HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

SCIENCE CURRICULUM

GRADE 8

AUGUST 2021

Grade 8 Science
Course Overview

The eighth grade science curriculum utilizes an inquiry-based storyline philosophy to explore students' questions that arise from students' interactions with phenomena. It continues to develop an understanding of the physical, life, and earth sciences and builds on the K–5 ideas and practices. At each step, students make progress on the classroom's questions through science and engineering practices to figure out a piece of a science idea. Each piece they figure out adds to the developing explanation, model, or designed solution. Each step may also generate questions that lead to the next step in the storyline. Together, what students figure out helps explain the unit's phenomena or solve the problems they have identified. A storyline provides a coherent path toward building science ideas and understanding piece by piece, anchored in students' own questions, experiences, and sensemaking.

The eighth grade science curriculum encourages inquiry and sensemaking through a wide variety of learning strategies and resources that develop science and engineering practices, core ideas, and crosscutting concepts. Students utilize laboratory investigations, educational websites, current events, articles, and other multimedia resources including videos, interactive websites, animations, and simulations to make sense of the world around them.

The eighth grade course of study includes six interconnected units: Chemical Reactions & Matter, Chemical Reactions & Energy, Metabolic Reactions, Matter Cycling & Photosynthesis, Ecosystem Dynamics, and Natural Resources & Human Impact. In Chemical Reactions & Matter students develop and use a model of atoms and molecules to represent different substances and how they are rearranged and mass is conserved in chemical reactions. Students investigate property changes in the stuff they have before and after a chemical reaction and after a phase change to argue for whether new substances are created in these processes.In the Chemical Reactions & Energy unit students build on their learning and develop a model of energy transfer in chemical reactions and design a device to transfer the thermal energy produced from a chemical reaction to other parts of a system. The Metabolic unit builds on their model of energy and chemical reactions to explain how humans and other animals get the energy they need to survive and the building blocks to grow from the food that they eat. Students explain how this matter and energy transfer occurs as cells can make new substances out of food molecules through chemical reactions. Students further their models in Matter Cycling and Photosynthesis by investigating how food molecules become a part of the food they eat (both natural and processed foods). Students investigate how plants make food molecules and the source of the matter and energy needed for this process to do this. Students develop a model to explain that the major atoms that make up food (carbon, hydrogen, and oxygen) are continually recycled between biotic and abiotic parts of our world. In the Ecosystem Dynamics unit students investigate how interactions among organisms and changes to the environment (e.g. resource availability) can affect population sizes. Students develop a model including different type of relationships (competitive, predatory, etc.), and biotic/abiotic interactions to explain stability and change in ecosystems. In the final unit of the year, natural Resources & Human Impact students investigate the uneven distribution of water, mineral, and fossil fuel resources on the planet. Students investigate how increase in human populations and percapita resource consumption affects Earth's natural systems (climate, biosphere) in potentially hazardous ways. Students investigate natural carbon sinks, carbon sources, and the movement of carbon from fossil fuels into the atmosphere. Students develop a model of changes in the Earth's climate system, and design systems to mitigate human effects on natural systems.

The eighth grade science curriculum meets the requirements of the New Jersey Student Learning Standards for Science. It also helps to prepare students to meet and exceed the standards assessed by the New Jersey State administered assessments through higher order application of various skills required for complete understanding and sensemaking of science phenomena at the eighth grade developmental level.

Unit Title	**Time Frame/Pacing**
Chemical Reactions and Matter	33 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
When solid bath bombs are added to water, they start breaking apart, and gas bubbles appear on and around them for a few minutes, until no solid is left.

Anchoring Question:
How can we make something new that was not there before?

Supporting Questions:
- Lesson 1: What happens when a bath bomb is added to water (and what causes it to happen?
- Lesson 2: Where is the gas coming from?
- Lesson 3: What's in the bath bomb that is producing the gas?
- Lesson 4: Which combinations of the substances in the bath bomb produce a gas?
- Lesson 5: What gas(es) could be coming from the bath bomb?
- Lesson 6: How can we explain another phenomenon where gas bubbles appear from combining different substances together?
- Lesson 7: How can we revise our model to represent the differences in the matter that goes into and comes out of the bath bomb system?
- Lesson 8: How can particles of a new substance be formed out of the particles of an old substance?
- Lesson 9: Does heating liquid water produce a new substance in the gas bubbles that appear?
- Lesson 10: When energy from a battery was added to water, were the gases produced made of the same particles as were produced from heating the water?
- Lesson 11: How do Dalton's models of the particles that change in a reaction compare to the ones we developed?
- Lesson 12: How can a new substance (a gas) be produced and the total mass of the closed system not change?
- Lesson 13: Why do different substances have different odors and how do we detect them?
- Lesson 14: What is happening to the Taj Mahal?

Enduring Understandings

- Substances have properties.
- Gas(es) in the bubbles are substance(s) that are different from any of the substances we started with.
- Density and flammability are properties.
- In high concentrations, gases that are non-flammable will extinguish a flame.
- Gases or liquids that are less dense float upward when surrounded by gases or liquids that are more dense; gases or liquids that are more dense sink

downward when surrounded by gases or liquids that are less dense.

- Flammability data can help us identify the types of gases that aren't being produced in this process.
- Testing the melting/freezing point, density and/or comparing the results of the flammability test to results from controls could help identify additional substances that aren't being produced in this process.
- The same substance is made of the same type of particles throughout.
- Different substances are made of different types of particles throughout.
- When new substances form from old substances, the particles of the old substances might break apart and/or stick together to form new combinations of particles.
- Density is determined as a ratio of mass to volume (a unit rate). It is constant (a property) for any sample of a substance, regardless of size.
- The gas produced by the heated water is made of the same type of particles as those in the water that we started with.
- The matter that makes up all of the substances must come from matter that made up some of the original particles.
- Molecules are made of atoms and all the substances in our world are made of very few types of atoms.
- The same substance is made of the same type of molecules (or atoms throughout). The number, type, and arrangement of atoms in the molecules that make up a substance are unique to that substance.
- In a chemical reaction, the particles that make up old substances can be broken apart and the atoms that make them up can be rearranged to form new molecules to make new substances
- In a chemical reaction, the amount of matter at the beginning (in the reactants) is the same amount of matter at the end of the reaction (in the products). This is because all of the atoms we started with are still there. No new atoms can appear that weren't there to start with.
- Chemical reactions, phase changes, and dissolving are all chemical processes that involve rearrangement of the particles that make up the matter in the system.
- Odor is a property of substance that is determined by the number, type, and arrangement of atoms that make up that substance.
- Molecules of substances must travel into our nose in order for us to detect an odor from them.
- Our nose has many different cells that each have different structures (sensory receptors for odor) that different shaped molecules can fit into, which will cause that cell to send a signal to other nerve cells that relay that signal to our brain.
- The perception of different scents is the result of the combination of signals that the brain receives from these different nerve cells.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- 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.
- MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

- MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. **Analyzing and Interpreting Data** • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. **Engaging in Argument from Evidence** • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration	**PS1.A: Structure and Properties of Matter** • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2), (MS-PS1-3) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) **PS1.B: Chemical Reactions** • 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. (MS-PS1-2), (MS-PS1-3), (MS-PS1-5) • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. **Scale, Proportion, and Quantity** • 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. • Scientific relationships can be represented through the use of algebraic expressions and equations. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes.

and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**LS1.D: Information Processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- MP.4 Model with mathematics. (MS-PS1-1), (MS-PS1-5)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)
- CCSS.MATH.CONTENT.7.RP.A.2.A Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
- CCSS.MATH.CONTENT.7.RP.A.2.B Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

ELA

- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1), (MS-PS1-2), (MS-PS1-4), (MS-PS1-5)
- CCSS.ELA-LITERACY.SL.7.1.C Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
- CCSS.ELA-LITERACY.W.7.1 Write arguments to support claims with clear reasons and relevant evidence.
- CCSS.ELA-LITERACY.SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- CCSS.ELA-LITERACY.SL.7.1 Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- CCSS.ELA-LITERACY.SL.7.1 Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.

- CCSS.ELA-LITERACY.W.7.1.A Introduce claim(s), acknowledge alternate or opposing claims, and logically organize the reasons and evidence.
- CCSS.ELA-LITERACY.W.7.1.B Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
- CCSS.ELA-LITERACY.W.7.1.C Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.
- CCSS.ELA-LITERACY.W.7.1.D Establish and maintain a formal style.
- CCSS.ELA-LITERACY.W.7.1.E Provide a concluding statement or section that follows from and supports the argument presented.
- CCSS.ELA-LITERACY.W.7.2.C Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.
- CCSS.ELA-LITERACY.W.7.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.
- CCSS.ELA-LITERACY.W.7.2.E Establish and maintain a formal style.

Computer Science and Design Thinking

- 8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.CI.1 Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1)
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.3 Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.5 Analyze and interpret local or public data sets to summarize and effectively communicate the data.
- 9.4.8.TL.1 Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.
- 9.4.8.TL.5 Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.

Social-Emotional Learning Competencies

- **Social Awareness**
  - Recognize and identify the thoughts, feelings, and perspectives of others.

- Demonstrate an understanding of the need for mutual respect when viewpoints differ.
- Demonstrate an awareness of the expectations for social interactions in a variety of settings.

- **Responsible Decision-Making**
  - Develop, implement, and model effective problem-solving and critical thinking skills.
  - Identify the consequences associated with one's actions in order to make constructive choices.
  - Evaluate personal, ethical, safety, and civic impact of decisions.
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1 Develop a model showing what is happening at a scale smaller than we can see (patterns) to help explain what happened to the matter in the solid bath bombs (matter) and what caused the gas bubbles to appear (matter). Ask questions that arise from our observations of different bath bombs before and after they were added to water in order to seek additional information about what caused the changes (effects) we saw occurring. This includes what happened to the matter in the solid bath bombs and what caused the gas bubbles to appear as well as what kind of changes are happening to the matter in examples of other related phenomena we raised.	Observe what bath bombs do when added to water. Establish shared norms. Model what happened to the matter that was in the bath bomb and what caused the gas bubbles to appear. Brainstorm related phenomena. Develop a Driving Question Board (DQB).	Initial Model: What Happens to a Bath Bomb When Put in Water? Consensus Discussion Driving Question Board (DQB)
Lesson 2 Collaboratively plan and carry out an investigation in a closed system to answer the question, "*Where does the gas produced by the bath bomb come from?*" Construct and present an oral and written argument supported by empirical evidence and scientific reasoning to support the claim that gas is not	Investigate bath bombs and take careful mass measurements to determine where the gas bubbles that we observe come from. Measure the mass in a closed and open system before and after crushing the bath bombs and before and after adding them to water.	Construct an argument in science notebooks. Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker

