**5th Grade Launch Unit**

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| **Unit Topic: Balanced and Unbalanced Forces**  **Estimated Time: 2 Weeks**  **This Launch Unit was designed to address a possible learning gap between 4th Grade Science and 5th Grade Science.** | | | | | |
| **Standards** | | | | | |
| **S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces**  a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.  b. Construct an argument to support the claim that gravitational force affects the motion of an object.  c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks. *(Clarification statement: The use of mathematical formulas is not expected.)*  [Click here to see the Force and Motion Learning Progression – Appendix A](#appendixA) | | | | | |
| **Science and Engineering Practices & Crosscutting Concepts:** [See Appendix B](#AppendixB) | | | | | |
| **Teacher Background Knowledge** | | | | | |
| *This section is included for your own background knowledge and*  *is not intended for direct student instruction.*   * As we consider the motion of objects, we must ensure that students understand that a force is a push or a pull that causes an object to start moving, stop moving, or change direction. Students are familiar with forces in their everyday life such as pulling a wagon forward or hitting a baseball with a bat to change the direction of the ball. In a soccer game there are many examples of forces that act on the ball such as starting the ball in motion, stopping it, or changing the direction of the ball as a result of a force that is applied to the ball. * It is also important for students to understand that more force is needed to make an object go faster. Remind students what it is like to bump into a person who is running down the hall at a fast speed versus running into someone moving at a slow speed. The force is much greater for the two people running into each other at a faster speed than a slower speed. Students who have been to the beach can think about the different types of waves in the ocean and their forces. The larger waves have a stronger force than a smaller wave. * Gravity is the force that keeps us on earth; it pulls objects toward the center of the earth. Because of gravity objects fall to the ground and we don’t float into the air. It also keeps or moon in orbit and the sun’s gravity keeps the planets in orbit. Gravity is the force that causes a roller coaster to move along the track. As the roller coaster begins the chain pulls the cars to the top of the hill and then the roller coaster is pulled by gravity and momentum through the rest of the ride. On roller coasters the first hill is your tallest and steepest hill and then the roller coaster goes faster as it accelerates toward the ground. * One common misconception that students and adults have about gravity is that lighter objects fall slower toward the earth while heavier objects fall faster. All objects accelerate to earth due to gravity at the same rate. A piece of paper or a feather fall slower toward the earth due to the effect of air resistance. If the objects were placed in a vacuum, they would all fall at the same rate towards earth. * Simple machines are “simple” because they have one or no moving parts. A machine is a device that makes work easier. In order for work to occur something must move in the direction the force is being applied. A simple machine reduces the effort (force) need to move the object by moving the object a greater distance. The simplest machine is the inclined plane or ramp. It works by allowing you to lift an object to a higher level by traveling a greater distance up the ramp. A wedge is an inclined plane turned on its side. A wedge pushes two objects apart; examples are a knife, shovel, nail or an ax. A screw is also made up of an inclined plane wrapped around a cylinder. The spacing of the threads determines how hard it will be to turn the screw. Another simple machine is a lever. The point where the lever moves is called the fulcrum. When you change the position of the fulcrum you are able to do work with less effort. Examples of levers include a seesaw, rake, and hockey stick. A wheel and axle allows you to roll an object by reducing the amount of friction on the object. The larger the wheel the easier it is to move an object. The final simple machine is a pulley. It is made of a wheel and axle with a rope or chain or attached. A pulley allows you to change the direction of the motion so that you can lift an object off of the ground. | | | | | |
| **Big Ideas/Enduring Understandings:**   * A force is simply a push or pull (usually on an object) * Forces can cause objects to start moving, stop moving, or change direction * An object’s size and the amount of force exerted on an object affect its speed and motion * Gravity is the earth’s pull on things. Things on or near the earth are pulled toward it by the earth's gravity * Simple machines are tools that help us do work. Simple machines make work easier for us by changing the amount of force (pushing or pulling) needed to do certain kinds of work | | | **Essential Questions:**   * What is the difference between a balanced and unbalanced force? * How is the motion of an object related to the amount of force that is applied to the object? * How can forces be used to make objects move, change direction, or stop? * How does gravity affect the motion of an object? * How do simple machines change forces to make work easier for people? | | |
| **Vocabulary:**  Force  Gravity  Friction  Balanced forces Unbalanced forces Distance | Motion  Roll  Slide  Pull  Rest  Length | | Speed  Push  Lever  Pulley  Wedge | | Inclined plane  Wheel and axle  Screw  Forces |
| **Literature Connections:**  Forces and Motionby Leon Gray  The Great Wonder: The Building of the Great Pyramid(Smithsonian Odyssey) by Annabelle Howard  The Lazy Bear by Brian Wildsmith | | | **STEM Career Connections:**  Mechanical engineer, biomechanical engineer, physicist, construction worker, carpenter, machinist | | |
| **Materials and Safety Considerations:**  \*\*Lessons are designed with simplicity in mind. Full materials lists and safety considerations can be found if you look below for “Click here for full lesson.” | | | **Distance Learning Options:**  \*\*Pieces of the lessons that can easily be adapted or used as-is for distance learning are highlighted below | | |
| **Lesson Components** | | | | | |
| **PHENOMENA** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * I can make a ball start moving by kicking it. | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * When you let go of an object, it falls to the ground. * When dropped, objects of different masses (but more or less the same shape) will hit the ground at the same time. | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * The Great Pyramids of Giza were built in 2500 B.C. Each block that makes of the pyramids weighs 2.5 tons (about how much a car weighs). No one is really sure how they were built. | |
