**Middle School Integrated Science Course 3**

The 8th 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**

### [Inheritance of Traits](http://www.nap.edu/openbook.php?record_id=13165&page=158)

* [Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.](http://www.nap.edu/openbook.php?record_id=13165&page=158)

### [Variation of Traits](http://www.nap.edu/openbook.php?record_id=13165&page=160)

* [In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.](http://www.nap.edu/openbook.php?record_id=13165&page=160)

### [Natural Selection](http://www.nap.edu/openbook.php?record_id=13165&page=163)

* [In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.](http://www.nap.edu/openbook.php?record_id=13165&page=163)
* [Natural selection leads to the predominance of certain traits in a population, and the suppression of others.](http://www.nap.edu/openbook.php?record_id=13165&page=163)

### [Evidence of Common Ancestry and Diversity](http://www.nap.edu/openbook.php?record_id=13165&page=162)

* [The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.](http://www.nap.edu/openbook.php?record_id=13165&page=162)
* [Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.](http://www.nap.edu/openbook.php?record_id=13165&page=162)
* [Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.](http://www.nap.edu/openbook.php?record_id=13165&page=162)

### [Adaptation](http://www.nap.edu/openbook.php?record_id=13165&page=164)

* [Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.](http://www.nap.edu/openbook.php?record_id=13165&page=164)

**Space Science**

### [The Universe and Its Stars](http://www.nap.edu/openbook.php?record_id=13165&page=173)

* [Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.](http://www.nap.edu/openbook.php?record_id=13165&page=173)
* [Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.](http://www.nap.edu/openbook.php?record_id=13165&page=173)

### [Earth and the Solar System](http://www.nap.edu/openbook.php?record_id=13165&page=175)

* [This model of the solar system can explain eclipses of the sun and the moon. Earth’s spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.](http://www.nap.edu/openbook.php?record_id=13165&page=175)
* [The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.](http://www.nap.edu/openbook.php?record_id=13165&page=175)
* [The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.](http://www.nap.edu/openbook.php?record_id=13165&page=175)

**Earth Science**

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

* [The geologic time scale interpreted from rock strata provides a way to organize Earth’s history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.](http://www.nap.edu/openbook.php?record_id=13165&page=177)

**Physical Science**

### [Forces and Motion](http://www.nap.edu/openbook.php?record_id=13165&page=114)

* [For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law).](http://www.nap.edu/openbook.php?record_id=13165&page=114)
* [The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.](http://www.nap.edu/openbook.php?record_id=13165&page=114)
* [All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.](http://www.nap.edu/openbook.php?record_id=13165&page=114)

### [Types of Interactions](http://www.nap.edu/openbook.php?record_id=13165&page=116)

* [Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.](http://www.nap.edu/openbook.php?record_id=13165&page=116)
* [Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.](http://www.nap.edu/openbook.php?record_id=13165&page=116)
* [Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).](http://www.nap.edu/openbook.php?record_id=13165&page=116)

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

* [Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.](http://www.nap.edu/openbook.php?record_id=13165&page=120)
* [A system of objects may also contain stored (potential) energy, depending on their relative positions.](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [Relationship Between Energy and Forces](http://www.nap.edu/openbook.php?record_id=13165&page=126)

* [When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.](http://www.nap.edu/openbook.php?record_id=13165&page=126)

### [Wave Properties](http://www.nap.edu/openbook.php?record_id=13165&page=131)

* [A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.](http://www.nap.edu/openbook.php?record_id=13165&page=131)
* [A sound wave needs a medium through which it is transmitted.](http://www.nap.edu/openbook.php?record_id=13165&page=131)

### [Electromagnetic Radiation](http://www.nap.edu/openbook.php?record_id=13165&page=133)

* [When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.](http://www.nap.edu/openbook.php?record_id=13165&page=133)
* [The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.](http://www.nap.edu/openbook.php?record_id=13165&page=133)
* [A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.](http://www.nap.edu/openbook.php?record_id=13165&page=133)
* [However, because light can travel through space, it cannot be a matter wave, like sound or water waves.](http://www.nap.edu/openbook.php?record_id=13165&page=133)

### [Information Technologies and Instrumentation](http://www.nap.edu/openbook.php?record_id=13165&page=136)

* [Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.](http://www.nap.edu/openbook.php?record_id=13165&page=136)

**Earth and Human Activity**

### [Human Impacts on Earth Systems](http://www.nap.edu/openbook.php?record_id=13165&page=194)

* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=194)

