# Unit 2: Physical Science - Why Do Some Things Stop While Others Keep Going?

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **5 weeks**
Status: **Published**

## General Overview, Course Description or Course Philosophy

*Science and engineering—significant parts of human culture that represent some of the pinnacles of human achievement—are not only major intellectual enterprises but also can improve people's lives in fundamental ways. Although the intrinsic beauty of science and a fascination with how the world works have driven exploration and discovery for centuries, many of the challenges that face humanity now and in the future—related, for example, to the environment, energy, and health—require social, political, and economic solutions that must be informed deeply by knowledge of the underlying science and engineering.*

## OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Learning Set 1: What Determines How Fast or High an Object Will Go? How is energy transferred and conserved? What is energy? What is meant by conservation of energy? How is energy transferred between objects or systems? How are forces related to energy?

Learning Set 2 - Why Do Some Things Stop? How can one explain the structure, properties, and interactions of matter? How do particles combine to form the variety of matter one observes? What is energy? How is energy transferred and conserved? What is energy? What is meant by conservation of energy? How is energy transferred between objects or systems? How are forces related to energy? How are waves used to transfer energy and information? What are the characteristic properties and behaviors of waves? What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there? How are instruments that transmit and detect waves used to extend human senses?

Learning Set 3 - Why Do Some Things Keep Going? How can one explain the structure, properties, and interactions of matter? How do particles combine to form the variety of matter one observes? How do substances combine or change (react) to make new substances? How doesone characterize and explain these reactions and make predictions about them? How do engineers solve problems? What is the process for developing potential design solutions? What is the process for developing potential design solutions? How can one explain and predict interactions between objects and within systems of objects? What underlying forces explain the variety of interactions observed? How is energy transferred and conserved? What is energy? What is meant by conservation of energy? How is energy transferred between objects or systems? How are forces related to energy? What are the characteristic properties and behaviors of waves? What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there? How are instruments that transmit and detect waves used to extend human senses?

## CONTENT AREA STANDARDS

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| 6-8.MS-PS1-4 | Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. |
| 6-8.MS-PS1-6 | Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. |
| 6-8.MS-PS2-3 | Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. |
| 6-8.MS-PS3-1 | Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. |
| 6-8.MS-PS3-5 | Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. |
| 6-8.MS-PS4-3 | Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. |
| 6-8.MS-PS4-1 | Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. |
| 6-8.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. |
| 6-8.MS-PS3-3 | Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. |
| 6-8.MS-PS4-2 | Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. |

## RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

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| MA.7.RP.A.2 | Recognize and represent proportional relationships between quantities. |
| LA.WHST.6-8.1.A | Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. |
| MA.7.EE.B.3 | Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. |
| LA.WHST.6-8.1.B | Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. |
| LA.WHST.6-8.1.C | Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. |
| MA.7.EE.B.4 | Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. |
| LA.WHST.6-8.1.D | Establish and maintain a formal/academic style, approach, and form. |
| LA.WHST.6-8.1.E | Provide a concluding statement or section that follows from and supports the argument presented. |
| LA.WHST.6-8.2.D | Use precise language and domain-specific vocabulary to inform about or explain the topic. |
| MA.7.SP | Statistics and Probability |

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| LA.WHST.6-8.6 | Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently. |
| LA.WHST.6-8.10 | Write routinely over extended time frames (time for research, reflection, metacognition/self correction, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |
| TECH.9.4.8.CI.1 | Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4). |
| TECH.9.4.8.CT.1 | Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2). |
| TECH.9.4.8.CT.3 | Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome. |

## Declarative Knowledge

Students will understand that:

- 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.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
- Proportional relationships (e.g.speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
- Models can be used to represent systems and their interactions such as inputs, processes, andoutputs – and energy and matter flows within systems.
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide.
- In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
- The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred

to or from the object.

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.
- Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- Some chemical reactions release energy, others store energy.
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
- 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 the characteristics may be incorporated into the new design.
- The 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.
- 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.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- The more precisely a 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 is likely to limit possible solutions.
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- A sound wave needs a medium through which it is transmitted.
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.  However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

## Procedural Knowledge

Students will be able to:

- Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed
- Undertake a design project to construct, test, and modify a device that either releases or absorbs

thermal energy by chemical processes.

- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces
- Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- Interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- 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.
- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- Construct arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Use arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- Develop a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- Use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

## EVIDENCE OF LEARNING

## Formative Assessments

PS2.A: Reading 1.2: Newton's Cradle, Activity 4.2: Measuring Forces with Force Probes and Newton's Third Law, Activity 4.3: Revisiting Familiar Apparatuses, Activity 6.1: Graphs That Show When a Ball Moves.

