged objects interacting at a distance exert forces on each other that can transfer energy between the interacting objects.]		
• Lights Sound Action	• Hot Stuff: Heat on the Move (A)	•
NGSS: MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.		
• Sports Physics	• Weapons Older than Dirt: The History of Some of the World's Most Ancient Weapons (A) • Things That Go BOOM!: The History and Chemistry of Explosives (A)	•
NGSS: MS-PS3-5: Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.		
• Lights Sound Action • Sports Physics	• Weapons Older than Dirt: The History of Some of the World's Most Ancient Weapons (A) • Machines of Ancient War: The Physics and History of Siege Engines (A)	•
NGSS: MS-ESS3: Earth and Human Activity-How do Earth's surface processes and human activities affect each other?		
NGSS: MS-ESS3.A: Natural Resources How do humans depend on Earth's resources? [Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geological processes. Renewable energy resources, and the technologies to exploit them, are being rapidly developed.]		
•	•	•
NGSS: MS-ESS3.C: Human impacts on earth systems How do humans change the planet? [Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of many other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically,, as human populations and per capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.]		

•	•	•
NGSS: MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
• Pollution	• Global Temperatures (A)	•
NGSS: MS-ETS1: Engineering design-how do engineers solve problems?		
NGSS: MS-ETS1.A: Defining and delimiting an engineering problem What is a design for? What are the criteria and constraints of a successful solution? [The more precisely and design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions (e.g., familiarity with the local climate may rule out certain plants for the school garden).]		
• Artificial Satellites • Character Traits of a Good Scientist • Learning from Natural Disasters • Pollution	• Inventor of the Toughest Stuff (A) • Antlers, Beaks, Geckos and Us (V) • Safe from Tsunamis (V) • An Amazing Teen Scientist (A)	• Context Clues (CL-3 A-1 Things That Go Boom!) • Determining Importance (CL-2, A-1. Dragonflies: Flying Aces)
NGSS: MS-ETS1.B: Developing possible solutions What is the process for developing potential design solutions? [A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. In any case, it is important to be able to communicate and explain solutions to others. Models of all kinds are important for testing solutions, and computers are a valuable tool for stimulating systems. Simulations are useful for predicting what would happen if various parameters of the model were changed, as well as for making improvements to the model based on peer and leader (e.g., teacher) feedback.]		
• Superstition or Science	• Computer's Best Friend(A) • Things That Go BOOM!: The History and Chemistry of Explosives (A) • Crazy Careers in Science (A) • Space psychologist (A) • From Waste to Energy: Bacteria Gives a Boost(V) • Hydrogen Power(V) • Wave of Future- Green Gasoline (V) • Pig Poop & Other Energy Sources (V) • Getting Ready for Earthquakes (V) • Chores Don't Have to be a Pain in the But...ler (V) • Musical Computer (V) • Robots of Your Dreams(V) • Robots with Whiskers (V) • Sensible Sensors (V) • Signing Made Simple (V) • Smart Cars!(V) • The Ins and Outs of the Brain (V) • Strong & Sensitive: Metal Foam (V) • Smart Helicopters (V) • X-Ray Vision: Beyond the Bones (V) • Picking Your Brain (V) • The Creative Brain (V) • The Good, Bad, and Baby (V) • What Makes Us Tick (V)	• Context Clues (CL-3 A-1 Things That Go Boom!)

	• Locked-in Syndrome: (V) • Nanoparticles: Tiny Glowing Cancer Killers (V) • Tongue Driven (V) • Vision for Blind People - Fact or Fiction(V) • Extreme Bacteria (V) • Lord of the Tree Rings (V) • Coral Corrosion (V) • Disappearing Frogs (V) • Earthworm Invasion (V) • ESP: A Lab in a Can (V) • Flowing Free (V) • Virtual Wildfires (V) • Women Powered Robots (V) • Wave of the Future: Clean Ocean Energy (V)	
NGSS: MS-ETS1.C: Optimizing the design solution How can the various proposed design solutions be compared and improved? 'There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Comparing different designs could involve running them through the same kinds of tests and systematically recording the results to determine which design performs best. Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process-that is, some of those characteristics may be incorporated into the new design. This iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. Once such a suitable solution is determined, it is important to describe that solutions, explain how it was developed, and describe the features that make it successful.]		
• Microscopes • Space Race • Superstition or Science	• Do Scientists Cheat? (A)	•
NGSS: MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
• Artificial Satellites • Character Traits of a Good Scientist • Learning from Natural Disasters • Pollution	• Inventor of the Toughest Stuff (A) • Antlers, Beaks, Geckos and Us (V) • Safe from Tsunamis (V) • An Amazing Teen Scientist (A)	• Context Clues (CL-3 A-1 Things That Go Boom!) • Determining Importance (CL-2, A-1. Dragonflies: Flying Aces)
NGSS: MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
• Superstition or Science	• Computer's Best Friend(A) • Things That Go BOOM!: The History and Chemistry of Explosives (A) • Crazy Careers in Science (A) • Space psychologist (A) • From Waste to Energy: Bacteria Gives a Boost(V) • Hydrogen Power(V)	• Context Clues (CL-3 A-1 Things That Go Boom!)

	• Wave of Future- Green Gasoline (V) • Pig Poop & Other Energy Sources (V) • Getting Ready for Earthquakes (V) • Chores Don't Have to be a Pain in the But...ler (V) • Musical Computer (V) • Robots of Your Dreams(V) • Robots with Whiskers (V) • Sensible Sensors (V) • Signing Made Simple (V) • Smart Cars!(V) • The Ins and Outs of the Brain (V) • Strong & Sensitive: Metal Foam (V) • Smart Helicopters (V) • X-Ray Vision: Beyond the Bones (V) • Picking Your Brain (V) • The Creative Brain (V) • The Good, Bad, and Baby (V) • What Makes Us Tick (V) • Locked-in Syndrome: (V) • Nanoparticles: Tiny Glowing Cancer Killers (V) • Tongue Driven (V) • Vision for Blind People - Fact or Fiction(V) • Extreme Bacteria (V) • Lord of the Tree Rings (V) • Coral Corrosion (V) • Disappearing Frogs (V) • Earthworm Invasion (V) • ESP: A Lab in a Can (V) • Flowing Free (V) • Virtual Wildfires (V) • Women Powered Robots (V) • Wave of the Future: Clean Ocean Energy (V)	
NGSS: MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the solution to better meet the criteria for success		
• Microscopes • Space Race • Superstition or Science	• Do Scientists Cheat? (A)	•
NGSS: MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved		
• Microscopes • Space Race • Scientific Method	•	• Graphic Features (CL-2, A-1 High School Track)