**Middle School Integrated Science Course 2**

The 7th grade middle school science course, based on an integrated grouping (as determined by the CDE) of Next Generation Science Standards will introduce students to the following concepts (arranged topically)[[1]](#footnote-1):

**Life Science**

[**Organization for Matter and Energy Flow in Organisms**](http://www.nap.edu/openbook.php?record_id=13165&page=147)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=147)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=147)

[**Interdependent Relationships in Ecosystems**](http://www.nap.edu/openbook.php?record_id=13165&page=150)

* [Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.](http://www.nap.edu/openbook.php?record_id=13165&page=150)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=150)
* [Growth of organisms and population increases are limited by access to resources.](http://www.nap.edu/openbook.php?record_id=13165&page=150)
* [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 ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.](http://www.nap.edu/openbook.php?record_id=13165&page=150)

[**Cycle of Matter and Energy Transfer in Ecosystems**](http://www.nap.edu/openbook.php?record_id=13165&page=152)

* [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 aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.](http://www.nap.edu/openbook.php?record_id=13165&page=152)

[**Ecosystem Dynamics, Functioning, and Resilience**](http://www.nap.edu/openbook.php?record_id=13165&page=154)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=154)

**[Biodiversity and Humans](http://www.nap.edu/openbook.php?record_id=13165&page=166)**

* [Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.](http://www.nap.edu/openbook.php?record_id=13165&page=166)

[**Developing Possible Solutions**](http://www.nap.edu/openbook.php?record_id=13165&page=206)

* [There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.](http://www.nap.edu/openbook.php?record_id=13165&page=206)

[**Ecosystem Dynamics, Functioning, and Resilience**](http://www.nap.edu/openbook.php?record_id=13165&page=154)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=154)

**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.

### 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.

**Earth Science**

[**Earth’s Materials and Systems**](http://www.nap.edu/openbook.php?record_id=13165&page=179)

* [The planet’s systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth’s history and will determine its future.](http://www.nap.edu/openbook.php?record_id=13165&page=179)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=179)

[**The Roles of Water in Earth's Surface Processes**](http://www.nap.edu/openbook.php?record_id=13165&page=184)

* [Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.](http://www.nap.edu/openbook.php?record_id=13165&page=184)

[**The History of Planet Earth**](http://www.nap.edu/openbook.php?record_id=13165&page=177)

* [Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.](http://www.nap.edu/openbook.php?record_id=13165&page=177)

[**Plate Tectonics and Large-Scale System Interactions**](http://www.nap.edu/openbook.php?record_id=13165&page=182)

* [Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth’s plates have moved great distances, collided, and spread apart.](http://www.nap.edu/openbook.php?record_id=13165&page=182)

**Physical Science**

[**Structure and Properties of Matter**](http://www.nap.edu/openbook.php?record_id=13165&page=106)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.](http://www.nap.edu/openbook.php?record_id=13165&page=106)

[**Chemical Reactions**](http://www.nap.edu/openbook.php?record_id=13165&page=109)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=109)
* [The total number of each type of atom is conserved, and thus the mass does not change.](http://www.nap.edu/openbook.php?record_id=13165&page=109)
* [Some chemical reactions release energy, others store energy.](http://www.nap.edu/openbook.php?record_id=13165&page=109)

[**Definitions of Energy**](http://www.nap.edu/openbook.php?record_id=13165&page=120)

* [The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.](http://www.nap.edu/openbook.php?record_id=13165&page=120)
* [The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.](http://www.nap.edu/openbook.php?record_id=13165&page=120)

**Earth and Human Activity**

[**Natural Resources**](http://www.nap.edu/openbook.php?record_id=13165&page=191)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=191)

[**Natural Hazards**](http://www.nap.edu/openbook.php?record_id=13165&page=192)

* [Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.](http://www.nap.edu/openbook.php?record_id=13165&page=192)

**Engineering and Design**

**[Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)**

* [There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [Models of all kinds are important for testing solutions.](http://www.nap.edu/openbook.php?record_id=13165&page=206)

[**Optimizing the Design Solution**](http://www.nap.edu/openbook.php?record_id=13165&page=208)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=208)
* 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.

[**Defining and Delimiting Engineering Problems**](http://www.nap.edu/openbook.php?record_id=13165&page=204)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=204)

