

Standards Alignment for “Growing Food on the Moon”

Grades 3-5

NGSS Standards

5-PS3-1 Use models to describe that the energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Engage - Asking Questions and Defining Problems

Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2 element)

Explore - Planning and Carrying Out Investigations

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Explain - Using Mathematics and Computational Thinking

Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.

Elaborate - Engaging in Argument from Evidence

Construct and/or support an argument with evidence, data, and/or a model.

Evaluate - Obtaining, Evaluating, and Communicating Information

Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.

PS3.D: Energy in Chemical Processes and Everyday Life

The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)

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

Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)

Patterns

Patterns can be used as evidence to support an explanation.

Scale, Proportion, and Quantity

Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Energy and Matter

Energy can be transferred in various ways and between objects.

Other Important Content Standards (Math, Computer Science, ELA, 21st Century)

English Language Arts (Common Core State Standards)

CCSS.ELA-LITERACY.W.4.2

Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

CCSS.ELA-LITERACY.W.4.2.A

Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

CCSS.ELA-LITERACY.W.4.2.B

Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.

Mathematics (Common Core State Standards)

CCSS.Math.Content.5.NF.B.3: Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

CCSS.Math.Content.5.NF.B.5: Interpret multiplication as scaling (resizing), by:

CCSS.Math.Content.5.NF.B.5.a: Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.

Middle School

NGSS Standards

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:

Engage - 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.

Explore - Planning and Carrying Out Investigations

Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

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 investigation.

Explain - Using Mathematics and Computational Thinking

Use mathematical representations to describe and/or support scientific conclusions and design solutions.

Elaborate - Engaging in Argument from Evidence

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 - Obtaining, Evaluating, and Communicating Information

Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

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)

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)

Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)

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.

Scale, Proportion, and Quantity

Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

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.

Energy and Matter

Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

The transfer of energy can be tracked as energy flows through a designed or natural system.

Other Important Content Standards (Math, Computer Science, ELA, 21st Century)

English Language Arts (Common Core State Standards)

CCSS.ELA-LITERACY.W.7.1

Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-LITERACY.W.7.1.A

Introduce claim(s), acknowledge alternate or opposing claims, and organize the reasons and evidence logically.

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.

Mathematics (Common Core State Standards)

CCSS.Math.Content.5.NF.B.6: Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

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.d: Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

CCSS.Math.Content.7.RP.A.1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

CCSS.Math.Content.7.RP.A.2: Recognize and represent proportional relationships between quantities.

CCSS.Math.Content.7.G.A.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

High School

NGSS Standards

HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem

Engage - Asking Questions and Defining Problems

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Explore - Planning and Carrying Out Investigations

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled.

Explain - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Elaborate - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.

Evaluate - Obtaining, Evaluating, and Communicating Information

Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

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

As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)

Patterns

Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. Mathematical representations are needed to identify some patterns. Empirical evidence is needed to identify patterns.

Scale, Proportion, and Quantity

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Energy and Matter

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Other Important Content Standards (Math, Computer Science, ELA, 21st Century)

English Language Arts (Common Core State Standards)

CCSS.ELA-LITERACY.W.9-10.1

Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

CCSS.ELA-LITERACY.W.9-10.1.A

Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.

CCSS.ELA-LITERACY.W.9-10.1.B

Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.

Mathematics (Common Core State Standards)

CCSS.Math.Content.HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.Math.Content.HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.

CCSS.Math.Content.HSG.MG.A.3: Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*