**4th Grade Launch Unit**

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| **Unit Topic:** Heat  **Estimated Time:** 2 Weeks  This Launch Unit was designed to address a possible learning gap between 3rd Grade Science and 4th Grade Science. | | | | | |
| **Standards** | | | | | |
| **S3P1. Obtain, evaluate, & communicate information about the ways heat energy is transferred & measured.**  a. Ask questions to identify sources of heat energy. (*Clarification statement:*Examples could include sunlight, friction, and burning.)  b. Plan & carry out an investigation to gather data using thermometers to produce tables & charts that illustrate the effect of sunlight on various objects (*Clarification statement:*The use of both Fahrenheit and Celsius temperature scales is expected.)  c. Use tools & everyday materials to design & construct a device/ structure that will increase/ decrease the warming effects of sunlight on various materials.  (*Clarification statement:*Conduction, convection, and radiation are taught in upper grades.)  [Click here to see the energy and waves learning progression and possible student misconceptions: 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.*   * **Heat** is the form of energy that is transferred between two objects at different temperatures. The direction of heat energy flow is always from the object of higher temperature to the object of lower temperature. The terms “heat” and “temperature” are often used interchangeably, but this is incorrect.  **Temperature** is the measure of the degree of hotness or coldness of an object. Temperature is measured in degrees using the **Celsius (C)** or **Fahrenheit** (F) scales. In the United States we are most familiar with the Fahrenheit scale but most countries use the Celsius scale as it is much more helpful to use (the Celsius scale has exactly 100 units between the freezing and boiling of water – the most important molecule on our planet). Temperature is measured by a **thermometer** and most thermometer include both temperature scales. * In simplest terms, temperature is how hot or cold an object is, while heat is the energy that flows from a hotter object to a cooler one. For example, the temperature of a cup of coffee may be 150 F. If you pick it up, heat from the coffee will begin to flow from the cup and then into your (colder) hand. * Life on earth depends on heat from the sun. This sun’s heat is generated from nuclear reactions that take place within it. Heat can also be generated by friction which is produced which is produced when one surface is rubbed against another. For example, rubbing two sticks together in just the right way can generate enough heat to start a fire. * Some materials conduct heat better than others. Dense materials like iron usually conduct well due to the more tightly packed particles within the material, allowing for more collisions and thus a quicker transfer of energy. Materials that conduct heat easily are termed thermal conductors and those that conduct poorly are termed thermal insulators. Materials are selected for specific purpose based on thermal properties (e.g. metal frying pans and Styrofoam drink coolers) | | | | | |
| **Big Ideas/Enduring Understandings:**   * The Sun is the main source of energy for the Earth * Energy is produced in different ways * Heat is transferred from one place to another * Thermometers are used to measure temperature changes * The transfer of heat energy from the sun differs according to the materials * Some materials conduct, or move, heat better than others * Insulation affects heating and cooling | | | **Essential Questions:**   * What produces heat? * How is heat transferred? * What materials change the sun’s ability to warm an object? * What is the difference between heat and temperature? * How does temperature affect the states of matter? * What causes objects to change temperature? | | |
| **Vocabulary:**  Sources  Heat  Energy  Warming | Transfer  Sunlight  Friction | | Burning  Thermometer  Celsius Scale | | Fahrenheit Scale  Device  Structure |
| **Literature Connections:**  How Heat MovesBy Sharon Coon | | | **STEM Career Connections:**  Environmental Scientists, Geologists, Electrical Engineers, Mechanical Engineers, Drilling Crews | | |
| **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: Sources of heat energy***   * When we rub our hands together, they get hotter. | | ***TOPIC 2: Effect of sunlight on objects***   * You can fry an egg on a hot sidewalk (video link [here](https://www.youtube.com/watch?v=0MPNgCo9auk)) | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***   * Some plants can be grown in places that don’t have their ideal growing conditions | |
| **ENGAGE** | | | | | |