trapped in the bath bomb to start with but must come from some change to the matter that was already in the system to begin with.	Argue from evidence for whether the gas was trapped inside the bath bomb to start with or whether some of the solid or liquid matter that was there to start with changed into a gas.	
Lesson 3 Analyze and interpret data to identify patterns in the characteristic properties of substances. Plan and carry out an investigation to collect data to identify patterns in the characteristic properties of substances from a bath bomb when they are individually added to water.	Analyze an ingredient list and recipes of bath bombs and make observations on each of the main ingredients in these, recording the properties of each. Investigate what each ingredient does as it is added to water and will conclude that the ingredients interact with water in different ways.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 4 Conduct an investigation to produce data to serve as the basis for evidence to determine which combinations (patterns) of substances in a bath bomb cause bubbles of gas to appear (effect). Construct and present a written and oral argument supported by citing empirical evidence and scientific reasoning that only certain combinations (patterns) of substances (water, baking soda, and citric) result (cause) in the formation of a gas (effect). Apply scientific ideas and evidence (patterns in properties) to co-construct an explanation that the substance(s) in the gas bubbles must be a different substance(s) than the water, baking soda, or citric acid.	Test different combinations of substances from a bath bomb and use the results to support an argument that the gas is a different substance than those we started with and this substance must come from the matter that makes up baking soda, citric acid, and water.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 5 Analyze and interpret the data for common gases to look for patterns that could be used to identify an	Analyze the density and flammability data for common gases.	Predictive Explanations for the Gas from a Bath Bomb Individual argument on notebook paper or in

unknown gas by its characteristic properties. Apply scientific reasoning based on patterns in the densities for a known set of gases to explain how either of two different possible outcomes from a future investigation could help us narrow down the sub-set of candidate substances from what could be in the unknown gas from the bath bomb. Construct, use, and present an oral and written argument for an explanation that the gas in the bubbles from the bath bomb can be narrowed down to only three possible substances (out of ten of the most common ones in the air) supported by the patterns in the results from density and flammability tests and data on their properties and the use of related key model idea.	Test the flammability of the gas from the bath bomb. Carry out an investigation to see if the gas from the bath bomb rises or sinks. Argue from evidence that the gas from the bath bomb can be narrowed down to three candidate gases.	student notebooks. Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 6 Apply key model ideas and patterns in mass and property data to construct three explanations for: a) why the mass of a system decreases when substances are mixed together, b) which substance(s) could or could not be produced in that process, and c) what additional tests could be done on the gas (or other gases) to help identify additional substances that aren't being produced in this process.	Apply what we have figured out about properties to explain a related phenomena (elephant's toothpaste). Revisit our Driving Question Board (DQB) and reflect on what other related phenomena we might be able to explain using these same key model ideas.	Related Phenomena Explanation Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 7 Develop and revise a model to predict and describe the unseen interactions between particles in a system to show that matter is conserved in a process where the type of particles that make up the starting substances (system inputs) somehow change through their interactions to make different type(s)	Summarize key model ideas we figured out in earlier lessons. Develop a new way to represent everything we figured out using an input/output table to represent the particles in the system.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Input/Output Table Revisit Driving Question Board Models WIS/WIM

of particle(s) in the ending substances (system outputs).	Identify an unanswered question about where the particles that make up the substance(s) of the gas come from	Update Progress Tracker
Ask questions related to the development of alternate models for what is happening to the matter at a particle level (patterns) when old substances interact to produce new substances by combining or rearranging parts/particles (systems and system models), and determine ways we might go about investigating these ideas.	Develop alternate models for making new particles from old particles using manipulatives. Formulate questions about what happens when new substances are made from old. Read about what Dalton and other scientists did to test this idea. Outline a plan for a line of similar investigations to pursue.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 9 Use mathematical and computational thinking by graphing mass vs. volume data for different substances and finding the ratio of mass to volume (a unit rate) [scale, proportion, quantity] for the samples measured to determine the density of different clear liquids. Argue from evidence and critique two arguments on the same topic; strengthen these arguments by using additional empirical evidence (patterns) and scientific reasoning to support an explanation for whether the substances collected from the gas produced by the heated water is made of different types of particles or the same type of particles (patterns) as those in the water that we started with.	Carry out an investigation on the flammability of the gas produced by heating water. Collect data on the mass and volume of this liquid that formed from that gas. Argue that the resulting property data indicates that the gas we collected is made of the same particles that were in the water we started with.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 10 Students apply scientific ideas and evidence (property data) to construct an explanation for	Carry out an investigation to test the flammability of gases produced by providing energy to water with electricity.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion

whether the gas(es) produced from water using energy from a battery were made of the same particles (patterns) as those produced from heating the water.	Construct an explanation for whether the gas(es) produced from water using energy from a battery were made of the same particles as those produced from heating the water.	Revisit Driving Question Board Models WIS/WIM Update Progress Tracker Individual argument about whether the gas(es) produced from water using energy from a battery is made of the same particles that were produced from heating the water.
Lesson 11 Gather and communicate information from a scientific text adapted for classroom use to determine the central ideas of Dalton's atomic theory with regard to the patterns in the particulate structure of matter that makes up all substances. Construct an explanation using models of the molecular structures of different substances to predict which gas must be produced (effect) in the bath bomb reaction based on the types of atoms that make up the substances (patterns), and use it to explain what is happening to the particles (matter) in the system to cause the production of this new substance.	Gather and summarize information from a reading on investigations that Dalton and other scientists did and will compare the models they developed for the particles that get broken apart, rearranged, and put together in chemical reactions to the models we developed. Use Dalton's models to represent what happens with water molecules during the electrolysis lab.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 12 Construct an explanation for how the atoms in the molecules of the starting substances rearrange to form new products in the bath bomb, but the number and types of atoms do not change and thus mass is conserved and evaluate two different molecular models for different ratios of reactant and product molecules to determine which better supports this explanation.	Revise our consensus model with the molecules of the reactants and the gas produced from the bath bomb. Explain how other possible products could be produced in this chemical reaction. Develop a model to represent what is happening to particles in different chemical processes.	Explaining New Aspects of the Anchoring Phenomena Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Revised Consensus Models WIS/WIM Update Progress Tracker

Construct an explanation for whether additional substances could have been produced in the bath bomb reaction based on the patterns in the atoms that make up the molecules of the different substances. Analyze and interpret data on the properties of substances (patterns) before and after substances interact to determine if the chemical reaction that produces gas in a bath bomb also produces another new substance.	Revisit the Driving Question Board (DQB) to identify questions we made progress on.	Explaining New Aspects of the Anchoring Phenomena by constructing two explanations having to do with the bath bomb reaction. • How the same atoms that are in the molecules of the starting substances rearrange to form new products made of different molecules. • Whether more than one substance can be produced during a chemical reaction.
Lesson 13 Read scientific texts adapted for classroom use to determine how the molecular structure of different substances (patterns) is related to their odor, how those molecules reach our nose (cause), and how those molecules interact with different sensory receptors there that each cause a different signal to travel through our nerve cells that leads to the perception of different scents (effect).	Carry out an investigation about the scents of different substances to see if we can identify these substances by their odors. Gather information from a reading about how sensory receptors in our nose work. Use what we figure out from the odor lab and the reading to write an explanation about why different substances have different odors and how we detect them.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Individual Explanation (Revised) Update Progress Tracker
Lesson 14 Collect data to produce evidence and use the patterns in the properties of substances to make an argument about whether malic acid secreted by algae is causing a chemical reaction to break down the calcium carbonate in the marble of the Taj Mahal. Use molecular models to explain which products could be produced (patterns) from a chemical reaction between either a) the calcium carbonate in the marble surface of the Taj Mahal and pollutants	Apply what we figured out about properties to explain a related phenomena (pollution and erosion on marble). Revisit our Driving Question Board (DQB) and reflect on what other related phenomena we might be able to explain using these same key model ideas.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Consensus Discussion Revisit Driving Question Board Models WIS/WIM Related Phenomena Assessment: Part 1: Explaining Marble Changes in the Taj Mahal Part 2: Explaining Iron Changes in the Taj Mahal

in the air or b) iron in the rods and clamps of the Taj Mahal and pollutants in acid rain. Analyze and interpret data and use it as evidence in an explanation to the government of India about which pollutants in the air around the Taj Mahal could be causing the marble surface of the Taj Mahal to break apart and wash away (effect).		

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Provide scaffolds such as sentence starters and images that can support students
- Word Wall: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word. If students struggle to find the right words to use, have them refer to the Word Wall.
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- Science notebook: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Teacher notes and classroom copy of notes accessible to student
- Provide an alternative video of the investigations for students to re-watch and return to.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
    - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a "standard" definition

from the teacher. • When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition. • Allow students choice in how they test their ideas when applicable • Plan partnerships ahead of time when possible • Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.	
Common Assessment(s)	**Assessment Modifications and/or Accommodations *when appropriate* (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Lesson 6 (mid-point) - Explaining phenomena • Lesson 14 Summative	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment

Unit Title	Time Frame/Pacing
Chemical Reactions and Energy	19 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
The flameless heater in a Meal, Ready-to-Eat significantly increases in temperature and is able to heat food when the user simply adds water to the pouch and waits a few minutes.

Anchoring Question:
How can we help people design a flameless heater?

Supporting Questions:

- Lesson 1: How can we heat up food when we don't have our typical methods available?
- Lesson 2:What's inside the MRE flameless heater that's making it warm?
- Lesson 3: What other chemical processes could we use to heat up food?
- Lesson 4: How can we refine our criteria and constraints?
- Lesson 5: How much food and reactants should we include in our homemade flameless heater?
- Lesson 6: How can we redesign our homemade flameless heater?
- Lesson 7: How did our design compare to others in the class?
- Lesson 8: What are the effects of changes we might make in our designs?
- Lesson 9: What is our optimal design for a homemade flameless heater?
- Lesson 10: How can we decide between competing designs?

Enduring Understandings

- Root killer and aluminum foil mixed together in saltwater caused a large increase in temperature.
- Exothermic processes can release energy; these processes feel warm.
- Endothermic processes absorb energy; these processes feel cold. Chemical processes can transfer energy to other systems.
- The more reactants we use in a chemical process, the greater the temperature change, which corresponds to more energy being transferred into or out of the system.
- Designs need to be tested to inform modifications that will lead to a better solution.
- Different kinds of models are helpful for testing design solutions.
- Planned design changes result in unplanned changes to other design characteristics.
- Considering how stakeholders are impacted by these changes helps to confidently decide which changes to implement to optimize the design.

- Design performance needs to be optimized by revising and retesting.
- Parts of different solutions can be combined to create a solution that is better than any of its predecessors.
- Designs and instructions need to be peer tested to inform modifications that will lead to a better solution.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- 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.
- Some chemical reactions release energy.
- Increasing the amount of reactants in an exothermic reaction corresponds to an increase in energy transferred out of that system.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- 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.
- MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
- MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- 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.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Planning and Carrying Out Investigations • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the	**PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original	**Patterns** • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data

investigation. • Evaluate the accuracy of various methods for collecting data. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions • Collect data about the performance of a proposed object, tool, process, or system under a range of conditions. **Constructing Explanations and Designing Solutions** • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.	substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-3), (MS-PS1-5) • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) • Some chemical reactions release energy, others store energy. (MS-PS1-6) **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** • 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.	**Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a designed or natural system.

	(MS-ETS1-3) • 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. (MS-ETS1-4)	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- MP.4 Model with mathematics. (MS-PS1-1), (MS-PS1-5)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)
- CCSS.MATH.CONTENT.6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
- CCSS.MATH.CONTENT.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- CCSS.MATH.CONTENT.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
- CCSS.MATH.CONTENT.6.RP.A.3.A Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. During this lesson and Lesson 9, students will scale up the amount of reactants to use in their homemade heaters but maintain the same proportion of reactants they found to be most efficient in previous testing.
- CCSS.MATH.CONTENT.6.RP.A.3.C Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
- CCSS.MATH.CONTENT.6.RP.A.3.D Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
- CCSS.MATH.CONTENT.7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

ELA

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS1-2), (MS-PS1-3)
- RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1), (MS-PS1-2), (MS-PS1-4), (MS-PS1-5)
- WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)
- CCSS.ELA-LITERACY.SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- CCSS.ELA-LITERACY.SL.7.1.A Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- CCSS.ELA-LITERACY.SL.7.1.B Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.
- CCSS.ELA-LITERACY.SL.7.1.C Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
- CCSS.ELA-LITERACY.SL.7.1.D Acknowledge new information expressed by others and, when warranted, modify their own views.
- CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
- CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- CCSS.ELA-LITERACY.RST.6-8.10 By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

Computer Science and Design Thinking

- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
- 8.2.8.ED.4 Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.

