NGSS Grade 7: Unit 2 Sequencing

Matter cycles and energy flows in living systems and Earth systems.

Sequence Developed by TUSD Teachers, March 2016

PEs Assessed: MS-LS1-6, MS-LS1-7, MS-ESS2-1, MS-PS1-2, MS-PS1-5, MS-PS1-6, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

DCIs

LS1.A: Structure and Function
-All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)
-Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)

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)

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)

LS1.C: Organization for Matter and Energy Flow in Organisms
- 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)

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)

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-PS1-5)

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)

LS2.B Cycle of Matter and Energy Transfer in Ecosystems
- 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.A: Defining and Delimiting Engineering Problems
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

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. (secondary to MS-PS1-6)

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 the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) 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. (secondary to MS-PS1-6)

ESS2.A: Earth's Materials and Systems
All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)

Additional Concepts

-organization of life- from atoms to biosphere
-review of cells
-organelles
-mitochondria
-chloroplast
-go deeper into Ecosystems and habitats

-energy vs. matter
-glucose, ATP, and storage
-review of molecules
-history of Earth- oxygen formation

-photosynthesis
-cellular respirations
-cycle between them
-chemical reactions
-rearrangement of atoms
-molecular structure

-review

-balancing of equations with photosynthesis and cellular respiration
-products
-reactants
-Introduce chemical vs. physical changes (deeper in unit 3)

-emphasize the flow of energy vs. matter cycles in living systems
-connect to non- living
-connect to Earth systems (carbon cycle, nitrogen cycle)

- introduce conservation of mass, but go into more deeply in unit 3
-endothermic and exothermic reactions

-engineering design challenge- heat/cold pack
-engineering design process

-Rock cycle
-melting, crystallization, rock formation, types of rock
-weathering, deformation
-deposition, sedimentation
-Earth's sedimentary layers
-mountain building
-plate boundaries
-location of earthquakes and volcanoes
-topography
-convection currents in the mantle

SEPs

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. ,(MS-LS1-6)

Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6), (MS-PS1-2)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
-Develop a model to describe unobservable mechanisms. (MS-LS1-7)

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
-Develop a model to describe unobservable mechanisms. (MS-PS1-5)

Science Models, Laws, Mechanisms, and Theories
Explain Natural Phenomena Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

All 4 SEPs are also included in this project for ETS1

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MSPS1-6)

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MSESS2-1),

CCCs

Energy and Matter
Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1- 6)

Patterns
Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

Energy and Matter
Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5), (MS-LS1-7)

Energy and Matter
-The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Stability and Change
Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

PEs (boundaries of PE)

Bio Bottle Findings

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. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

Activity Brainstorm
- Students create bio bottles that will be used again or referenced again in unit 3 ecosystems (decomposers/food web)
- Begin by looking at living vs. nonliving in ecosystems and habitats
- Students are provided directions for bio bottle, as a group students decide on the design to create a closed working system
- Students research the role of photosynthesis in the cycling of matter and flow of energy into and out organisms.
- Students draw 3 images of bio bottles, modeling the cycling of gases, matter, energy
- Students record data on the "health" of their ecosystem and share results with the class
- Students add to drawings the components needed to fill in the gaps within the bio bottle system when things go wrong- what's missing?
- Example directins: http://www.pcc.edu/about/events/sustainability-training/documents/ecosystem-in-a-bottle.pdf
- **Assessment:** lab write up, 30 hands project, imovie, ect- sharing results of their bio bottle and explaining the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. Models should be referenced when explaining

Chemical vs. Physical Changes Pear Deck

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. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

Activity Brainstorm:
- This is just an intro to chemical vs. physical reactions
- **Assessment:** students participate in several interactive slides in Pear Deck to assess basis of understanding on this concept

Modeling Chemical Reactions (Photosynthesis and Cellular Respiration)

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. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

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. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]

Activity Brainstorm
- Students draw each atom a different color or cut out circles from colored construction paper to represent atoms
- Students arrange atoms into molecular structures or reactants
- Students rearrange molecules into molecular structures of products.
- Students can take images, create pic collages, or videos to represent how atoms just rearrange in chemical reactions and the total number does not change.
- **Assessment:** Stop start animation with narration showing the rearrangement or any other way students can model and prove understanding of this concept

Hot/Cold Pack Design Challenge

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*[Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
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.

Activity Brainstorm
- Students are challenged to make the hottest hot pack or coldest cold pack for the longest period of time
- Students design how hot/cold pack would function or be used
- Materials would include: ziploc baggies, duct tape, styrofoam cups, tin foil, or anything students want to bring from home
- Hot/cold pack should be used for first aid situations
- **Assessment**: iMovie that communicates the results of the engineering design process and pitches why their pack should win (alternatively, results can be written in Step 9 on engineering design process in notebooks)

Modeling Energy in the Rock Cycle

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

Activity Brainstorm:
- Use sugar cubes to model the creation and formation of different types of rock, explain the processes of melting, crystallization, weathering, sedimentation https://drive.google.com/file/d/0Bw_IhQ3QXKMoc0ZjdXUxaVk1X3c/view?usp=sharing
- **Assessment:** Students create posters or media product that represents the cycling of Earth's materials and flow of energy that drives these processes
- Can extend into mountain building. Some ideas might come from : http://www.teachingboxes.org/mountainBuilding/index.jsp
- Intro plate boundaries and plate tectonics- leads into unit 3