| **ENGAGE** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * Have students observe a ball kicked with light and hard kicks. Students will describe what happens, noting cause and effect relationships * Students will make a t-chart listing pushes and pulls in everyday life | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * Use the [Leaning Tower of Pisa Recording Sheet](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=10f85673-0c97-45dd-a550-91514de96c18) to guide this activity where you drop a ball, a flat piece of paper, a crumpled piece of paper, and a larger ball to compare gravity’s effect on each object. (This is an Engage and Explore activity) | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * Push a brick across the table with your finger, tie a string around the brick and pull it, then use the same string, but put the brick on a row of round pencils. Students will ask questions and observe each step of the task to introduce simple machines. | |
| **EXPLORE** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * Students will identify balanced and unbalanced forces in this [Tug of War Video](https://youtu.be/rP2MviNn52g) | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * See Leaning Tower of Pisa activity above | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * Students will work in groups to complete 6 [Simple Machine Stations](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=58ea6427-c76c-4dbe-86ef-d07b6d9722c6). Students should pay careful attention to cause/effect relationships. * Students can use simple machines to design digital Rube Goldberg machines using a free app called [Inventioneers](https://www.filimundus.com/inventioneers/). | |
| **EXPLAIN** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * HMH GA SCIENCE TEXTBOOK RESOURCES   Unit 6, Lesson 1 (pp. 303-305, p. 308-311, p. 314-315) Flip Chart p. 36 and accompanying Student Worktext pages: Unit 6, Lesson 3 (pp. 325A-326) Digital Lesson: *What Are Forces?*   * HMH DIMENSIONS ONLINE RESOURCES   **Grade 3** Unit 2 Lesson 1, pp. 68–73 Unit 2 Lesson 2, pp. 88–93  Hands On Activity: *Exploring Forces*  Unit Project: *Balanced Forces*  Unit Performance Task: *Engineer It! Moved Without Touching* | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * HMH GA SCIENCE TEXTBOOK RESOURCES   Unit 6, Lesson 1 (p. 306)   * HMH DIMENSIONS ONLINE RESOURCES   Grade 3 Unit 2 Lesson 2, pp. 96-98  Grade 5Unit 5 Lesson 1, pp. 282-286  Grade 5 Unit 5 Lesson 1, Extra Hands-On Activity: Falling to Earth, p. 272B (TE) | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * HMH GA SCIENCE TEXTBOOK RESOURCES   Unit 6, Lesson 4 (pp. 329A-346)  Flip Chart page 37- *Machines and Forces*   * HMH DIMENSIONS ONLINE RESOURCES   Grade 3 SE/TE:  Unit 2 Lesson 1, pp. 83–84  Science and Engineering Leveled Readers:  On Level/Extra Support Readers: *How Do We Use Machines?* Enrichment Reader: *Building with Machines* | |
| **EXPAND** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * [Balanced Forces Unit Project](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=7ad62c48-dca1-47ab-b3f9-9f8af8d5d819): Students will work in teams to keep an object at rest when forces are changing around it | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * Mini-STEM Challenge: [Engineer a parachute](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=5c45f0f2-a194-4027-9236-8895342e1606)   Students will design a parachute that a plastic skydiver can use to jump from 3 meters high and float to the ground | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * Students will choose one Rube Goldberg machine featured on [this site](http://coolmaterial.com/roundup/rube-goldberg-machines/) and describe all the simple machines that were used. | |
| [Click here to download the unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=1ba1f103-5500-4a30-8df4-8dffcd1d7519) | | [Click here to download the unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=1ba1f103-5500-4a30-8df4-8dffcd1d7519) | | [Click here to download the](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=fbba68fa-af46-41be-8ab3-14664581f3b4)  [unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=fbba68fa-af46-41be-8ab3-14664581f3b4) | |
| **ADDITIONAL RESOURCES** | | | | | |
| **STEM Challenges**   * [Roller Coaster Rally](https://drive.google.com/file/d/15RbW1bEvgI4YSEmtZB9SfGfozeOoNZ97/view?usp=sharing) * [Ancient Machines](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=4dfa1122-7e6f-4544-b198-32bd34f19745&t=v) | **Science Probes**   * [Apple on a Desk](https://www.dropbox.com/sh/msgq2lnc423z0bk/AADX_F_dit5H_BEgAUN2oz4Ia/4th%20Grade%20Science%20Probes?dl=0&preview=AppleOnTheDeskV3-ch8.pdf&subfolder_nav_tracking=1&t=v) * [Rolling Marbles](https://www.dropbox.com/sh/msgq2lnc423z0bk/AADX_F_dit5H_BEgAUN2oz4Ia/4th%20Grade%20Science%20Probes?dl=0&preview=RollingMarblesV3-ch9.pdf&subfolder_nav_tracking=1&t=v) * [Dropping Balls](https://www.dropbox.com/sh/msgq2lnc423z0bk/AADX_F_dit5H_BEgAUN2oz4Ia/4th%20Grade%20Science%20Probes?dl=0&preview=DroppingBallsV3-ch10.pdf&subfolder_nav_tracking=1&t=v) * [Talking about Gravity](https://www.dropbox.com/sh/msgq2lnc423z0bk/AADX_F_dit5H_BEgAUN2oz4Ia/4th%20Grade%20Science%20Probes?dl=0&preview=TalkingAboutGravityV1-ch13.pdf&subfolder_nav_tracking=1&t=v) | | **Picture Perfect Sci**   * Sheep in a Jeep | | **Mystery Science**   * How could you win a tug-of-war against a bunch of adults? * What makes bridges so strong? * How can you go faster down a slide? |
| **ASSESSMENT** | | | | | |
| ***TOPIC 1: Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.***   * HMH Georgia Science:   p. 319, #5; p. 350, #19   * HMH Dimensions:   3rd Grade Unit 1 Lesson 1  p. 92 #6  p. 93 #7-8  p. 105 #1 | | ***TOPIC 2: Construct an argument to support the claim that gravitational force affects the motion of an object.***   * Students will construct an argument using the [CER Framework](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=41059482-c954-4489-8625-999d9df09672) to support the claim “Gravity affects the motion of an object.” * HMH Georgia Science   p. 319, #6; p. 350, #20 | | ***TOPIC 3: Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.***   * HMH Georgia Science   p. 344, #3; p. 345, #6   * Share with students the line attributed to Archimedes, “If I had a place to stand and a lever big enough, I could move the world.” Have students write a letter to Archimedes agreeing or disagreeing with him while **explaining how forces are changed when simple machines are used.** | |
| **Differentiation:**  \*\*Click on full versions of lessons listed above for specific suggestions for differentiation | | | | | |