Career Readiness, Life Literacies, and Key Skills

- 9.1.8.PB.3 Explain how to create a budget that aligns with financial goals.
- 9.4.8.CI.2 Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3)
- 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).
- 9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

Social-Emotional Learning Competencies

• **Social Awareness**
  ○ Recognize and identify the thoughts, feelings, and perspectives of others.
  ○ Demonstrate an awareness of the differences among individuals, groups, and others' cultural backgrounds.
  ○ Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  ○ Demonstrate an awareness of the expectations for social interactions in a variety of settings.
• **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills.
• **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.

Learning Targets	**Investigations/Resources**	**Formative Assessment**
Lesson 1 Ask questions that arise from careful observation of a flameless heater that is able to heat food (effect) using a chemical process (cause). Define a design problem that can be solved through the development of a homemade flameless heater with multiple criteria and constraints that uses a chemical process (system 1) to heat up food (system 2). Apply scientific ideas to design a model for a flameless heater that uses a chemical process to heat food.	Develop an initial model to consider how a flameless heater works. Evaluate problems with prepackaged MREs. Brainstorm criteria and constraints to create designs for a homemade flameless heater. Develop a Design Questions Board and gather ideas for investigations that will guide our work as we continue designing.	Initial Model Consensus Discussion Driving Question Board (DQB)
Lesson 2 Conduct an investigation to serve as the basis for evidence (patterns) that explains which substances in the flameless heater cause food to heat up in a prepackaged MRE.	Examine images of an MRE flameless heater that is cut open and will see a list of ingredients inside. Investigate ingredients one at a time with water to see which substance is responsible for heating up.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 3 Collect data to serve as the basis for evidence	Test different chemical processes to determine if any of them cause an increase in temperature for use	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook)

(patterns) for choosing a chemical process that releases energy to the food for our homemade flameless heater. Develop and use the LOL energy model to determine that adding more reactants in an exothermic chemical process releases more energy from the system.	in our homemade flameless heater designs. Identify a process with which to move forward and investigate energy transfer from that system using LOL energy models.	Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 4 Analyze data by identifying patterns to define an optimal operational range for our homemade flameless heater designs that best meets criteria for success because 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.	Define our stakeholders to revise the criteria and define constraints for optimal food temperature, cost of materials, and reasonable weights for the overall homemade heater. Use new criteria and constraints to create a Design Matrix to keep track of these ideas during future investigations.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Design Models WIS/WIM Design Matrix Update Progress Tracker
Lesson 5 Analyze data to determine patterns in the relationship between the total amount of food we can heat and the amount of energy that is transferred to it. Evaluate and use accurate methods of data collection to gather and then analyze data to define an optimal proportion of reactants that result in the greatest temperature change.	Analyze data to inform our design and meet our criteria and constraints. Analyze the data to determine how much food we can heat up. Conduct an investigation to determine which proportion of reactants will work best to heat up the food.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 6 Undertake a design project to construct and test a solution that meets specific design criteria and constraints, including the transfer of energy. Collect data about the patterns of performance of a proposed design by testing a physical model.	Draw models of our homemade flameless heaters. Build prototypes and test them using a Design Testing Matrix based on our criteria and constraints. Reflect on our work with self-assessments of our engineering work and our teamwork.	Team Design Models Teamwork Self-Assessment

Lesson 7 Respectfully provide and receive critiques about design solutions to evaluate competing designs with respect to how they meet criteria and constraints and consider patterns across multiple designs to determine which design characteristics caused more effective outcomes in performance.	Compare our flameless heater designs with other teams and identify the most promising design characteristics.	Peer Feedback on Designs
Lesson 8 Systematically evaluate competing design solutions based on jointly developed and agreed-upon design criteria, using a Cascading Consequences Chart to show how small changes in one design characteristic might cause unexpected changes in other design characteristics, to help decide what to modify for the optimal homemade heater design.	Use the design characteristic ideas that are most promising to investigate if making those changes will affect other characteristics of our design and impact stakeholders.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Design Models WIS/WIM Update Progress Tracker
Lesson 9 Communicate technical information in writing about how to transfer energy through a system that was designed to perform better than any of its predecessors by using parts of different solutions. Optimize performance of a design that transfers energy through a system by prioritizing criteria, making trade-offs, testing, revising, and retesting a design that incorporates characteristics of designs that performed the best in each test.	Redesign, optimize, build, and test our homemade heater prototypes. Refine our instructions and exchange with a partner team. Reflect on how well our team works as engineers and how we meet expectations as teammates. Revisit our DQB to address any remaining questions.	Team Design Models Teamwork Self-Assessment
Lesson 10 Make a written argument that supports or refutes the advertised performance of a sea turtle incubator based on evidence from patterns in data concerning whether or not the incubator meets relevant criteria and constraints, such as transferring the right amount of energy to the sea turtle eggs, and	Evaluate different designs and develop an argument for which sea turtle incubator design or combination of design features would work best based on relevant criteria and constraints.	Transfer Task: Sea Turtle Incubator

combines different parts of solutions to create an optimal solution.		

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Offer sentence starters to support students as they engage in writing
- Word wall: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- Science notebook: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Having different modes for interacting with the readings will provide different ways to access the readings
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
    - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a "standard" definition from the teacher.
- When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition.
- Allow students choice in how they test their ideas when applicable
- Plan partnerships ahead of time when possible
- Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate**

• Lesson 9 - Engineering Design Rubric • Lesson 10 - Summative assessment	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment

Hillsborough Township Public Schools
Grade 8 Science Curriculum

Unit Title	Time Frame/Pacing
Metabolic Reactions	29 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
The Patient's Doctor's Note describes the symptoms in different parts of her *body.*

Anchoring Question:
How do things inside our bodies work together to make us feel the way we do?

Supporting Questions:

- Lesson 1: What is going on inside Patient X's body that is making her feel the way she does?
- Lesson 2: Can we see anything inside Patient X's that looks different?
- Lesson 3: Why do molecules in the small intestine seem like they are disappearing?
- Lesson 4: What happens to food molecules as they move through the small intestine and large intestine?
- Lesson 5: Why do large food molecules, like some complex carbohydrates, seem to disappear in the digestive system?
- Lesson 6: What happens to the different substances in food as it travels through the digestive system?
- Lesson 7: What is the function of the digestive system, and how is Patient X's digestive system different?
- Lesson 8: What does the surface of Patient X's small intestine look like up close compared with a healthy one?
- Lesson 9: How can a problem in one body system cause problems in other systems?
- Lesson 10: Why is Patient X's losing so much weight?
- Lesson 11: What happens to matter when it is burned?
- Lesson 12: Does this chemical reaction to burn food happen inside our bodies?
- Lesson 13: How does a healthy body use food for energy and growth, and how is Patient X's body functioning differently?
- Lesson 14: Do all animals do chemical reactions to get energy from food like humans?
- Lesson 15: What questions on our Driving Question Board can we now answer?

Enduring Understandings

- The digestive system is made up of different parts called organs. The different organs have similarities and differences in their structures.
- The structure of the walls of the small intestine and dialysis tubing must have microscopic openings/gates in them that let small food molecules through but not large ones.
- Sugar molecules, such as glucose, are much smaller than molecules of complex carbohydrates, such as starch, but both are made up of the same types of atoms (carbon, hydrogen, and oxygen).

- As food moves through a healthy digestive system, food molecules disappear.
- Fiber always stays the same in the digestive system and leaves the body as poop.
- Most other molecules are gone when they reach the large intestine in a healthy person. Only fiber and water remain.
- Poop contains some additional food molecules (glucose, starch, fatty acids) too, which are not found in a healthy person's solid waste.
- Some types of complex carbohydrates decrease in the mouth while glucose increases.
- Chemical reactions that occur in the mouth break down some types of complex carbohydrates into glucose, and no matter disappears when this happens.
- Some new substances that were not there before start appearing in the stomach (amino acids and fatty acids).
- When the amount of one substance increases in the mouth or stomach, a different substance decreases by the same amount. Chemical reactions in the mouth and stomach account for patterns in the data.
- In a healthy digestive system, multiple subsystems, or organs, work together to help the body break large food molecules down into smaller food molecules.
- Large food molecules are broken down into smaller food molecules through chemical reactions that occur in the mouth, stomach, and small intestine.
- Each organ plays a different role in the breakdown of large food molecules.
- In a healthy person, the small intestine absorbs the small food molecules that had been broken down in preceding organs in the digestive system.
- Effective models include inputs, processes, and outputs.
- Body systems are organized by System > Subsystems > Tissues > Cells.
- The intestinal wall surface is flat, and a healthy person's is folded back and forth (forming villi).
- Increased villi height results in more surface area that food molecules come into contact with as they flow through the small intestine; this results in a greater rate of absorption in a healthy small intestine than in the Patient's.
- When food is burned, it goes through a chemical reaction that releases energy.
- Fats require oxygen to release energy.
- When a fat or food reacts with oxygen to release energy, carbon dioxide gas and water vapor are products of that process.
- Oxygen is taken in (inhaled) through the lungs, and carbon dioxide is exhaled through them. These gases enter and exit the blood by passing through the lung membrane wall and are transported to and from the cells of the body.
- Chemical reactions that happen within cells in the body rearrange glucose and oxygen into carbon dioxide, water, and energy that the cells can use - cellular respiration.
- The digestive system takes in food and breaks it down through chemical reactions. The small food molecules get absorbed into the body's circulatory system through the small intestine.
- The respiratory system and circulatory system work together to bring food molecules and oxygen to cells in the body and to remove carbon dioxide.
- Humans need to take in food. Food is a type of fuel, which means that it can react with other substances to release energy.
- Cells rearrange food and oxygen through a chemical reaction, which creates carbon dioxide and water and releases energy that cells can use.
- The body system's inputs are food (molecules mainly with C,H,O's) and oxygen. Outputs are mainly carbon dioxide, water, and energy (students might also include poop, which is mostly fiber and water).
- When the body takes in excess food, it can be stored for later use in the form of fat molecules in the body.
- When the body doesn't take in enough food, it can use the stored fat or food molecules dedicated for growth to burn as fuel. Most of the matter goes into

the air when fat is burned.
- Animals, aside from humans, rearrange matter in food through chemical reactions to release energy.
- In animals, besides humans, oxygen reacts with food to produce carbon dioxide and provide energy.
- Animals might have different structures inside of their bodies to perform the same functions.
- Other living things, such as anaerobic bacteria, don't need oxygen for chemical reactions to get energy.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-LS1-3 Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
- MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing & Using Models • Evaluate limitations of a model for a proposed object or tool. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.	**LS1.A: Structure and Function** • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.B: Growth and Development of Organisms** • Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) **LS1.C: Organization for Matter and Energy Flow in Organisms**	**Systems & System Models** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. • Models are limited in that they only represent certain aspects of the system under study. **Structure & Function** • Complex and microscopic structures and

Analyzing & Interpreting Data • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. **Engaging in Argument from Evidence** • Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a	• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) **PS3.D: Energy in Chemical Processes and Everyday Life** • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary to MS-LS1-7)*	systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.

phenomenon or a solution to a problem.		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4), (MS-LS1-5)
- MP.2 Reason abstractly and quantitatively. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- MP.4 Model with mathematics. (MS-PS1-1), (MS-PS1-5)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)
- CCSS Math 6.SP.B.5.C Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
- CCSS.MATH.CONTENT.6.NS.C.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane.
- CCSS.MATH.CONTENT.7.SP.C.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.
- CCSS.MATH.CONTENT.7.SP.C.8.C Design and use a simulation to generate frequencies for compound events.