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| **MS Course 2** [[CA Integrated by topic 4/2014 CDE]](http://www.cde.ca.gov/pd/ca/sc/documents/ngsscagr7inttopicapr2014.doc) **7th Grade** | | |
| [**MS. Matter and Energy in Organisms and Ecosystems**](http://www.nextgenscience.org/msls-meoe-matter-energy-organisms-ecosystems)[🡨 Note: This is a ‘[Topic Arrangement’](http://www.nextgenscience.org/sites/ngss/files/NGSS%20Combined%20Topics%2011.8.13.pdf) term] | | |
| CEDS | [MS-LS1-6.](http://www.nextgenscience.org/ms-ls1-6-molecules-organisms-structures-and-processes) | From Molecules to Organisms: Structures and Processes |
| DUM | [MS-LS1-7.](http://www.nextgenscience.org/ms-ls1-7-molecules-organisms-structures-and-processes) | From Molecules to Organisms: Structures and Processes |
| AID | [MS-LS2-1.](http://www.nextgenscience.org/ms-ls2-1-ecosystems-interactions-energy-and-dynamics) | Ecosystems: Interactions, Energy, and Dynamics |
| DUM | [MS-LS2-3.](http://www.nextgenscience.org/ms-ls2-3-ecosystems-interactions-energy-and-dynamics) | Ecosystems: Interactions, Energy, and Dynamics |
| EAE | [MS-LS2-4](http://www.nextgenscience.org/ms-ls2-4-ecosystems-interactions-energy-and-dynamics). | Ecosystems: Interactions, Energy, and Dynamics |
| [**MS. Interdependent Relationships in Ecosystems**](http://www.nextgenscience.org/msls-ire-interdependent-relationships-ecosystems) | | |
| CEDS | [MS-LS2-2.](http://www.nextgenscience.org/ms-ls2-2-ecosystems-interactions-energy-and-dynamics) | Ecosystems: Interactions, Energy, and Dynamics |
| EAE | [MS-LS2-5.](http://www.nextgenscience.org/ms-ls2-5-ecosystems-interactions-energy-and-dynamics) | Ecosystems: Interactions, Energy, and Dynamics |
| [**MS. History of Earth**](http://www.nextgenscience.org/msess-he-history-earth) **[**MS-ESS1-4. 🡪 8th grade] | | |
| CEDS | [MS-ESS2-2.](http://www.nextgenscience.org/ms-ess2-2-earths-systems) | Earth's Systems |
| AID | [MS-ESS2-3.](http://www.nextgenscience.org/ms-ess2-3-earths-systems) | Earth's Systems |
| [**MS. Earth’s Systems**](http://www.nextgenscience.org/msess-es-earth-systems) **[**MS-ESS2-4. 🡪 6th grade] | | |
| PCI | [MS-ESS2-1.](http://www.nextgenscience.org/ms-ess2-1-earths-systems) | Earth's Systems |
| DUM | [MS-ESS3-1.](http://www.nextgenscience.org/ms-ess3-1-earth-and-human-activity) | Earth and Human Activity |
| [**MS. Structure and Properties of Matter**](http://www.nextgenscience.org/msps-spm-structure-properties-matter) | | |
| DUM | [MS-PS1-1.](http://www.nextgenscience.org/ms-ps1-1-matter-and-its-interactions) | Matter and its Interactions |
| OECE | [MS-PS1-3.](http://www.nextgenscience.org/ms-ps1-3-matter-and-its-interactions) | Matter and its Interactions |
| DUM | [MS-PS1-4.](http://www.nextgenscience.org/ms-ps1-4-matter-and-its-interactions) | Matter and its Interactions |
| [**MS. Chemical Reactions**](http://www.nextgenscience.org/msps-cr-chemical-reactions) | | |
| AID | [MS-PS1-2.](http://www.nextgenscience.org/ms-ps1-2-matter-and-its-interactions) | Matter and its Interactions |
| DUM | [MS-PS1-5.](http://www.nextgenscience.org/ms-ps1-5-matter-and-its-interactions) | Matter and its Interactions |
| CEDS | [MS-PS1-6.](http://www.nextgenscience.org/ms-ps1-6-matter-and-its-interactions) | Matter and its Interactions |
| [**MS. Human Impacts**](http://www.nextgenscience.org/msess-hi-human-impacts) **[**MS-ESS3-3, 🡪 6th grade, MS-ESS3-4 🡪 8th grade] | | |
| AID | [MS-ESS3-2.](http://www.nextgenscience.org/ms-ess3-2-earth-and-human-activity) | Earth and Human Activity |
| [**MS. Engineering Design**](http://www.nextgenscience.org/msets-ed-engineering-design)[Addressed in 6th and 8th grade courses as well] | | |
| AQDP | [MS-ETS1-1](http://www.nextgenscience.org/ms-ets1-1-engineering-design) | Engineering Design |
| EAE | [MS-ETS1-2](http://www.nextgenscience.org/ms-ets1-2-engineering-design) | Engineering Design |
| AID | [MS-ETS1-3](http://www.nextgenscience.org/ms-ets1-3-engineering-design) | Engineering Design |
| DUM | [MS-ETS1-4](http://www.nextgenscience.org/ms-ets1-4-engineering-design) | Engineering Design |

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| [Science and Engineering Practices:](http://www.nap.edu/openbook.php?record_id=13165&page=41) | | | |
| [PCI:](http://www.nap.edu/openbook.php?record_id=13165&page=59) | Plan and carry out investigations | [CEDS](http://www.nap.edu/openbook.php?record_id=13165&page=67): | Constructing explanations and designing solutions |
| [DUM](http://www.nap.edu/openbook.php?record_id=13165&page=56): | Develop and use models | [AQDP](http://www.nap.edu/openbook.php?record_id=13165&page=54): | Ask questions and define problems |
| [EAE:](http://www.nap.edu/openbook.php?record_id=13165&page=71) | Engage in arguments from Evidence | [AID](http://www.nap.edu/openbook.php?record_id=13165&page=61): | Analyzing and interpreting data |
| [OECE:](http://www.nap.edu/openbook.php?record_id=13165&page=59) | Obtain, evaluate, and communicating evidence | [UMCT](http://www.nap.edu/openbook.php?record_id=13165&page=64): | Using mathematics and computational thinking |
| The ‘yellowed’ items and ‘Performance Expectations’ above should be used for instructor facilitated ‘whole class’ experiments/investigations. | | | |

1. Note: In this original ‘draft’ form (.doc), many of the items cited above are hyperlinked to the NGSS website [<http://www.nextgenscience.org/> ] and to its supporting framework [[A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas ( 2012 )](http://www.nap.edu/catalog.php?record_id=13165) ]. [↑](#footnote-ref-1)