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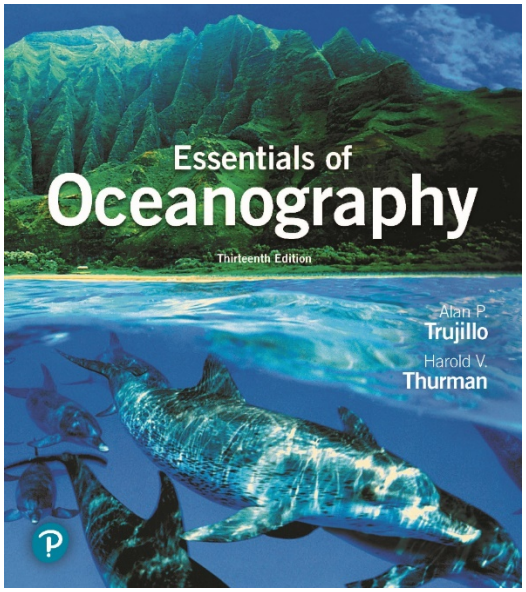

To the

Next Generation Science Standards
Physical Science Performance Expectations

Grades 9-12

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NGSS Physical Science **Grades 9-12 Performance Expectations**	**Essentials of Oceanography** **13th Edition ©2020**
Physical Sciences	
(HS-PS1) Matter and Its Interactions	
(HS-PS1-1) Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	**SE/TE:** Chapter 5 Water and Seawater, 5.1 Why Does Water Have Such Unusual Chemical Properties?, Atomic Structure, 139–140 Chapter 5 Water and Seawater, 5.1 Why Does Water Have Such Unusual Chemical Properties?, The Water Molecule, 140–141 Chapter 5 Water and Seawater, 5.1 Why Does Water Have Such Unusual Chemical Properties?, CONCEPT CHECK 5.1: Specify water's unique chemical properties, Questions 1-5, p. 142
(HS-PS1-2) Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	**SE/TE:** This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS1-3) Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	**SE/TE:** Chapter 5 Water and Seawater, 5.1 Why Does Water Have Such Unusual Chemical Properties?, The Water Molecule, 140–141
(HS-PS1-4) Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	**SE/TE:** For supporting content, please see Chapter 5 Water and Seawater, 5.2 What Important Physical Properties Does Water Possess?, Water's Thermal Properties, 142–146
(HS-PS1-5) Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.	For supporting content, please see Chapter 5 Water and Seawater, 5.2 What Important Physical Properties Does Water Possess?, Water's Thermal Properties, 142–146

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(HS-PS1-6) Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS1-7) Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	For supporting content, please see Chapter 5 Water and Seawater, 5.2 What Important Physical Properties Does Water Possess?, Water's Thermal Properties, 142–146
(HS-PS1-8) Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	For supporting content, please see Chapter 1 Introduction to Planet "Earth", 1.5 How Were Earth and the Solar System Formed?, Proto-Earth, 20
(HS-PS2) Motion and Stability: Forces and Interactions	
(HS-PS2-1) Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS2-2) Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS2-3) Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS2-4) Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS2-5) Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	**SE/TE:** Chapter 2 Plate Tectonics and the Ocean Floor, 2.2 What Additional Observations Led to the Theory of Plate Tectonics?, Earth's Magnetic Field and Paleomagnetism, 44–46, 49

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(HS-PS2-6) Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS3) Energy	
(HS-PS3-1) Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	This Performance Expectation is beyond the scope of *Essentials of Oceanography, 13th Edition ©2020.*
(HS-PS3-2) Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).	**SE/TE:** Chapter 5 Water and Seawater, 5.2 What Important Physical Properties Does Water Possess?, Water's Thermal Properties, HEAT, TEMPERATURE, AND CHANGES OF STATE, 142–143 Chapter 8 Waves and Water Dynamics, 8.1 How Are Waves Generated, and How Do They Move?, Wave Movement, 251
(HS-PS3-3) Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	For supporting content, please see Chapter 16 The Oceans and Climate Change, 16.5 What Can Be Done to Reduce Greenhouse Gases?, 559–565
(HS-PS3-4) Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	**SE/TE:** Chapter 5 Water and Seawater, 5.6 How Does Seawater Density Vary with Depth?, Temperature and Density Variation with Depth, 162–163 Chapter 5 Water and Seawater, 5.6 How Does Seawater Density Vary with Depth?, Thermocline and Pycnocline, 163–164
(HS-PS3-5) Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	**SE/TE:** Chapter 5 Water and Seawater, 5.1 Why Does Water Have Such Unusual Chemical Properties?, The Water Molecule, 140–141

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(HS-PS4) Waves and Their Applications in Technologies for Information Transfer	
(HS-PS4-1) Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Clarification Statement Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the earth.	**SE/TE:** Chapter 8 Waves and Water Dynamics, 8.2 What Characteristics Do Waves Possess?, Deep-Water Waves, 254–255 Chapter 8 Waves and Water Dynamics, 8.2 What Characteristics Do Waves Possess?, Shallow-Water Waves, 255 Chapter 8 Waves and Water Dynamics, 8.2 What Characteristics Do Waves Possess?, Transitional Waves, 255–256 Chapter 8 Waves and Water Dynamics, 8.5 How Are Tsunami Created?, 269–271
(HS-PS4-2) Evaluate questions about the advantages of using digital transmission and storage of information.	For supporting content, please see Chapter 3 Marine Provinces, 3.1 What Techniques Are Used to Determine Ocean Bathymetry?, 82–86
(HS-PS4-3) Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	**SE/TE:** Chapter 13 Biological Productivity and Energy Transfer, 13.1 What Is Primary Productivity?, Light Transmission in Ocean Water, THE ELECTROMAGNETIC SPECTRUM, 415
(HS-PS4-4) Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	For supporting content, please see Chapter 13 Biological Productivity and Energy Transfer, 13.1 What Is Primary Productivity?, Light Transmission in Ocean Water, THE ELECTROMAGNETIC SPECTRUM, 415
(HS-PS4-5) Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	**SE/TE:** Chapter 3 Marine Provinces, 3.1 What Techniques Are Used to Determine Ocean Bathymetry?, 82–86 Chapter 7 Ocean Circulation, 7.1 How Are Ocean Currents Measured?, Surface Current Measurement, DIRECT METHODS, 208