**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 3** [[CA Integrated by topic 4/2014 CDE]](http://www.cde.ca.gov/pd/ca/sc/documents/ngsscagr8inttopicapr2014.doc) **8th Grade** |
| [**MS. Growth, Development, and Reproduction of Organisms**](http://www.nextgenscience.org/msls-gdro-growth-development-reproduction-organisms) **[**MS-LS1-4, 5., MS-LS3-2. 🡪 6th grade] |
| DUM | [MS-LS3-1.](http://www.nextgenscience.org/ms-ls3-1-heredity-inheritance-and-variation-traits) | Heredity: Inheritance and Variation of Traits |
| OECE | [MS-LS4-5.](http://www.nextgenscience.org/ms-ls4-5-biological-evolution-unity-and-diversity) | Biological Evolution: Unity and Diversity |
| [**MS. Natural Selection and Adaptations**](http://www.nextgenscience.org/msls-nsa-natural-selection-adaptations)[🡨 Note: This is a ‘[Topic Arrangement’](http://www.nextgenscience.org/sites/ngss/files/NGSS%20Combined%20Topics%2011.8.13.pdf) term] |
| AID | [MS-LS4-1](http://www.nextgenscience.org/ms-ls4-1-biological-evolution-unity-and-diversity). | Biological Evolution: Unity and Diversity |
| CEDS | [MS-LS4-2.](http://www.nextgenscience.org/ms-ls4-2-biological-evolution-unity-and-diversity) | Biological Evolution: Unity and Diversity |
| AID | [MS-LS4-3.](http://www.nextgenscience.org/ms-ls4-3-biological-evolution-unity-and-diversity) | Biological Evolution: Unity and Diversity |
| CEDS | [MS-LS4-4.](http://www.nextgenscience.org/ms-ls4-4-biological-evolution-unity-and-diversity) | Biological Evolution: Unity and Diversity |
| UMCT | [MS-LS4-6.](http://www.nextgenscience.org/ms-ls4-6-biological-evolution-unity-and-diversity) | Biological Evolution: Unity and Diversity |
| [**MS. Space Systems**](http://www.nextgenscience.org/msess-ss-space-systems) |
| DUM | [MS-ESS1-1](http://www.nextgenscience.org/ms-ess1-1-earths-place-universe) | Earth's Place in the Universe |
| DUM | [MS-ESS1-2](http://www.nextgenscience.org/ms-ess1-2-earths-place-universe) | Earth's Place in the Universe |
| AID | [MS-ESS1-3](http://www.nextgenscience.org/ms-ess1-3-earths-place-universe) | Earth's Place in the Universe |
| [**MS. History of Earth**](http://www.nextgenscience.org/msess-he-history-earth)[MS-ESS2-2, 3., 🡪 7th grade] |
| PCI | [MS-ESS1-4.](http://www.nextgenscience.org/ms-ess1-4-earths-place-universe) | Earth's Place in the Universe |
| [**MS. Forces and Interactions**](http://www.nextgenscience.org/msps-fi-forces-interactions) |
| PCI | [MS-PS2-1](http://www.nextgenscience.org/ms-ps2-1-motion-and-stability-forces-and-interactions) | Motion and Stability: Forces and Interactions |
| PCI | [MS-PS2-2](http://www.nextgenscience.org/ms-ps2-2-motion-and-stability-forces-and-interactions) | Motion and Stability: Forces and Interactions |
| AQDP | [MS-PS2-3](http://www.nextgenscience.org/ms-ps2-3-motion-and-stability-forces-and-interactions) | Motion and Stability: Forces and Interactions |
| EAE | [MS-PS2-4](http://www.nextgenscience.org/ms-ps2-4-motion-and-stability-forces-and-interactions) | Motion and Stability: Forces and Interactions |
| PCI | [MS-PS2-5](http://www.nextgenscience.org/ms-ps2-5-motion-and-stability-forces-and-interactions) | Motion and Stability: Forces and Interactions |
| [MS. Energy](http://www.nextgenscience.org/msps-e-energy) [MS-PS3-3,4,5., 🡪 6th grade] |
| AID | [MS-PS3-1.](http://www.nextgenscience.org/ms-ps3-1-energy) | Energy |
| DUM | [MS-PS3-2.](http://www.nextgenscience.org/ms-ps3-2-energy) | Energy |
| [**MS. Waves and Electromagnetic Radiation**](http://www.nextgenscience.org/msps-wer-waves-electromagnetic-radiation) |
| UMCT | [MS-PS4-1.](http://www.nextgenscience.org/ms-ps4-1-waves-and-their-applications-technologies-information-transfer) | Waves and Their Applications in Technologies for Information Transfer |
| DUM | [MS-PS4-2.](http://www.nextgenscience.org/ms-ps4-2-waves-and-their-applications-technologies-information-transfer) | Waves and Their Applications in Technologies for Information Transfer |
| OECE | [MS-PS4-3.](http://www.nextgenscience.org/ms-ps4-3-waves-and-their-applications-technologies-information-transfer) | Waves and Their Applications in Technologies for Information Transfer |
| [**MS. Human Impacts**](http://www.nextgenscience.org/msess-hi-human-impacts) **[**MS-ESS3-2. 🡪 7th grade, MS-ESS3-3. 🡪 6th grade] |
| EAE | [MS-ESS3-4](http://www.nextgenscience.org/ms-ess3-4-earth-and-human-activity) | Earth and Human Activity |
| [**MS. Engineering Design**](http://www.nextgenscience.org/msets-ed-engineering-design)[Addressed in 6th and 7th 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)