ELA

- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1), (MS-PS1-2), (MS-PS1-4), (MS-PS1-5)
- RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3), (MS-LS1-4)
- CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
- CCSS.ELA-LITERACY. SL.6-8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6-8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- CCSS.ELA-LITERACY.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.
- CCSS ELA RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- CCSS.ELA-LITERACY.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
- CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

- CCSS.ELA-LITERACY.W.6.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Computer Science and Design Thinking
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

- 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).
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations.

Social-Emotional Learning Competencies

- **Social Awareness**
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the differences among individuals, groups, and others' cultural backgrounds.
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Demonstrate an awareness of the expectations for social interactions in a variety of settings.
- **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills.
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1 Develop models based on evidence to predict the relationships between components of a system (organs and body systems) to explain what is causing the Patient to feel the way she does (effect). Ask questions that arise from careful observation of *the Patient's Doctor's Note* to clarify and seek additional information about what is going on inside the body of the Patient that is causing her symptoms (effect).	Analyze the Patient's Doctor's Note and develop initial models to explain what is going on inside the Patient's body and why her symptoms are affecting so many different body systems. Generate a list of related phenomena and develop a Driving Question Board to guide future investigations.	Initial Model Consensus Discussion Driving Question Board (DQB)

Lesson 2 Analyze and interpret data to identify patterns in how the structures of the digestive system and relative amounts of substances in a food sample appear in a healthy person as compared to in the Patient.	Examine the Patient's endoscopy report and graphs that compare what is in food when it enters the body to what can be found in the small intestine (of both a healthy body and the Patient's body).	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 3 Plan and conduct an investigation in order to produce data to determine whether food molecules can travel from one side of a system to the other side separated by a solid structure with properties similar to the walls of the small intestine. Argue from evidence to revise a model to show how the results of this investigation and graphs of different types of food molecules traveling through the small intestine explain how the structure of the walls impacts the function of the small intestine.	Conduct an investigation to determine how molecules could be absorbed into the body from the small intestine.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 4 Analyze and interpret data to determine patterns and limitations of the relative amounts of different molecules in food as it moves through the digestive system of a healthy person versus the Patient.	Investigate food data from the mouth to the large intestine and determine that (1) most of the molecules are gone by the time they reach the large intestine, and only fiber and water remain, and (2) the Patient has other molecules in her large intestine, like complex carbohydrates, glucose, and fatty acids. Examine poop data to confirm that water and fiber are typical to find in poop, but other substances are not.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 5 Analyze and interpret data to identify a relationship within the data that shows that the amount of	Make observations about what happens to some complex carbohydrates in the mouth, noting that the	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board

certain food molecules (complex carbohydrates) decrease, and other food molecules (glucose) increase as they move through the mouth, which is a correlational relationship. Students argue that we need more data to determine the cause of the observed increases and decreases in food molecules. Plan and conduct an investigation to produce data to determine whether food containing complex carbohydrates, but not glucose, undergoes a chemical reaction in the mouth and that this reaction turns the complex carbohydrates into glucose when mixed with a substance found in saliva (amylase), which is identified by a pattern change in the color of the food indicator.	decrease in complex carbohydrates and increase in glucose seem to be correlated. Plan and conduct an investigation to determine whether some complex carbohydrates can undergo a chemical reaction when mixed with a substance in saliva to produce glucose. Argue from evidence that some complex carbohydrates are broken down into glucose molecules through chemical reactions occurring in the mouth.	Models WIS/WIM Update Progress Tracker
Lesson 6 Analyze and interpret data to identify patterns in the amount that certain food molecules (complex carbohydrates, proteins, and fats) decrease and other food molecules (glucose, amino acids, and fatty acids) increase as they move through different organs in the digestive system. Analyze and interpret these data as evidence that the digestive system is a system of interacting subsystems composed of organs that each perform different functions.	Analyze more food data starting from before it enters the mouth and continuing through the large intestine, noting how it changes across different parts of a healthy digestive system. Find patterns in which some molecules decrease by the same amount that other molecules increase. Argue from investigative evidence that this is a sign of chemical reactions happening in the digestive system.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 7 Develop a model based on multiple lines of evidence to represent the inputs, processes, and outputs of the digestive system and the role that the	Develop models to answer the questions, "How does a healthy digestive system work?" and "How is the Patient's digestive system functioning differently than a healthy one?"	Consensus Model: Student (group sensemaking) Assessment

system, and the subsystems within it, play in breaking down matter inputs through chemical reactions, absorbing food, and excreting unused matter. Respectively provide and receive critiques about small-group models developed to explain how various subsystems in a healthy digestive system interact to move food through a series of chemical reactions to break down large food molecules. Engage in an argument from evidence to eliminate two of the five possible gastrointestinal conditions that could be causing the symptoms that the Patient is experiencing in her digestive system, based upon how they affect the body as a whole system.	Examine conditions that might be causing the Patient's symptoms.	
Lesson 8 Engage in an argument from evidence supported by scientific reasoning for how a healthy digestive system rearranges matter through chemical reactions and absorbs food, and how and why the Patient's digestive system is functioning differently. Analyze and interpret data to identify the relationship that taller villi (structure) have more cells that work together to impact the rate of absorption (function) of food molecules into the bloodstream.	Use an interactive simulation to learn that taller villi have more cells, so they are able to allow for more absorption. Use the simulation model to construct an individual explanation for the Patient's digestive symptoms.	DBQ Assessment
Lesson 9 Ask questions to gather more information about how problems in one body system interact with other systems after revisiting the Patient's symptom	Revisit the Driving Question Board (DQB) to see our progress and reorganize questions into clusters related to body systems.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models

list.	Analyze the Patient's symptoms in other systems, and add these questions to our DQB: "How can a problem in one body system cause problems in other systems?" and "How are these different systems connected?"	WIS/WIM Update Progress Tracker
Lesson 10 Analyze and interpret data using graphical displays and statistics to identify temporal relationships to provide evidence for how the Patient's pattern of body growth and weight have changed over time compared with typical children her age. Obtain, evaluate, and communicate information to determine the central ideas in an article to help determine where fat (matter) goes when people lose weight. Plan and carry out an investigation to produce data to serve as the basis for evidence to answer the question, Where does matter go when people lose weight?	Analyze trends in the Patient's weight and height data and look at images of weight loss over time. Read an article that says, when kids lose weight, the fat is being "burned." Investigate different types of fats on fire to see what happens when they burn.	Initial Ideas Discussion Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 11 Construct an explanation using both qualitative and quantitative data and scientific reasoning (that burning food produces energy, in the form of heat and light, and products, such as carbon dioxide and water) to describe why the mass of oil burned in an open system changes, while it stays the same in a closed system.	Conduct two investigations to trap the gases produced by burning food. Use the results of the gas trap investigations to figure out that food needs to undergo a chemical reaction with oxygen to release energy and that carbon dioxide gas and water vapor are products of that process.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 12 Analyze and interpret data to identify spatial and temporal relationships in order to determine causes for changes to blood glucose, oxygen, and carbon	Gather multiple sources of evidence to argue that a chemical reaction is occurring to burn food inside the cells of our body. We will consider the purpose of the reaction and analyze activity data to see that,	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models

dioxide levels in the body. Obtain, evaluate, and communicate information to clarify a claim that a chemical reaction that produces energy in the body is occurring in different parts of the body and that the body uses more glucose and oxygen to provide energy to cells (effect) during exercise (cause) than while resting.	if the activity level changes, then this chemical reaction will happen more or less depending on how much energy our cells need.	WIS/WIM Update Progress Tracker
Lesson 13 Develop models of three possible pathways showing how food is rearranged in the body to create energy, store matter for later use, and use matter for growth within a body system. Construct an explanation to explain the relationships between differences in the Patient's digestive system and a healthy digestive system in order to predict symptoms (effects), such as the Patient's decreased growth rate.	Build small-group models, drawing primarily on what we figured out in Lessons 8-12, to explain how food is rearranged in the body to create energy, store matter for later use, and use matter for growth. Compare our models and then develop a consensus model to explain how a healthy body obtains energy and how the Patient's body could be functioning differently.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board System Models- Healthy/Patient WIS/WIM Update Progress Tracker
Lesson 14 Engage in an argument from evidence that, in animals, oxygen reacts with carbon-containing molecules to provide energy and produce carbon dioxide and that organisms might have different structures that work together to do similar functions.	Investigate different organisms and argue from evidence whether (1) our organism does chemical reactions to break down and burn food molecules and (2) it has the same structures inside its body that work together to do those processes.	Gallery walk Self-assessment rubric General argumentation rubric DBQ
Lesson 15 Develop a model to explain how bears can rearrange matter in food through chemical reactions to release energy and use stored food in the form of fat to survive during hibernation.	Revisit the Driving Question Board and discuss all of our questions that we answered.	Modeling Transfer Task

Construct an explanation by applying scientific ideas and evidence to show how bears obtain energy to survive for several months without eating during hibernation.		

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Offer sentence starters to support students as they engage in writing
- <u>Word wall</u>: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- <u>Science notebook</u>: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Having different modes for interacting with the readings will provide different ways to access the readings
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
    - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a “standard” definition from the teacher.
- When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition.
- Allow students choice in how they test their ideas when applicable
- Plan partnerships ahead of time when possible
- Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.

Common Assessment(s)	**Assessment Modifications and/or Accommodations**

	(ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate
• Lesson 8 Argue from Evidence • Lesson 15 - Final summative	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment

Unit Title	**Time Frame/Pacing**
Matter Cycling & Photosynthesis	29 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Students taste maple syrup, which comes from plants and contains food molecules. Nutrition labels show that all foods that come from plants contain food molecules.

Anchoring Question:
Where does food come from, and where does it go next?

Supporting Questions:
- Lesson 1: Where does this stuff come from?
- Lesson 2: Do plants get their food molecules by taking them in?
- Lesson 3: What other inputs could be sources of food molecules for the plant?
- Lesson 4: Are any parts that make up food molecules coming into the plant from above the surface?
- Lesson 5: How are these gases getting into and out of leaves?
- Lesson 6: How are all these things interacting together in this part of the plant?
- Lesson 7: Why do plants need light?
- Lesson 8: Where are plants getting food from?
- Lesson 9: Where do the food molecules in the maple tree come from?
- Lesson 10: Why don't plants die at night?
- Lesson 11: Why don't plants die when they can't make food?
- Lesson 12: Where does the rest of our food come from?
- Lesson 13: What happens to food that doesn't get eaten?
- Lesson 14: Where does food come from and where does it go next?
- Lesson 15: Where does food come from, and where does it go next?