| ***TOPIC 1: Sources of heat energy***   * Students will replicate the above listed phenomenon and ask questions about their observations. Introduce friction and discuss what would happen if other objects were rubbed together. | | ***TOPIC 2: Effect of sunlight on objects***   * Students will watch the video linked above explore why the manhole cover got so hot. | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***   * Introduce this phenomenon: Tomatoes need 3 to 4 months of warm, clear, fairly dry weather to produce best. Tomatoes need consistent night temperatures between 55°F and 75°F to set fruit. In Iceland, the average high temperature during the DAY in June-August is 55°F. Yet tomato crops are able to be grown in Iceland because of greenhouses. [Here’s](https://www.kelownanow.com/files/files/images/icelandic_greenhouses.JPG) a photo. Help students explore how greenhouses work. | |
| **EXPLORE** | | | | | |
| ***TOPIC 1: Sources of heat energy***   * Students will explore this [interactive thermometer](https://www.mathsisfun.com/measure/thermometer.html) * Students will use the [thermometer handout](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=629a344e-54d4-458d-b4cb-d310c0fe44b2) to explore the temperature of different areas and items * Students will record the temperature of a jar half filled with sand before and after shaking it for 1 minute to measure the effect of friction | | ***TOPIC 2: Effect of sunlight on objects***   * Work through the flip chart on p. 23 of the HMH GA Science textbook * Ask students to design an investigation using thermometers to determine how color affects temperature and record their results | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***   * Students will use provided materials to construct a structure that either increases or decreases the warming effect of sunlight- test them out and record data. | |
| **EXPLAIN** | | | | | |
| ***TOPIC 1: Sources of heat energy***  HMH GA SCIENCE TEXTBOOK RESOURCES:   * Unit 5, Lesson 1 (pp. 167A-178) | | ***TOPIC 2: Effect of sunlight on objects***  HMH GA SCIENCE TEXTBOOK RESOURCES:   * Unit 5, Lesson 3 (pp. 183A-192) | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***  HMH GA SCIENCE TEXTBOOK RESOURCES:   * Flip Chart p. 24 and accompanying Student Worktext pages: Unit 5, Lesson 4 (pp. 193A-194) | |
| **EXPAND** | | | | | |
| ***TOPIC 1: Sources of heat energy***   * Flip Chart page 22 and accompanying Student Worktext pages: Unit 5, Lesson 2 | | ***TOPIC 2: Effect of sunlight on objects***   * Have students conduct their own version of the egg frying demonstration to try and determine whether GA gets hot enough to fry an egg | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***   * HMH GA SCIENCE: STEM- *Warm it Up* pp. 195-196 and accompanying Flip Chart Activity p. 25- *Design It: Greenhouse* | |
| [Click here to download the unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=920da2a0-131a-4f7e-9b52-6324be246d46) | | [Click here to download the unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=6c140522-c9d3-4f9d-aa64-698a721da847) | | [Click here to download the](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=00c0f7ba-0fba-48bb-9608-b4c906503b30)  [unabridged version of this lesson](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=00c0f7ba-0fba-48bb-9608-b4c906503b30) | |
| **ADDITIONAL RESOURCES** | | | | | |
| **STEM Challenges**   * [Design an Energy Efficient Home](https://cobbteachingandlearningsystem.cobbk12.org/GetFile.aspx?f=81d27c09-fc4a-4fdf-9e20-b54373bfa420&t=v) * HMH Georgia Science: STEM- *Warm it Up* pp. 195-196 and accompanying Flip Chart Activity p. 25- *Design It: Greenhouse* | **Science Probes**   * [Ice Water](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=IceWaterV4-ch6.pdf) * [Mixing Water](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=MixingWaterV2-ch11.pdf) * [Ice-Cold Lemonade](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=IceColdLemonadeV2-ch10.pdf) * [Warming Water](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=WarmingWaterV4-ch7.pdf) * [Objects and Temperature](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=ObjectsAndTemperatureV1-ch15.pdf) * [The Mitten Problem](https://www.dropbox.com/sh/m2rz0z6rwptvdyd/AAD5AHM0sfM5nAM6NM66bLVKa?dl=0&preview=TheMittenProblemV1-ch14.pdf) | | **Picture Perfect Sci**   * Sunshine on my Shoulders from MORE Picture Perfect Science | | **Mystery Science**   * How long did it take to travel across the country before cars and planes? |
| **ASSESSMENT** | | | | | |
| ***TOPIC 1: Sources of heat energy***   * Students complete “Sum it Up” on p. 176 * HMH Georgia Science p. 200 #13 | | ***TOPIC 2: Effect of sunlight on objects***   * Students will make a chart of their egg frying data and write an explanation about how the sun heats up objects differently * HMH Georgia Science p. 192 #s 2-4; p. 200 #14 | | ***TOPIC 3: Increasing/decreasing the warming effects of sunlight***   * Students will revise their initial model and explanation about how a greenhouse works | |
| **Differentiation:**  \*\*Click on full versions of lessons listed above for specific suggestions for differentiation | | | | | |

