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***Marine Science: Marine Biology and Oceanography, Third Edition***

**correlation to selected elements of the**

**Next Generation Science Standards**

| **Standard** | **Descriptor** | **Citations** |
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| **HS-ESS1 Earth’s Place in the Universe** | | |
| DCI-ESS2.B-H2  Plate Tectonics and Large-Scale System Interactions | [Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth’s surface and provides a framework for understanding its geologic history](https://ngss.nsta.org/DisciplinaryCoreIdeas.aspx?id=32&detailid=283). | SE: 411–414, 415–419  TE: 201, 202 |
| **HS-ESS2 Earth’s Systems** | | |
| DCI-ESS2.C-H1  The Roles of Water in Earth’s Surface Processes | The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water’s exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. | SE: 385, 387–393, 395–398, 404–405, 406–407, 644–645  TE: 193, 194, 199, 293–295 |
| DCI-ESS2.D-H1  Weather and Climate | The foundation for Earth’s global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy’s re-radiation into space. | SE: 448–451  TE: 213–214 |
| DCI-ESS2.D-H2  Weather and Climate | Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. | SE: 393  TE: 193 |
| DCI-ESS2.D-H3  Weather and Climate | Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. | SE: 457–460, 467  TE: 216–217 |
| DCI-ESS2.E-H1  Biogeology | The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth’s surface and the life that exists on it. | SE: 589–594  TE: 270–271 |
| **HS-ESS3 Earth and Human Activity** | | |
| DCI-ESS2.D-H4  Weather and Climate | Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. | SE: 460  TE: 216–217 |
| DCI-ESS3.B-H1  Natural Hazards | Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. | SE: 439–440, 452–455, 460, 530–531, 538–539, 546–547  TE: 204, 205, 207, 215, 251–252 |
| DCI-ESS3.C-H1  Human Impacts on Earth Systems | The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. | SE: 322–323, 329, 376–377, 404–405, 626–627, 636–638, 673, 674–675  TE: 109, 139, 158, 161, 162, 166, 174, 196, 283, 290, 300, 303–304 |
| DCI-ESS3.C-H2  Human Impacts on Earth Systems | Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. | SE: 460, 619–621, 626–627, 638  TE: 53, 139, 283, 290 |
| DCI-ESS3.D-H1  Global Climate Change | Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. | SE: 404–405, 460 |
| DCI-ESS3.D-H2  Global Climate Change | Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. | SE: 404–405, 460, 467 |
| **HS-LS1 From Molecules to Organisms: Structures and Processes** | | |
| DCI-LS1.C-H1  Organization for Matter and Energy Flow in Organisms | The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. | SE: 500, 555  TE: 236 |
| **HS-LS2 Ecosystems: Interactions, Energy, and Dynamics** | | |
| DCI-LS2.A-H1  Interdependent Relationships in Ecosystems | Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. | SE: 107  TE: 71, 72, 147 |
| DCI-LS2.B-H1  Cycles of Matter and Energy Transfer in Ecosystems | Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. | SE: 95, 99, 104–105, 500, 555, 576  TE: 67, 236 |

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| DCI-LS2.B-H2  Cycles of Matter and Energy Transfer in Ecosystems | 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. | SE: 104–105, 119–120, 149, 589–594, 595–599  TE: 70, 82, 270–271, 272 |
| DCI-LS2.B-H3  Cycles of Matter and Energy Transfer in Ecosystems | Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. | SE: 118–119, 151–152, 590–591 |
| DCI-LS2.C-H1  Ecosystem Dynamics, Functioning, and Resilience | A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. | SE: 107, 376–377, 596–597, 603–607, 612–613  TE: 147, 272, 275–276, 278 |

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| DCI-LS2.C-H2  Ecosystem Dynamics, Functioning, and Resilience | Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. | SE: 140–141, 192–193, 289–290, 322–323, 360, 365, 367, 376–377, 404–405, 466–467, 514–515, 572, 605–607, 621–628, 630–633, 634, 672  TE: 72–73, 84, 89, 139, 150, 158, 166, 180, 193, 196, 205, 219, 238, 240, 259, 260, 275, 285, 286, 287, 302 |
| DCI-LS4.D-H1  Biodiversity and Humans | Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). | SE: 662–664  TE: 300 |
| DCI-LS4.D-H2  Biodiversity and Humans | Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. | SE: 289–290, 322–323, 621–628, 630–633, 634–635, 636–638, 643, 648–657, 657–661, 664–667, 672, 674–675  TE: 84, 109, 112, 128, 139, 140, 150, 153, 158, 161, 162, 174, 179, 181, 196, 260, 285, 286, 287, 290, 297–298, 299, 300, 302, 303–304 |
| DCI-ETS1.B-H1  Developing Possible Solutions | When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. | SE: 37, 492–493  TE: 34, 55, 162 |

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| **HS-LS4 Biological Evolution: Unity and Diversity** | | |
| DCI-LS4.C-H1  Adaptation | Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. | SE: 107–108  TE: 73 |
| DCI-LS4.C-H2  Adaptation | Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. | SE: 107–108, 128–129, 131–132, 140–141, 195, 215–217, 313–317, 327–334, 335–340, 348–349, 477–479, 482, 501, 503–504, 551, 553–556, 576–579  TE: 73, 84, 90–92, 123–124, 129, 163, 171, 172, 175–177, 225, 254, 257, 261 |
| DCI-LS4.C-H4  Adaptation | Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. | SE: 108, 139, 466–467, 662–664  TE: 139, 300 |
| DCI-LS4.C-H5  Adaptation | Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ evolution is lost. | SE: 662–663  TE: 300 |

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| **HS-PS2 Motion and Stability: Forces and Interactions** | | |
| DCI-PS2.B-H1  Types of Interactions | Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. | SE: 521 |
| DCI-PS2.B-H2  Types of Interactions | Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. | SE: 518, 521–523  TE: 245 |
| **HS-PS3 Energy** | | |
| DCI-PS3.A-H1  Definitions of Energy | Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. | SE: 471 |
| DCI-PS3.A-H2  Definitions of Energy | At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. | SE: 471, 497, 505–506  TE: 235, 238 |
| DCI-PS3.B-H1  Conservation of Energy and Energy Transfer | Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. | SE: 471 |
| DCI-PS3.B-H2  Conservation of Energy and Energy Transfer | Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. | SE: 471 |

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| **HS-PS4 Waves and Their Applications in Technologies for Information Transfer** | | |
| DCI-PS4.A-H2  Wave Properties | The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. | SE: 497, 506–508, 516–517, 526–527, 546–547  TE: 235, 238, 241–243, 246, 250 |
| DCI-PS4.B-H1  Electromagnetic Radiation | Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. | SE: 497–500  TE: 235 |
| DCI-PS4.B-H2  Electromagnetic Radiation | When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. | SE: 498 |
| DCI-PS4.C-H1  Information Technologies and Instrumentation | Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. | SE: 10–13, 60–64, 509, 515  TE: 22, 48, 204 |
| **HS-ETS1 Engineering Design** | | |
| DCI-ETS1.A-H1  Defining and Delimiting Engineering Problems | Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. | TE: 55 |

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| DCI-ETS1.A-H2  Defining and Delimiting Engineering Problems | Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. | SE: 492–493, 619–621  TE: 53, 162, 230, 283, 290 |
| DCI-ETS1.B-H1  Developing Possible Solutions | When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. | SE: 37, 492–493  TE: 34, 55, 162 |
| DCI-ETS1.B-H2  Developing Possible Solutions | Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. | TE: 22, 23, 38, 217 |