Enduring Understandings

- All plant foods we looked up nutrition information for have food molecules in them. Not all of the plants have the same food molecules (carbohydrates, fats, proteins), but all of them have some sugar.
- Plants might get their food molecules from different sources (i.e., water, sunlight, soil).
- Plants can grow without soil.

- Air, hydroponic plant food, and water contain the same atoms that food molecules contain. These are parts of food molecules that could be taken in by plants.
- Carbon dioxide enters plants through the leaves.
- Since carbon dioxide is the only input containing carbon, it is the source of carbon in food molecules.
- Plants also release water and oxygen from their leaves.
- Leaves are made of cells.
- Water and carbon dioxide molecules, along with light, interact in chloroplasts in plant cells, where they are used to make oxygen and sugar molecules. Each of these inputs is needed to produce these outputs.
- In this process, molecules of water and carbon dioxide are broken apart and the atoms that make them up (carbon, hydrogen, and oxygen) are rearranged to form new substances.
- As more inputs are provided to the plant cell, the more oxygen and sugar are produced.
- Water and carbon dioxide don't provide energy (measured in calories) for the body, but glucose does.
- Plants must use sunlight as an input for energy so that they can do chemical reactions to make sugar (glucose and other complex food molecules).
- Plants use energy from the sun to make sugars (food) from carbon dioxide and water. Plants release oxygen as an additional output in this process. This process is called photosynthesis..
- All plants make their own food molecules through the process of photosynthesis.
- Photosynthesis occurs in the chloroplasts of plant cells.
- In the dark, plants do not do photosynthesis. Instead, they do some kind of chemical reaction that takes in oxygen and releases carbon dioxide and water (cellular respiration).
- Plants do cellular respiration. This is how their cells (and our cells) get energy to survive and grow.
- If plants make sugar (through photosynthesis) faster than their cells use it for energy (through cellular respiration), they store up that extra food by converting it to starches (or fats). These can be used later for fuel or building blocks.
- Plants use their stored food as building blocks by reassembling the atoms in that food to make new substances (e.g., cellulose for cell walls).
- Everything we eat contains matter that came from either plants or animals.
- Some foods we eat have been processed either physically or chemically, but we can still trace them back to originally coming from plants.
- Decomposers recycle dead plant and animal matter and put energy back into the system.
- Decomposers use matter for food that humans (and many animals) cannot use for energy and matter.
- The outputs of living things become the inputs of other living things and part of the nonliving components of the system.
- Atoms are continuously recycled between living (producers, consumers, and decomposers) and non-living (air and water) components in our world.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

- MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Partial NGSS Performance Expectations (PEs) addressed by this unit:

- MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. (Specifically, chloroplasts and mitochondria.)

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using Models • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. **Constructing Explanations and Design Solutions** • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. **Engaging in Argument from Evidence** • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence	**LS1.C: Organization for Matter and Energy Flow in Organisms** • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in	**Systems and System Models** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. • Models are limited in that they only represent certain aspects of the system under study. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • The transfer of energy can be tracked as

and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **Obtaining, Evaluating, and Communication Information** • Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.	aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) **PS1.A: Structure and Properties of Matter** • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2), (MS-PS1-3) **PS1.B: Chemical Reactions** • 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. (MS-PS1-2), (MS-PS1-3), (MS-PS1-5) **PS3.D: Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)*	energy flows through a designed or natural system.
Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking		

Math

- MP.2 Reason abstractly and quantitatively. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- MP.4 Model with mathematics. (MS-PS1-1), (MS-PS1-5)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1), (MS-PS1-2), (MS-PS1-5)
- 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)
- CCSS.MATH.CONTENT.6.NS.C.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane.
- CCSS.MATH.CONTENT.6.SP.B.5.B Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
- CCSS.MATH.CONTENT.6.SP.B.5.C Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

ELA

- CCSS.ELA-Literacy.SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
- CCSS.ELA-LITERACY.WHST.6-8.1.B As students are practicing the skills needed to craft a strong argument by supporting claims.
- CCSS.ELA-LITERACY.RST.6-8.1 Students first read and understand the text, then use evidence from the text to answer questions about patterns of movement within plant cells. Students combine the information from this reading with prior knowledge to make predictions about the role of light in plant cells.
- CCSS.ELA-LITERACY.RST.6-8.7 (Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table) because they must integrate what they read in the text to correctly read and interpret the content of the food label. Information from both sources must be used to answer the reflection questions.
- CCSS.ELA-LITERACY.WHST.6-8.1 As students must introduce and support a claim about why the scientist was able to survive in the sealed box. Students are provided a scaffold with the components of a strong written scientific argument to ensure that they include each element outlined in parts A-E of the standard.
- CCSS.ELA-LITERACY.WHST.6-8.2.A By working with both written language and visuals such as graphs or pictures, students also increase their own capacity for sensemaking.
- CCSS.ELA-LITERACY.RST.6-8.2 By recommending that students summarize the text and tease out any questions they have that relate to their prior knowledge
- CCSS.ELA-LITERACY.RST.6-8.9 Is addressed as students integrate information from video, texts, data tables, and other media to come to these conclusions.
- CCSS.ELA-LITERACY.RST.6-8.1 By reading a text, synthesizing the information, and reporting it out to their peers to answer specific questions..

- CCSS.ELA-LITERACY.RST.6-8.7 and CCSS.ELA-LITERACY.RST.6-8.9 As students must integrate information from a variety of sources to build their understanding of the role and function of decomposers in matter cycling. With each video, reading, and examination of images from experiments, students compare the information and build on their initial ideas.
- CCSS.ELA-LITERACY.RST.6-8.1 Students must cite evidence from the texts they read to answer questions about synthetic materials, which addresses

Computer Science and Design Thinking

- 8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

- 9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1)
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.3 Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.5 Analyze and interpret local or public data sets to summarize and effectively communicate the data.
- 9.4.8.TL.1 Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Social Awareness**
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the differences among individuals, groups, and others' cultural backgrounds.
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Demonstrate an awareness of the expectations for social interactions in a variety of settings.
- **Responsible Decision-Making**
  - Develop, implement, and model effective problem-solving and critical thinking skills.
  - Evaluate personal, ethical, safety, and civic impact of decisions.
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.
- **Self Management:** Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1 Develop an initial model to describe the inputs of the system where plants get food molecules (matter). Ask questions that arise from careful observation of food-related phenomena that the class can investigate to explain how plants get matter and energy to make food molecules.	Brainstorm food we eat that we think come from plants, animals, or other sources. We taste maple syrup and maple sap - foods that we are surprised come from plants and watch a video of sap being extracted from a tree. Review nutrition labels for the plant foods investigated. Develop a model to try to explain how plants get their food. Develop a Driving Question Board to guide future investigations	Initial Plant System Model Driving Question Board
Lesson 2 Plan and carry out an investigation collaboratively by identifying controls to produce data as evidence to determine whether hydroponic plant food contains food molecules as inputs. Engage in argument from evidence to support or refute possible inputs of where plants get their food molecules from, such as hydroponic plant food or soil.	Investigate possible sources of food molecules such as carbohydrates, proteins, and fats inside plants using a hydroponic plant system and a list of potential candidates. Use food indicators to confirm or eliminate each candidate.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 3 Construct an explanation by applying scientific reasoning to show why data found in images and charts show patterns that parts of inputs could be the source of food molecules in a plant.	Revisit the composition of air and light to look for possible sources of food molecules.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker

Lesson 4 Engage in argument from evidence by comparing and critiquing claims that plants take in (input) water through their roots and give off (output) water through their leaves. Analyze and interpret data and graphs to identify patterns to show that plants are taking in (inputs) carbon dioxide and releasing water and oxygen (outputs).	Use data to determine that plants are taking in carbon dioxide and releasing water and oxygen.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM- Experimental Data Update Progress Tracker Student Assessment: Comparing and Critiquing Arguments about Water in Plants
Lesson 5 Obtain information from scientific texts to describe how chloroplasts (microscopic leaf structures) respond to light (an external stimuli).	Observe the surface of leaves and see small openings that could be how gases get into and out of leaves. Explore the inside of leaves and see green chloroplasts inside plant cells and discover that they move in response to light.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM Update Progress Tracker
Lesson 6 Plan and carry out an investigation to support a claim about how the inputs to a plant are related to what the plant cell can produce from chemical reactions in the chloroplasts (outputs). Engage in argument from evidence about what plants need to make food molecules using evidence from the computer simulation and scientific reasoning to support an explanation for why decreasing the amount of water, carbon dioxide, light, or chloroplasts (cause) in a plant cell decreases the amount of sugar and oxygen it produces (effect).	Use a computer simulation to explore how water, carbon dioxide, light, and chloroplasts interact in a plant cell. Investigate how changing the amount of one of these inputs affects the outputs of the plant cell and use the evidence collected to argue how water, carbon dioxide, light, and chloroplasts interact to produce oxygen and sugar molecules.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM Update Progress Tracker
Lesson 7 Obtain, evaluate, and communicate information to show the relationships among matter and energy	Examine food labels to figure out how much energy the different inputs and outputs of the plant system provide for the body.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board

between the inputs and outputs for the process by which plants use energy from light to make sugars from carbon dioxide and water (photosynthesis). Engage in argument from evidence and scientific reasoning to support the claim that plants use sunlight for energy to convert carbon dioxide and water into sugar that provides a form of energy the body can use.	Argue from evidence that sunlight must be the source of the energy for plants to rearrange the Cs, Hs, and Os.	Models Recorded Observations WIS/WIM DBQ Update Progress Tracker
Lesson 8 Develop and use models based on multiple sources of evidence to show that plants use energy from light to make sugars (food) from carbon dioxide and water through the process of photosynthesis and release oxygen as an output and that energy is transferred from the sunlight to the plant through this process. Argue from evidence that carbon dioxide is an input for plants and oxygen is an output.	Build a consensus model to explain how plants get food molecules and where food molecules come from.	Consensus Model Individual Midpoint Assessment of Related Phenomenon
Lesson 9 Ask questions to refine our model of plants to show the inputs and outputs, and energy and matter flows over time to explain how food molecules can be present during times that plants do not have leaves or chloroplasts.	Apply our models to try to explain how sugar can come out of maple trees when leaves aren't present.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM Update Progress Tracker
Lesson 10 Use a model of the plant system to predict that plants do not do photosynthesis in the dark.	Use our model to predict that plants don't make food molecules at night and confirm this by analyzing first- and secondhand data. Argue from evidence that plants in the dark take in oxygen and release carbon dioxide and water will	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM - Night Data

Analyze and interpret data to identify patterns that show that in the dark, plants take in oxygen and release carbon dioxide and water. Communicate information about the relationship between energy and the cycling of carbon dioxide and oxygen (matter) in and out of plants.	push us to wonder whether plants also do cellular respiration.	Update Progress Tracker
Lesson 11 Plan and carry out an investigation collecting data of relative concentration of carbon dioxide changes over time in different closed systems to answer the question, *Why don't plants die when they can't do photosynthesis?* Obtain and evaluate information from scientific texts to clarify the claim that the plant system doesn't die when it can't do photosynthesis because the sugars it produced can be stored for later use in the form of starches. The stored food molecules can be used for energy via cellular respiration or for growth. Construct an explanation by applying scientific ideas and evidence to explain: (1) why a tree that loses leaves in the winter doesn't die, (2) where it gets its energy during that time, and (3) where it gets the matter to grow new leaves and wood in the spring.	Plan and carry out an investigation to see whether plants without leaves (sprouting seeds) go through the process of cellular respiration. Read about where this happens in plant (and animal) cells and what plants do with extra food they produce from photosynthesis. Explain what happens to a maple tree in a time-lapse video over many years.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM Student Assessment: Write an explanation of how trees or saplings that do not have leaves can survive.
Lesson 12 Obtain information from text and a video to determine that the processed foods we eat contain matter (atoms) that came from plants; use this information to communicate and synthesize related information presented to peers.	Obtain information from ingredients lists for common processed foods,nutrition facts, and data about animal diets. Argue from evidence that processed foods are made of matter from plants and/or animals.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM

Engage in argument from evidence (readings about where different sweeteners come from) that all the food we eat contains matter that ultimately came from plants.		Update Progress Tracker Presentations
Lesson 13 Integrate scientific information about the inputs and outputs of decomposers. Communicate information to demonstrate how matter and energy is transferred between producers, consumers, and decomposers.	Watch videos of decomposers that recycle matter and energy from dead plants and animals. Examine data from bread mold in the light and dark and read about decomposers around the world. Revise our model to include decomposers as a living part of the system.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Recorded Observations WIS/WIM Update Progress Tracker Presentations
Lesson 14 Construct an explanation to describe the cycling of atoms (matter) into and out of organisms within a system, and respectfully provide and receive feedback on respective explanations with a partner.	Revise our consensus model to show how the outputs of one component of the system can become the inputs for other parts. Problematize how atoms can be continually cycled through a system as energy flows. Explain where our food comes from and where it goes next to explain the story of food atoms.	Consensus Model Student Assessment: Write a story of an atom from a breakfast food.
Lesson 15 Develop and revise a model to describe the cycling of matter and flow of energy among living and nonliving parts of a system. Construct an explanation based on evidence for the necessary role of photosynthesis in the cycling of matter and flow of energy in a system into and out of organisms.	Revisit the Driving Question Board and discuss all of our questions that we have now answered.	Student Assessment- Transfer Task

Obtain information from multiple sources to describe that synthetic materials come from the matter and energy in natural resources and impact society.		

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Offer sentence starters to support students as they engage in writing
- <u>Word wall</u>: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- <u>Science notebook</u>: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Having different modes for interacting with the readings will provide different ways to access the readings
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
    - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a "standard" definition from the teacher.
- When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition.
- Allow students choice in how they test their ideas when applicable
- Plan partnerships ahead of time when possible
- Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.

Common Assessment(s)	**Assessment Modifications and/or Accommodations**

	(ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate
• Lesson 8 (midpoint assessment) • Lesson 15 (end of unit assessment)	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment

Unit Title	**Time Frame/Pacing**
Ecosystem Dynamics	40 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Buying candy in the United States could be killing orangutans in Indonesia.

Anchoring Question:
How does changing an ecosystem affect what lives there?

Supporting Questions:
- Lesson 1: How could buying candy affect orangutan populations in the wild?
- Lesson 2: Can we replace palm oil with something else?
- Lesson 3: Can we grow oil palm trees somewhere else so that we're not cutting down rainforests?
- Lesson 4: Why do people cut down rainforests when they know it is harmful for the animals that live there?
- Lesson 5: If palm oil is not going away, how can we design palm farms to support orangutans and farmers?
- Lesson 6: How many orangutans is a healthy number?
- Lesson 7: Why do orangutans need so much forest space?
- Lesson 8: Could planting more fruit trees help the orangutan population increase?
- Lesson 9: Why is planting oil palm trees making the number of orangutans go down?
- Lesson 10: How is planting palm oil affecting other populations?
- Lesson 11: How can we make oil palm farms more like rainforests?
- Lesson 12: Why would planting more kinds of plants benefit the ecosystem and the farmers?
- Lesson 13: How does changing an ecosystem affect what lives there?
- Lesson 14: How can we design a palm farm to support both farmers and orangutans?
- Lesson 15: How can we use land in ways that work for people and other living things?

Enduring Understandings

- Different kinds of oils that we consume in foods and products come from farmed crops.
- Plants need regular sunlight, good precipitation, and warm temperatures in order to grow. These are called abiotic factors in an ecosystem.
- When you change parts of the ecosystem, you change how the whole system functions.
- People rely on ecosystems for resources. We gain resources when we change ecosystems but lose other resources.
- Populations of organisms are made up of many individuals living in the same area.

- Individual organisms and populations of organisms are dependent upon a certain amount of space.
- Organisms in the same population compete with each other for food.
- Competition between individuals within a population increases when availability of resources is limited.
- If an organism cannot meet its needs, it may not grow and survive. Over a timespan of years, this could affect the total population number.
- If an organism cannot meet its needs, it may not reproduce. Over a timespan of years, this could affect the total population number.
- If there are a lot of resources available, populations go up. If the resource is limited, populations go down.
- Organisms, and populations of organisms, are dependent on their environmental interactions.
- Organisms with similar requirements for food compete with each other for limited resources, lack of access to which consequently constrains their growth and reproduction.
- It is normal for populations to fluctuate depending on resource availability from year to year. Drastic changes to resource availability can cause unusual and unstable changes to populations.
- Populations depend on other populations for shelter.
- There is competition between populations of organisms that need the same resource.
- Predators depend on prey populations for food.
- There are patterns in the way that populations interact across ecosystems.
- Some populations can meet their needs in different systems, while other populations are dependent on one system or one component in the system.
- Monoculture farms grow only one kind of plant.
- Diversified farms grow many different kinds of plants.
- If there are a lot of types of living things in an ecosystem, the ecosystem has more biodiversity
- A change to the living or nonliving parts of an ecosystem can cause a population to decrease below the typical range because there are fewer resources available to them.
- If an ecosystem has many connections between populations, the ecosystem has a better chance of being OK when a change happens.
- Populations with the fewest connections to other populations, or with connections to a few very important resources, will probably be the most affected if a part of the ecosystem changes.
- Ecosystems with more plant biodiversity can provide more human resources, such as food and timber products.
- Planting multiple crops on a set area of land, at different ratios, maximizes a farmer's economic yield.
- Farmers can reasonably set aside a portion of their land for native ecosystems and not reduce their yield.
- The local project should be closely tied to a land use change that is (1) in the students' community or affects them personally and (2) is problematic because of the reduction in plant biodiversity. In this way, students can use the generalized models for monoculture systems and diversified systems to help them understand the problem and to develop solutions.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

- MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **Developing and Using Models** • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena **Planning and Carrying Out Investigation**	**LS2.A: Interdependent Relationships in Ecosystems** • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **Systems and System Models** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. • Models are limited in that they only represent certain aspects of the system under study. **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales,

• Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. **Mathematical Reasoning and Computational Thinking** • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. **Constructing Explanations and Designing Solutions** • Construct an explanation using models or representations • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) **LS4.D: Biodiversity and Humans** • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HSLS2-7)	including the atomic scale. • Small changes in one part of a system might cause large changes in another part. • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. • Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- CCSS.MATH.CONTENT.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- CCSS.MATH.CONTENT.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
- CCSS.Math.Content.6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

- CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- CCSS.Math.Content.6.SP.B.5.c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
- CCSS.Math.Content.7.SP.A.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population.
- CCSS.Math.Content.6.SP.A.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.
- MP.4 Model with mathematics. (MS-LS2-5)

ELA

- CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- CCSS.ELA-Literacy.SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
- CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- CCSS.ELA-Literacy.SL.7.1.a Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- CCSS.ELA-Literacy.SL.7.2 Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
- CCSS.ELA-Literacy.SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- CCSS.ELA-Literacy.W.7.1.b Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
- CCSS.ELA-LITERACY.W.7.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- CCSS.ELA-LITERACY.W.7.2.A Introduce a topic; organize ideas, concepts, and information, using strategies, such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
- CCSS.ELA-LITERACY.W.7.2.B Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.
- CCSS.ELA-LITERACY.W.7.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.
- RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)

Computer Science and Design Thinking

- 8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

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- **Self Management:** Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1 Develop an initial systems model to describe a phenomenon in which changes to one living component of an ecosystem (cause) affects the other living parts of the ecosystem (effect).	Examine headlines that claim that our candy buying could affect orangutan populations in the wild. Examine candy ingredients and realize that one ingredient, palm oil, is produced in the same location in which orangutans live (the islands of	Initial models in science notebooks Driving Question Board

Ask questions that arise from initial observations of populations in an ecosystem to help seek additional information about the parts of the ecosystem and how they interact.	Borneo and Sumatra in Indonesia). Read about rainforests in Indonesia being cut down to make room for growing oil palm. Wonder how increasing oil palm trees can lead to a decrease in orangutans. After generating a list of related phenomena, develop a Driving Question Board to guide future investigations.	
Lesson 2 Define a pattern of design problems for systems that provides food resources that humans need (cause) but transforms the land and the biosphere once occupied by native plants and animals (effect).	Investigate what it means to be a plantation system and identify that there are different meanings biologically and historically. Read and examine data about soybean and canola oil as possible substitutes for palm oil. Conclude and communicate that all three oils require clearing land for farming,which harms animals, and palm oil is more efficient at producing oil per land area.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 3 Define a problem in which oil palm is dependent upon the same environmental interactions with non living factors as other tropical rainforest plants (pattern).	Identify places around the world that have suitable abiotic conditions for growing oil palm plants. Compare world sites suitable for growing oil palm plants to that of tropical forests. Discuss how both kinds of plants share the same abiotic requirements and compete for the same space.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 4 Define a new criterion for a solution to more	Listen to people who farm palm oil to learn the reasons that they cut down rainforests even though	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook)

sustainably grow oil palm in ways that protect the rainforest ecosystem but that also recognizes the needs of local farmers, who are part of the palm oil production system.	it is bad for the animals that live there. Determine reasons many of these farmers are struggling to make ends meet and that the rainforest is often the only resource from which they can make money.	Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 5 Define a design problem based on patterns in land use change and its effect on populations that lived in the original ecosystem. Define a design problem about the structure of palm farm systems to generate ideas for how to better design these systems to function for populations that live in or near the rainforest and for farmers who depend on the farms for their livelihoods.	Expand our thinking beyond palm oil to other locations at which people change natural ecosystems. Determine patterns across the cases,which will help us articulate a bigger problem about land use change. Examine before and after images of these systems,which will give us ideas of how to design a better palm farm. Develop criteria and constraints to guide our design decisions.We will revisit our Driving Question Board to add new questions and second driving question for the unit,"How can we use land in ways that work for people and other living things?"	Generalized model Self-documentation Palm Farm Designs: Part 1 and 2 Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 6 Apply mathematical concepts (ratio) to find patterns in numerical relationships about the number of orangutans that can live in a 1 km area.	Discuss how many orangutans is a healthy number and examine a StoryMap showing the number of orangutans in four protected areas of rainforest. Notice patterns of fluctuation and that larger areas have larger populations. Calculate a ratio of orangutans per area. Make predictions that this ratio is based on food availability and brainstorm how to test our ideas in a	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker

	simulation.	
Lesson 7 Carry out a series of investigations using a simplified computer simulation (system model) in which individual orangutans compete with each other for two different food sources in a variety of environmental conditions. Analyze measures of central tendency and range in class-constructed histograms to make claims about how populations of orangutans responded to a variety of environmental conditions and the ways in which the environmental conditions contributed to the stability of the population or changes in the population.	Gather data from a whole-group computer simulation in which individual orangutans compete with each other for two different food sources(figs and termites). Test the simulation in a variety of environmental conditions(independent variable). Construct class histograms using data from each simulation to examine how well individual orangutans and the orangutan population overall responds(dependent variables).	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models Histograms WIS/WIM Update Progress Tracker
Lesson 8 Collect data from an investigation to draw conclusions about how stable populations of orangutans fluctuate over shorter periods of time based on resource availability. Use mathematical representations to draw conclusions about how the size of orangutan populations changes over the long term, depending upon resource availability.	Conduct investigations in a simulation, manipulating the amount of resources(IV) over longer periods of time to observe how populations increase or decrease (DV). Analyze and interpret population size increases when resources are plentiful and decrease when resources are limited and that all populations have natural fluctuations in size. Make connections to our findings of the differences in population density in the different ecosystems from Lesson 6.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 9 Develop a model based on evidence from investigations to explain how changes to resource availability in the ecosystem in which orangutans live affect the size of the population living there.	Engage in consensus modeling to show what we have figured out so far about how changes to an ecosystem impact the population of organisms that live there.	Consensus Model Assessment: Transfer Task to elicit ideas about competition for resources and normal and unusual population changes, the task asks students to use mathematical reasoning and computational

