

**Jefferson County ESC
Virtual Learning Academy
Academic Content Standards
Marine Biology**

Lesson 01

The Principles of The Marine Sciences

Standard Benchmark and Indicator
S05. Scientific Inquiry
A. Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data. (11-12)
01. Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. (12)
04. Create and clarify the method, procedures, controls and variables in complex scientific investigations. (12)
S06. Scientific Ways of Knowing
A. Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories. (11-12)
01. Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). (11)
01. Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. (12)
02. Apply scientific inquiry to evaluate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. (11)
03. Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. (11)
B. Explain how ethical considerations shape scientific endeavors. (11-12)
06. Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. (11)
C. Explain how societal issues and considerations affect the progress of science and technology. (11-12)
07. Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. (12)
08. Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. (12)
11. Research how advances in scientific knowledge have impacted society on a local, national or global level. (12)

Lesson 02

"The Seafloor"

Standard Benchmark and Indicator
S01. Earth and Space Sciences
B. Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems. (11-12)
05. Investigate how thermal energy transfers in the world's oceans impact physical features (e.g., ice caps, oceanic and atmospheric currents) and weather patterns. (12)
06. Explain how interactions among Earth's lithosphere, hydrosphere, atmosphere and biosphere have resulted in the ongoing changes of Earth's system. (11)
07. Describe the effects of particulates and gases in the atmosphere including those originating from volcanic activity. (11)
08. Describe the normal adjustments of Earth, which may be hazardous for humans. Recognize that humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in Earth's solid crust. Realize that as societies have grown, become stable and come to value aspects of the environment, vulnerability to natural processes of change has increased. (11)
D. Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences. (11-12)
16. Describe advances in Earth and space science that have important long-lasting effects on science and society (e.g., global warming, Heliocentric Theory and Plate Tectonics Theory). (11)
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
03. Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. (12)
D. Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (11-12)
12. Recognize that ecosystems change when significant climate changes occur or when one or more new species appear as a result of immigration or speciation. (11)
E. Explain the interconnectedness of the components of a natural system. (11-12)
10. Explain how environmental factors can influence heredity or development of organisms. (11)
G. Summarize the historical development of scientific theories and ideas within the study of life sciences. (11-12)
11. Trace the historical development of a biological theory or idea (e.g., genetics, cytology and germ theory). (12)
S04. Science and Technology
A. Predict how human choices today will determine the quality and quantity of life on Earth. (11-12)
03. Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. (12)
04. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. (12)

Lesson 03

Chemical and Physical Properties of Seawater

Standard Benchmark and Indicator
S03. Physical Sciences
A. Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena. (11-12)
01. Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns. (12)

Lesson 04

Basics of Biology

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
01. Recognize that information stored in DNA provides the instructions for assembling protein molecules used by the cells that determine the characteristics of the organism. (12)
02. Recognize that chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Some of this energy is released as thermal energy. (11)
03. Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. (12)
04. Explain that carbon-containing molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes. (12)
B. Explain how humans are connected to and impact natural systems. (11-12)
05. Investigate the impact on the structure and stability of ecosystems due to changes in their biotic and abiotic components as a result of human activity. (11)
C. Explain how the molecular basis of life and the principles of genetics determine inheritance. (11-12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
07. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (11)
07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)
08. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (11)
09. Explain why and how living systems require a continuous input of energy to maintain their chemical and physical organization. Explain that with death and the cessation of energy input, living systems rapidly disintegrate toward more disorganized states. (12)

Lesson 05

Marine Microorganisms

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
03. Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. (12)

Lesson 06

Primary Production-Plants and Seaweeds

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
03. Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. (12)
04. Explain that carbon-containing molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes. (12)
B. Explain how humans are connected to and impact natural systems. (11-12)
D. Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (11-12)
10. Explain additional components of the evolution theory, including genetic drift, immigration, emigration and mutation. (12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
07. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (11)
08. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (11)
08. Based on the structure and stability of ecosystems and their nonliving components, predict the biotic and abiotic changes in such systems when disturbed (e.g. introduction of non-native species, climatic change, etc.). (12)
10. Explain how environmental factors can influence heredity or development of organisms. (11)
F. Explain how human choices today will affect the quality and quantity of life on earth. (11-12)
11. Investigate issues of environmental quality at local, regional, national and global levels such as population growth, resource use, population distribution, over-consumption, the capacity of technology to solve problems, poverty, the role of economics, politics and different ways humans view the earth. (11)