**APPENDIX A**

**Possible Misconceptions:**

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| **Misconceptions** | **Proper Conceptions** |
| * Heat and temperature are the same * Heat energy can be lost * Melting and dissolving are the same * Insulators make things hot or cold * Heat is generated from materials such as blankets, coats or hats * On a cold day when a door is opened the cold air comes in * Some materials such as metals are inherently cold | * Heat is the amount of thermal energy in an item * Temperature is a measure of thermal energy * Heat energy is transferred between objects * A change of state occurs when a substance gains or losses heat * Insulators reduce the transfer of heat energy between objects * Materials such as wool are insulators not heat generators * Heat is transferred outside when the door is opened on a cold day |

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

**Energy and Waves:**

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| **3rd Grade)** | **4th Grade** | **8th Grade** |
| S3P1. Obtain, evaluate, and communicate information about the ways heat energy is transferred and measured.  a. Ask questions to identify sources of heat energy. *(Clarification statement: Examples could include sunlight, friction, and burning.)*    b. Plan and carry out an investigation to gather data using thermometers to produce tables and charts that illustrate the effect of sunlight on various objects.  *(Clarification statement: The use of both Fahrenheit and Celsius temperature scales is expected.)*  c. Use tools and every day materials to design and construct a device/structure that will increase/decrease the warming effects of sunlight on various materials. *(Clarification statement: Conduction, convection, and radiation are taught in upper grades.)* | S4P1. Obtain, evaluate, and communicate information about the nature of light and how light interacts with objects.  a. Plan and carry out investigations to observe and record how light interacts with various materials to classify them as opaque, transparent, or translucent.  b. Plan and carry out investigations to describe the path light travels from a light source to a mirror and how it is reflected by the mirror using different angles.  c. Plan and carry out an investigation utilizing everyday materials to explore examples of when light is refracted.  *(Clarification statement: Everyday materials could include prisms, eyeglasses, and a glass of water.)*  **S4P2. Obtain, evaluate, and communicate information about how sound is produced and changed and how sound and/or light can be used to communicate.**  a. Plan and carry out an investigation utilizing everyday objects to produce sound and predict the effects of changing the strength or speed of vibrations.  b. Design and construct a device to communicate across a distance using light and/or sound | ENERGY: S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system.  a. Analyze and interpret data to create graphical displays that illustrate the relationships of kinetic energy to mass and speed, and potential energy to mass and height of an object.  b. Plan and carry out an investigation to explain the transformation between kinetic and potential energy within a system (e.g., roller coasters, pendulums, rubber bands, etc.).  c. Construct an argument to support a claim about the type of energy transformations within a system [e.g., lighting a match (light to heat), turning on a light (electrical to light)].  d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).  Waves  S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.  a. Ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves. (*Clarification statement: Include transverse and longitudinal waves and wave parts such as crest, trough, compressions, and rarefactions.)*  b. Construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy.    c. Design a device to illustrate practical applications of the electromagnetic spectrum (e.g., communication, medical, military).    d. Develop and use a model to compare and contrast how light and sound waves are reflected, refracted, absorbed, diffracted or transmitted through various materials. *(Clarification statement: Include echo and how color is seen but do not cover interference and scattering.)*  e. Analyze and interpret data to predict patterns in the relationship between density of media and wave behavior (i.e., speed).    f. Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy.  g. Develop and use models to demonstrate the effects that lenses have on light (i.e., formation an image) and their possible technological applications. |

**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:**