PS2.A: Activity 2.1: Analyzing Apparatuses, Activity 2.2: Systems and Contact Forces, Homework 2.2: The World's Greatest Sandwich, Reading 2.3: Balance and Force, Activity 2.4: Putting Things Together, Activity 3.1: Objects That Begin Moving, Activity 3.2: More Objects That Begin Moving, Homework 3.2: Heavy Duty Shopping, Activity 3.3: Complex Systems that Begin Moving, Reading 3.3: Why Does an Object Start Moving?, Activity 4.1: Measuring Forces, Reading 4.3: What Keeps Things from Moving?, Reading 4.4: Who Will Win a Tug-of-War?, Activity 5.1: A Book That Stops Moving, Homework 5.1: Hard and Soft Landings, Activity 5.2: Recoil in the Magnetic Cannon, Reading 5.2: What Affects How Quickly Something Stops Moving?, Homework 6.1: Rat Race, Activity 6.2: Graphs That Show How a Ball Moves, Homework 6.2: Rat Race Part 2, Activity 6.3: Motion Graphs for the Magnetic Cannon, Activity 7.1: Changing Speed, Homework 7.1: Forces and Motions, Activity 7.2: Changing Direction, Activity 7.3: Newton's First Law, Activity 8.1: Revisiting and Summarizing the Scientific Principles, Homework 8.1: Motion Graph, Activity 8.2: Can We Explain the Behavior of the Magnetic Cannon?, Activity 8.3: Concluding the Activity.

PS2.B: Reading 7.3: Tides

PS2.B: Activity 2.3: Forces That Act at a Distance

PS3.A, PS3.C: Activity 2.1: Analyzing Apparatuses, Activity 2.2: Systems and Contact Forces, Homework 2.2: The World's Greatest Sandwich, Reading 2.3: Balance and Force, Activity 2.4: Putting Things Together, Activity 3.1: Objects That Begin Moving, Activity 3.2: More Objects That Begin Moving, Homework 3.2: Heavy Duty Shopping, Activity 3.3: Complex Systems that Begin Moving, Reading 3.3: Why Does an Object Start Moving?, Activity 4.1: Measuring Forces, Reading 4.3: What Keeps Things from Moving?, Reading 4.4: Who Will Win a Tug-of-War?, Activity 5.1: A Book That Stops Moving, Homework 5.1: Hard and Soft Landings, Activity 5.2: Recoil in the Magnetic Cannon, Reading 5.2: What Affects How Quickly Something Stops Moving?, Homework 6.1: Rat Race, Activity 6.2: Graphs That Show How a Ball Moves, Homework 6.2: Rat Race Part 2, Activity 6.3: Motion Graphs for the Magnetic Cannon, Activity 7.1: Changing Speed, Homework 7.1: Forces and Motions, Activity 7.2: Changing Direction, Activity 7.3: Newton's First Law, Activity 8.1: Revisiting and Summarizing the Scientific Principles, Homework 8.1: Motion Graph, Activity 8.2: Can We Explain the Behavior of the Magnetic Cannon?, Activity 8.3: Concluding the Activity

PS3.B: Activity 1.1: Anchoring Activity, Activity 1.2: Driving Question Board

ESS1.A, ESS1.B: Reading 7.2: Planetary Motion

ESS1.B: Reading 6.3: The Universe

## Summative Assessments

- Benchmark Assessments

  ● Multiple Choice Assessment administered at the end of each marking period.

  Alternative Assessments

    - Oral Presentations
    - Questions for Comprehension
    - Performance Tasks
    - Scientific Journals/Notebooks
    - Self-Assessment
    - WebQuests

## RESOURCES (Instructional, Supplemental, Intervention Materials)

IQWST Unit Materials for Physical Science 3, Learning Sets 1 - 3

*A Framework For K-12 Science Education*

*Onlne Resources provided by IQWST not included in the program (to be used as support/reinforcement/enrichment):* [https://docs.google.com/spreadsheets/d/1VpyFCL4_50_-1w2NhcGpdNNZ2jj6aJJegcIUNCy_uzQ/pubhtml](https://docs.google.com/spreadsheets/d/1VpyFCL4_50_-1w2NhcGpdNNZ2jj6aJJegcIUNCy_uzQ/pubhtml)

## INTERDISCIPLINARY CONNECTIONS

Collaboration with Math and Language Arts teachers is an essential part of the IQWST curriculum.

Information Writing

Current Events

Topography

Data collection/analysis

Computations

Statistics

Enginereering

## ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.

IQWST provides audio recording for all readings in student workbook-available through teacher portal online

Reading differentiation strategies are embedded in the IQWST program and all students prepare for reading through a 'Getting Reading' section which begins each reading.

The sections are desgined to engage students, generate interest, activate prior knowledge and provide a purpose for reading.  Teachers use advance organizers for desired readings and to encourage students to plan and annote the passages.

A word wall is developed through vocabulary aquisition in the program. Students develop the word wall as words are learned in context and through experience in class.  This helps to build meaning and understanding which support students when reading text.

Students are encouraged to ask questions and post them to the Driving Question Board. This DQB helps students develp a greater level  of understanding and encourages students to work together to solve problems in and outside of class.

Supoort will be provided to students when writing in the student manual and use of teh computer, printing, and pasting into the manual is acceptable if there is a present need.