**APPENDIX A**

**Disciplinary Core Idea: Physical Science Learning Progression**

**Force & Motion**

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| Kindergarten | 2nd Grade | 4th | 8th | High School Physical Science |
| SKP2. Obtain, evaluate, and communicate information to compare and describe different types of motion.  a. Plan and carry out an investigation to determine the relationship between an object’s physical attributes and its resulting motion (straight, circular, back and forth, fast and slow, and motionless) when a force is applied. (Examples could include toss, drop, push, and pull.)  b. Construct an argument as to the best way to move an object based on its physical attributes. | **S2P2. Obtain, evaluate, and communicate information to explain the effect of a force**  **(a push or a pull) in the movement of an object (changes in speed and direction).**  a. Plan and carry out an investigation to demonstrate how pushing and pulling on an object affects the motion of the object.    b. Design a device to change the speed or direction of an object.  c. Record and analyze data to decide if a design solution works as intended to change the speed or direction of an object with a force (a push or a pull) | **S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces**  a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.  b. Construct an argument to support the claim that gravitational force affects the motion of an object.  c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks. *(Clarification statement: The use of mathematical formulas is not expected.)* | **S8P3. Obtain, evaluate, and communicate information about cause and effect relationships between force, mass, and the motion of objects.**  a. Analyze and interpret data to identify patterns in the relationships between speed and distance, and velocity and acceleration. (*Clarification statement: Students should be able to analyze motion graphs, but students should not be expected to calculate velocity or acceleration.)*  b. Construct an explanation using Newton’s Laws of Motion to describe the effects of balanced and unbalanced forces on the motion of an object.  c. Construct an argument from evidence to support the claim that the amount of force needed to accelerate an object is proportional to its mass (inertia) | **SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion**  a. Plan and carry out an investigation and analyze the motion of an object using mathematical and graphical models. *(Clarification statement: Mathematical and graphical models could include distance, displacement, speed, velocity, time and acceleration.)*  b. Construct an explanation based on experimental evidence to support the claims presented in Newton’s three laws of motion.  *(Clarification statement: Evidence could demonstrate relationships among force, mass, velocity, and acceleration.)*  c. Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects.  d. Use mathematics and computational thinking to identify the relationships between work, mechanical advantage, and simple machines. |

**APPENDIX B**

**Science and Engineering Practices:** Based on the fourth quarter standards, there may be a gap in the understanding of the following Science and Engineering Practices:

# Obtaining, Evaluating, and Communicating Information: Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.



**Cross-Cutting Concepts:**