G. Summarize the historical development of scientific theories and ideas within the study of life sciences. (11-12)

Lesson 07

Marine Invertebrates

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
07. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (11)
07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)
08. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (11)

Lesson 08

Marine Invertebrates, Part II

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
07. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (11)
07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)
08. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (11)

Lesson 09

Marine Invertebrates, Part III

Standard Benchmark and Indicator

A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
10. Explain how environmental factors can influence heredity or development of organisms. (11)
F. Explain how human choices today will affect the quality and quantity of life on earth. (11-12)
11. Investigate issues of environmental quality at local, regional, national and global levels such as population growth, resource use, population distribution, over-consumption, the capacity of technology to solve problems, poverty, the role of economics, politics and different ways humans view the earth. (11)

Lesson 10

Marine Fishes, Part I

Standard Benchmark and Indicator
S02. Life Sciences
A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)
02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)
D. Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (11-12)
E. Explain the interconnectedness of the components of a natural system. (11-12)
07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)
10. Explain how environmental factors can influence heredity or development of organisms. (11)
F. Explain how human choices today will affect the quality and quantity of life on earth. (11-12)
09. Give examples of how human activity can accelerate rates of natural change and can have unforeseen consequences. (11)
11. Investigate issues of environmental quality at local, regional, national and global levels such as population growth, resource use, population distribution, over-consumption, the capacity of technology to solve problems, poverty, the role of economics, politics and different ways humans view the earth. (11)
G. Summarize the historical development of scientific theories and ideas within the study of life sciences. (11-12)

Lesson 11

Marine Fishes Part II

Standard Benchmark and Indicator

01. Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens. (11)

E. Explain the interconnectedness of the components of a natural system. (11-12)

07. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (11)

Lesson 12

Marine Reptiles

Standard Benchmark and Indicator

S02. Life Sciences

E. Explain the interconnectedness of the components of a natural system. (11-12)

07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)

Lesson 13

Marine Birds

Standard Benchmark and Indicator

S02. Life Sciences

A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)

01. Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens. (11)

02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)

Lesson 14

Marine Mammals

Standard Benchmark and Indicator

S02. Life Sciences

A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)

01. Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens. (11)

02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)

Lesson 15

Marine Mammals Part II

Standard Benchmark and Indicator

S02. Life Sciences

A. Explain how processes at the cellular level affect the functions and characteristics of an organism. (11-12)

01. Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens. (11)

02. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (12)

Lesson 16

Intertidal Zone

Standard Benchmark and Indicator

S02. Life Sciences

D. Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (11-12)

12. Recognize that ecosystems change when significant climate changes occur or when one or more new species appear as a result of immigration or speciation. (11)

E. Explain the interconnectedness of the components of a natural system. (11-12)

08. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life. (11)

Lesson 17

Deep Sea

Standard Benchmark and Indicator

S01. Earth and Space Sciences

B. Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems. (11-12)

05. Investigate how thermal energy transfers in the world's oceans impact physical features (e.g., ice caps, oceanic and atmospheric currents) and weather patterns. (12)

07. Describe the effects of particulates and gases in the atmosphere including those originating from volcanic activity. (11)

S02. Life Sciences

E. Explain the interconnectedness of the components of a natural system. (11-12)

07. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (12)

Lesson 18

Marine Resources

Standard Benchmark and Indicator
S01. Earth and Space Sciences
B. Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems. (11-12)
06. Describe how scientists estimate how much of a given resource is available on Earth. (12)
C. Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future. (11-12)
12. Explain ways in which humans have had a major effect on other species (e.g., the influence of humans on other organisms occurs through land use, which decreases space available to other species and pollution, which changes the chemical composition of air, soil and water). (11)
S02. Life Sciences
B. Explain how humans are connected to and impact natural systems. (11-12)
05. Investigate the impact on the structure and stability of ecosystems due to changes in their biotic and abiotic components as a result of human activity. (11)
F. Explain how human choices today will affect the quality and quantity of life on earth. (11-12)