Apply mathematical concepts and processes to explain how the loss of short and tallgrass prairies to soybean oil production has caused a decline in the size of monarch butterfly populations.	Apply these understandings toward explaining a related phenomenon.	thinking and data analysis and interpretation. The focal crosscutting concept is stability and change.
Lesson 10 Develop two system models to compare the components and interactions that are similar and different in the two ecosystems.	Brainstorm different kinds of interactions between populations and develop system model for the rainforest and oil palm farm. Compare the two systems, looking for similarities and differences.We will figure out that the rainforest system has more components and interactions than the oil palm system, but there are similar types of interactions in both ecosystems. Use our models to brainstorm ideas to make the oil palm system more like the rainforest system.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisit Driving Question Board System Models: Rainforest vs. Palm Oil Farm WIS/WIM Update Progress Tracker
Lesson 11 Critically read scientific texts to determine patterns in ecosystem plant biodiversity in modern and historical diversified farming systems.	Investigate two cases of diversified oil palm farming and realize that these are like a rainforest because there are more different kinds of plants. Explore two related cases through StoryMaps and notice that those cases also have much more plant biodiversity.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisit Driving Question Board Models Story Maps WIS/WIM Update Progress Tracker
Lesson 12 Use a model to predict how a sudden change (cause) to a physical or biological component of a monoculture system and a diversified system will affect populations in the system and farmers (effect).	Determine why more kinds of plants are beneficial to a system. Investigate how ecosystems and farmers in diversified and monoculture farms are in three disruption scenarios: disease, drought, and price drop. Determine that a diversified farm is resilient	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisit Driving Question Board System Models: Diversified vs. Monoculture WIS/WIM Update Progress Tracker

	because it has more components and links.	
Lesson 13 Use a general model to show how changing one component of an ecosystem has ripple effects on other living things in the ecosystem (system modeling). Construct an explanation using models to show how changing part of an ecosystem (cause) affects the populations that live in the ecosystem (effects).	Co-construct different explanations to the unit driving question and do a gallery walk to view other groups' explanations. Engage in a Consensus Discussion to decide how changes to ecosystems impact other populations in the system. Use a generalized model to make predictions about changes to ecosystems.	Consensus Model Assessment: To elicit students' ideas about how ecosystem respond when disruptions occur and also engages students in modeling and constructing explanations. The focal crosscutting concepts are systems models and cause and effect.
Lesson 14 Use digital tools and mathematical concepts to compare proposed diversified palm farm designs to provide stable income for farmers based on growing and harvesting rates of crops. Undertake a design project to construct a diversified palm farm system that improves biodiversity and resilience, which benefits both farmers and orangutans. Construct an explanation using a diversified palm farm as an example of a system that supports biodiversity and minimizes the risk of disruptions impacting populations.	Revise our criteria and constraints for the palm farm design. Investigate crop options to diversify the palm farm to support farmers. Investigate utilizing a 20% forest corridor with surrounding farms to maximize a local orangutan population. Share and reflect on our best designs and write an individual explanation to support our palm farm design.	Palm Farm Design Task DBQ
Lesson 15 Students can apply their learning to a local land use change problem to make sense of the problem and design solutions.	Investigate a local project to design and/or communicate about land use change in our area that has led to a decrease in plant biodiversity and how that has affected other living things. Identify solutions to the problem and implement changes and/or advocate for changes to better	Communication of Ideas

	support biodiversity and improve the system's resilience.	

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Offer sentence starters to support students as they engage in writing
- Word wall: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- Science notebook: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Having different modes for interacting with the readings will provide different ways to access the readings
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
  - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a "standard" definition from the teacher.
- When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition.
- Allow students choice in how they test their ideas when applicable
- Plan partnerships ahead of time when possible
- Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate**

• Lesson 9 - Summative assessment (mid-point) • Lesson 13 - End of unit assessment	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment

Hillsborough Township Public Schools
Grade 8 Science Curriculum

Unit Title	Time Frame/Pacing
Natural Resources & Human Impact	30 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Floods and droughts are increasing across the US and there is a pattern of record heat and rising temperatures associated with both.

Anchoring Question:
How do changes in Earth's system impact our communities and what can we do about it?

Supporting Questions:

- Lesson 1: Why are floods and droughts happening more often?
- Lesson 2: What would we normally expect for these places and how do we know it's really changing?
- Lesson 3: How would increased temperatures affect evaporation?
- Lesson 4: Are rising temperatures affecting anything else in Earth's water system?
- Lesson 5: How are rising temperatures changing water stories in these communities?
- Lesson 6: Are there any changes in the air that could be related to rising temperatures?
- Lesson 7: Are changes in carbon dioxide and methane related to or causing temperatures to increase?
- Lesson 8: Are the changes in the amount of CO_2 in the atmosphere part of normal cycles that Earth goes through?
- Lesson 9: What is happening in the world to cause the sharp rise in carbon dioxide?
- Lesson 10: How could burning fossil fuels cause more CO_2 to get into the atmosphere?
- Lesson 11: How are changes to Earth's carbon system impacting Earth's water system?
- Lesson 12: Why is solving the climate change problem so challenging?
- Lesson 13: Which solution(s) could be possible to solve the problem?
- Lesson 14: How can we make changes to our daily lives to reduce carbon dioxide going into the atmosphere?
- Lesson 15: What solutions work best for our school or community?
- Lesson 16: What can we explain now, and what questions do we still have?

Enduring Understandings

- Droughts and floods are happening more often, and both cases seem to be linked to warmer temperatures.
- Changes in evaporation may be related to why, where, and when droughts and floods occur.
- Freshwater is distributed above the surface, at the surface, and below the surface of Earth and moves in between these spaces.
- Year-to-year variability in precipitation and temperature is a normal pattern.

- Precipitation is decreasing or groundwater and snowpack are declining in areas where there are more droughts.
- Increased temperatures can lead to an increase in evaporation rates, which increases the water vapor in the air.
- The larger amounts of water vapor in the air are moved to different locations by the wind, and more or less precipitation may fall in some places than normal causing flooding or droughts.
- Changes in atmospheric temperature are related to changes in the components and processes of Earth's water system.
- The atmosphere is made from different concentrations of gasses.
- GHGs are gas molecules in the atmosphere that absorb, vibrate, and release heat back into the atmosphere.
- As the amount of GHGs increases in our atmosphere, they cause the atmosphere to get warmer.
- $CO2$ levels over the last 100 years have been rising consistently.
- Large deposits of mineral resources (such as "fossil fuels") are used to power our communities and transportation networks, and this use has increased over time.
- Population growth increases consumption of resources (per-capita consumption of fossil fuels).
- A growing population that consumes large amounts of mineral resources is correlated with the rapid increases in $CO2$ in Earth's atmosphere.
- Photosynthesis is the only way to get carbon dioxide out of the atmosphere. The rate of photosynthesis is not enough to take up carbon dioxide from combustion of fossil fuels.
- Combustion of fossil fuels is creating a carbon imbalance in the atmosphere.
- Changes in the carbon system have an effect on Earth's water system.
- Our carbon imbalance in our atmosphere is due to human combustion of fossil fuels.
- Any reduction in emissions helps to slow the global temperature increase.
- Implementing only one solution will not lead to a decrease of carbon dioxide in the atmosphere. Multiple solutions need to be done together to have an impact on the imbalance of carbon dioxide in the atmosphere.
- Communities can use technologies and develop behaviors to reduce consumption and rebalance negative impacts of too much $CO2$ emissions.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- 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.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

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- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

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<tr><td colspan="3">3-Dimensional Learning Components</td></tr>
<tr><td>Science and Engineering Practices</td><td>Disciplinary Core Ideas (DCI)</td><td>Crosscutting Concepts</td></tr>
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Asking Questions and Defining Problems

Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Using Mathematics and Computational Thinking

Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems.

Obtaining, Communicating, and Evaluating Information

Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.

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ESS3.A Natural 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 geologic processes. (MS-ESS3-1)

ESS3.C Human Impacts on Earth Systems

Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
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. (MS-ESS3-3), (MS-ESS3-4)

ESS3.D Global Climate Change

Human activities, such as the release of greenhouse gasses from burning fossil fuels,

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Cause and Effect

Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
Cause and effect relationships may be used to predict phenomena in natural or designed systems

Scale, Proportion, and Quantity

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.
Scientific relationships can be represented through the use of algebraic expressions and equations.

Stability and Change

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.
Small changes in one part of a system might cause large changes in another part.
Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

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• Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. **Developing and Using Models** • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales **Analyzing and Interpreting Data** • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. • Constructing Explanations and Designing Solutions • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **Engaging in Argument from Evidence**	are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5) **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)	• Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms. **Patterns** • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a designed or natural system.

• Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- CCSS.Math.Content.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities
- CCSS.Math.Content.7.RP.A.2 Recognize and represent proportional relationships between quantities
- CCSS.Math.Content.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
- CCSS.Math.Content.6.RP.A.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent
- CCSS.MATH.CONTENT.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
- MP.2 Reason abstractly and quantitatively. (MS-ESS3-2), (MS-ESS3-5)
- 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3), (MS-ESS3-4)
- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1), (MS-ESS3-2), (MS-ESS3-3), (MS-ESS3-4), (MS-ESS3-5)

ELA

- CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- CCSS.ELA-Literacy.RST.6-8.10 By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.
- CCSS.ELA-LITERACY.W.7.1 Write arguments to support claims with clear reasons and relevant evidence.
- CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- CCSS.ELA-LITERACY.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately

through the effective selection, organization, and analysis of content.

- CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-LITERACY.CCRA.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- CCSS.ELA-LITERACY.CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning, and the organization, development, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1), (MS-ESS3-2), (MS-ESS3-4), (MS-ESS3-5)
- WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)
- WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
- WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS3-3)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1), (MS-ESS3-4)

Computer Science and Design Thinking

- 8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

- 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).
- 9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1)
- 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).

- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.5 Analyze and interpret local or public data sets to summarize and effectively communicate the data.
- 9.4.8.TL.1 Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Social Awareness**
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the differences among individuals, groups, and others' cultural backgrounds.
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Demonstrate an awareness of the expectations for social interactions in a variety of settings.
- **Responsible Decision-Making**
  - Develop, implement, and model effective problem-solving and critical thinking skills.
  - Evaluate personal, ethical, safety, and civic impact of decisions.
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.
- **Self Management:** Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1 Develop a model to explain how a small change in temperature can cause large scale changes in precipitation leading to floods and droughts. Develop a model to explain what could cause an increase in temperatures that are linked to an increase in floods and droughts. Ask questions that arise from initial observations of stories and headlines about rising temperatures, floods, and droughts to clarify whether increasing	Observe two news clips that tell the story of extreme flood and drought events in two different communities and share our own stories of when water in our communities has changed. Examine headlines that show a "new normal" of increased floods and droughts across the United States and notice that, in both situations, there is a pattern of record heat and rising temperatures. Develop an initial model explaining what could be causing those warmer temperatures and how those	Initial models in science notebooks Driving Question Board

temperatures are related to or causing both floods and droughts.	warmer temperatures could lead to both droughts and floods. Develop questions for our Driving Question Board (DQB) and brainstorm investigations we could do and sources of data that could help us figure out answers to our questions.	
Lesson 2 Develop and use a model to describe the components, interactions, and processes of water distribution and movement on Earth. Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal patterns in temperature, total precipitation, and seasonal precipitation in the local community and at case sites. Analyze and interpret data about patterns in rates of change and numerical relationships to determine similarities and differences between drought and flood sites.	Develop a systems model to describe where Earth's freshwater is stored above, at, and below the surface. Analyze and interpret temperature, precipitation, and drought or flood data in our local community and six other places in the US to figure out whether water or temperatures in these communities are changing over time.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 3 Analyze evaporation investigation data for patterns to provide evidence that increased temperatures can cause an increase in the rate of water vapor in the atmosphere through an increase in evaporation.	Create closed bottle setups to determine that increased temperatures can increase the evaporation rate and water vapor. Observe NASA water vapor and temperature visualizations and determine that temperatures affect the amount, location, frequency, type, and timing of precipitation events.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 4 Integrate scientific information with media and graphical displays of data to clarify how a small change in temperature affects components of	Obtain additional scientific and technical information about other components of Earth's water system and how those components are	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models

Earth's water system.	changing as temperatures increase. Figure out that all components and processes in the system have been affected. Update our model and look ahead to explaining how rising temperatures can cause floods and droughts.	WIS/WIM Update Progress Tracker
Lesson 5 Construct a scientific explanation based on valid and reliable evidence that changes in temperature can have impacts on the water sources available for communities. Compare graphs and charts depicting a changing climate in Alaska looking for similarities and differences to determine that trend lines and patterns across Alaskan claims are caused by increasing temperatures. Compare graphs and charts from multiple claims to identify patterns in the similarities and differences to determine that changes in the environments are caused by increasing temperatures.	Use our key models ideas to explain how changes in temperature have an impact on our case site communities. Revise our explanations using peer feedback and apply our key model ideas in an Alaskan assessment transfer task.	Water Story Explanation Peer Feedback Exit Ticket and self-reflection questions on their revised explanation Alaska Wildfire and Sea Ice Transfer Task
Lesson 6 Apply mathematical concepts of ratio and percent to understand the quantity of and stability and/or change in the concentration of gases in the atmosphere over time.	Build on our understanding of the composition of air to determine if changes happening in the air are related to the rising temperatures. Discuss and analyze data and develop a better understanding of parts per million. Using this understanding, we will find the percent change in the concentration of these gases over a 100-year period. Compare any increases or decreases in the	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker

	concentration of these gases over time. We will notice that some gasses remain stable, some change very little, while other gases change a lot.	
Lesson 7 Develop a model to describe how greenhouse gas molecules respond to energy transfer from Earth to the atmosphere and cause the temperatures to rise.	Figure out if the gases that are increasing in the atmosphere are causing the temperature to rise. Compare movement of different atmospheric gas molecules and apply that to heat transfer.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 8 Analyze and interpret data on graphs of carbon dioxide levels collected from ice cores to collect evidence of whether the changes in these levels are cyclical in nature and a normal occurrence or are changing at an non-normal rate.	Carry out an investigation and find that gas can be trapped in ice. We will find out about how scientists use ice core samples from locations on Earth that have very old ice to determine the amounts of carbon dioxide in the air over time. We focus on carbon dioxide and examine carbon dioxide data from ice cores dating back 800,000 years. We notice carbon dioxide naturally fluctuates up and down, but the current levels are outside of the normal high range for carbon dioxide.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 9 Integrate qualitative and quantitative scientific information in written text with visual displays of atmospheric carbon dioxide levels, energy consumption, and human population levels to determine a correlation between human activities and CO2 emissions over time.	Examine the last 200 years of Earth's history to understand what might have led to the rapid increase in CO2 emissions. Use a visualization and read about key innovations in human history that transformed the types of energy used to power our communities. Draw conclusions from data trends that as population grows and energy consumption rises, human activity contributes to the rapid rise in CO2.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 10 Ask questions to clarify whether the CO2 in the atmosphere can come from burning fossil fuels for	Burn a sample of fossil fuel and examine fossil fuel molecules. We will observe that, as the fuel loses mass, CO2 and water vapor are produced.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board

energy. Apply mathematical concepts to identify that the rate of combustion putting CO2 into the atmosphere is not proportional to the rate for photosynthesis taking CO2 out of the atmosphere leading to an imbalance in Earth's carbon system.	Model Earth's carbon system and trace carbon atoms once stored in fuels, as they burn and enter the atmosphere. We will figure out that photosynthesis cannot take up CO2 at the same rate that burning fuels puts CO2 in the atmosphere. Create an initial cause-and-effect diagram to link burning fossil fuels to the droughts and floods from the anchor.	Models CE Diagram WIS/WIM Update Progress Tracker
Lesson 11 Develop a model to describe how fossil fuel use causes changes to the climate, which affects community water resources. Construct an argument supported by science ideas to refute and clarify claims through an explanation of the causal chain of events between the changing climate and water resources.	Develop and support a causal model between fossil fuel use and changing water resources and will review and clarify a tweet regarding climate change and its impacts.	Social Media Assessment: Support and refute claims based on data and investigation evidence regarding human activities and climate change.
Lesson 12 Use the carbon dioxide model simulation to generate data and test ideas about different emissions rates scenarios to determine how to reach carbon dioxide equilibrium in the atmosphere. Ask questions about potential solutions that arise from careful observation of the carbon dioxide emissions level simulation and the impact of the solutions on projected global temperature increases over time.	Define our carbon dioxide problem and use a simulation to determine emission reduction needed to maintain current global temperatures. Discuss the practicality of eliminating fossil fuel use and define our criteria for a successful solution and begin to analyze other emission solutions.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker
Lesson 13 Evaluate competing solutions using a systematic process and jointly developed and agreed upon	Use a Design Matrix to organize the different solutions for reducing carbon dioxide in the atmosphere.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board

criteria to determine how small changes in behaviors and technologies can add up to larger impacts on reducing CO2 in the atmosphere.	Determine our constraints for the solutions in trying to meet the criteria of reducing the imbalance of carbon in the air. Reevaluate each solution using our constraints to decide which solutions would need to be implemented to meet our criteria.	Models Design Matrix WIS/WIM Update Progress Tracker
Lesson 14 Apply mathematical concepts to calculate the class's average carbon impact and possible carbon reductions and scale those reductions if more people change their behaviors.	Calculate our carbon footprint and share our impact on the class's Carbon Scoreboard. We will calculate the class average and compare it to the average American footprint. We will revisit our footprint and do a "lifestyle makeover" by selecting 2-4 changes to make that would reduce our footprint and benefit our family in other ways. We will compound the effects of these changes if more people could make similar ones.	Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Carbon Footprint Calculation Comparison Update Progress Tracker
Lesson 15 Communicate information in writing and oral presentation about how adopting one small change in the system, such as a new behavior or technology, when taken to scale, can have a large impact on carbon dioxide in the atmosphere over time.	Obtain and communicate information about carbon solutions to the problem that will require large-scale solutions combined with individual action. Discuss and target individual solutions and take them to scale. Choose one solution matched to the stakeholders in our community or school, and design a communication and/or outreach plan to inform our stakeholders of this new behavior or technology. Present our plans to our peers and/or stakeholders and receive feedback on our approach.	Obtaining and Communicating Information about Carbon Solutions Rubric Peer Feedback- Gallery Walk Exit Ticket
Lesson 16	Identify questions from our DQB that we will be	Check-Ins (Do Nows, Entrance Tickets, Exit

Identify and ask questions related to climate change (patterns) and its impact on our communities that can be investigated in the future.	able to answer. We will celebrate all that we have learned in this unit and across the school year. We will spend time identifying the questions that we were not able to answer and will build a new DQB of these questions. We will create a plan to answer some of the questions on our own and during the next school year and beyond.	Tickets, Interactive Notebook) Revisist Driving Question Board Models WIS/WIM Update Progress Tracker

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate

- Accommodations as per IEP/504/ELL
- Provide student with the opportunity to talk through his or her own thinking when building the DBQ and encourage them to ask the class for help
- Offer sentence starters to support students as they engage in writing
- Word wall: use student-friendly definitions, make connections to cognate/root words when possible, and include a visual representation of the word
- Emphasize socially safe activity structures (e.g., small-group or partner work before a whole-class discussion)
- Science notebook: Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic (e.g.,taping in photographs, creating drawings, tables, graphs, mathematical equations, and measurements) modes.
- Encourage all students to use words and/or drawings when representing and recording their investigation setup and observations.
- Use classroom norms to support engagement by creating a space where students are not worried about being right or wrong.
- Having different modes for interacting with the readings will provide different ways to access the readings
- Graphs with pre-labeled axes as needed
- Provide options for investigations when applicable (offer students supplies to *choose* from in planning what data they wish to collect and what observations they wish to make; giving students a choice to pursue a line of inquiry that is more relevant to them)
- Provide hands-on materials for students to demonstrate their ideas when possible/relevant
- Provide cause/effect sentence stems when relevant/as needed
- Provide paper copies of DQB questions as needed
- Students may need a direct definition for words, and you may choose to add them to a word wall display, including a drawing or image.
- Check that students are able to make predictions and say what the outcomes would mean based on the cause-and-effect relationships they observed in the instruments and speaker making sounds.
    - If some students are able to talk or write about the cause-and-effect implications, but others cannot, be sure to elicit multiple examples of what those outcomes might make us think during the share-out discussion.
- When recording definitions in their notebooks, students should be encouraged to write in their own words rather than copying a "standard" definition from the teacher.
- When adding words to the word wall, have several students share their definitions and ask the class if they agree or disagree with that definition.
- Allow students choice in how they test their ideas when applicable

• Plan partnerships ahead of time when possible • Strive to give students an opportunity to share their ideas with one or two peers before going public with the whole class.	
Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate**
• Lesson 5 - mid-point summative • Lesson 11 - Summative Assessment • Lesson 15 - End of unit project assessment	• Bolded keywords • Word banks • Reference images • Read directions to students to aide with comprehension as needed • Provide access to anchor charts and classroom labels relevant to science concepts • Scribe for students or allow students to use talk-to-text feature on Chromebooks when responding to questions as needed • Allow students to use a paper copy of the assessment