DRAFT CROSSWALK

***Excellence in Environmental Education: Guidelines for Learning K-12*, Ocean Literacy Principles, and Climate Literacy Principles**

EE Learner Guidelines (12th Grade Level)	**Climate Literacy Principles**	**Ocean Literacy Principles**
Strand 1: Questioning, Analysis & Interpretation Skills		
A) Questioning - Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose.		7.A) The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation. 7.B) Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.
B) Designing investigations—Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena.		7.B) Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.
C) Collecting Information—Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data.	5.B) Environmental observations are the foundation for understanding the climate system. From the bottom of the ocean to the surface of the Sun, instruments on weather stations, buoys, satellites, and other platforms collect climate data. To learn about past climates, scientists use natural records, such as tree rings, ice cores, and sedimentary layers. Historical observations, such as native knowledge and personal journals, also document past climate change.	
D) Evaluating accuracy and reliability— Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.		

E) Organizing Information—Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes.		
F) Working with models and simulations—Learners are able to create, use, and evaluate models to understand environmental phenomena.	5.A) The components and processes of Earth's climate system are subject to the same physical laws as the rest of the Universe. Therefore, the behavior of the climate system can be understood and predicted through careful, systematic study. 5.C) Observations, experiments, and theory are used to construct and refine computer models that represent the climate system and make predictions about its future behavior. Results from these models lead to better understanding of the linkages between the atmosphere-ocean system and climate conditions and inspire more observations and experiments. Over time, this iterative process will result in more reliable projections of future climate conditions. 5.D) Our understanding of climate differs in important ways from our understanding of weather. Climate scientists' ability to predict climate patterns months, years, or decades into the future is constrained by different limitations than those faced by meteorologists in forecasting weather days to weeks into the future.	7.E) Use of mathematical models is now an essential part of ocean sciences. Models help us understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.
G) Drawing conclusions and developing explanations—Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses.		

EE Learner Guidelines (12th Grade Level)	Climate Literacy Principles	Ocean Literacy Principles
Strand 2: Environmental Process and Systems		
2.1:Earth as a Physical System		
A) Processes that shape the Earth— Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.	1.C) The tilt of Earth's axis relative to its orbit around the Sun results in predictable changes in the duration of daylight and the amount of sunlight received at any latitude throughout a year. These changes cause the annual cycle of seasons and associated temperature changes. 1.E) A significant increase or decrease in the Sun's energy output would cause Earth to warm or cool. Satellite measurements taken over the past 30 years show that the Sun's energy output has changed only slightly and in both directions. These changes in the Sun's energy are thought to be too small to be the cause of the recent warming observed on Earth. 2.A) Earth's climate is influenced by interactions involving the Sun, ocean, atmosphere, clouds, ice, land, and life. Climate varies by region as a result of local differences in these interactions. 2.B) Covering 70% of Earth's surface, the ocean exerts a major control on climate by dominating Earth's energy and water cycles. It has the capacity to absorb large amounts of solar energy. Heat and water vapor are redistributed globally through density-driven ocean currents and atmospheric circulation. Changes in ocean circulation caused by tectonic movements or large influxes of fresh water from melting polar ice can lead to significant and even abrupt changes in climate, both locally and on global scales. 2.F) The interconnectedness of Earth's systems means that a significant change in any one component of the climate system can influence the equilibrium of the entire Earth system. Positive feedback loops can amplify these effects and trigger abrupt changes in the climate system. These complex interactions may result in climate change that is more rapid and on a larger scale than projected by current climate models.	1.A) The ocean is the dominant physical feature on our planet Earth—covering approximately 70% of the planet's surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian and Arctic. 1.B) An ocean basin's size, shape and features (such as islands, trenches, mid-ocean ridges, rift valleys) vary due to the movement of Earth's lithospheric plates. Earth's highest peaks, deepest valleys and flattest vast plains are all in the ocean. 1.C) Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of the Earth's rotation (Coriolis effect), the Sun, and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. 1.D) Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools. 1.E) Most of Earth's water (97%) is in the ocean. Seawater has unique properties: it is saline, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. The salt in seawater comes from eroding land, volcanic emissions, reactions at the seafloor, and atmospheric deposition. 1.F) The ocean is an integral part of the water cycle and is connected to all of the earth's water reservoirs via evaporation and precipitation processes. 1.G) The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

	4.A) Climate is determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year. 4.B) Climate is not the same thing as weather. Weather is the minute-by-minute variable condition of the atmosphere on a local scale. Climate is a conceptual description of an area's average weather conditions and the extent to which those conditions vary over long time intervals. 4.C) Climate change is a significant and persistent change in an area's average climate conditions or their extremes. Seasonal variations and multi-year cycles (for example, the El Niño Southern Oscillation) that produce warm, cool, wet, or dry periods across different regions are a natural part of climate variability. They do not represent climate change. 4.D) Scientific observations indicate that global climate has changed in the past, is changing now, and will change in the future. The magnitude and direction of this change is not the same at all locations on Earth. 4.E) Based on evidence from tree rings, other natural records, and scientific observations made around the world, Earth's average temperature is now warmer than it has been for at least the past 1,300 years. Average temperatures have increased markedly in the past 50 years, especially in the North Polar Region. 4.F) Natural processes driving Earth's long-term climate variability do not explain the rapid climate change observed in recent decades. The only explanation that is consistent with all available evidence is that human impacts are playing an increasing role in climate change. Future changes in climate may be rapid compared to historical changes. 7.A) Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the oceans warm, is causing sea level to rise. Seawater is beginning to move	1.H) Although the ocean is large, it is finite and resources are limited. 2.A) Many earth materials and geochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks. 2.B) Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land. 2.C) Erosion—the wearing away of rock, soil and other biotic and abiotic earth materials—occurs in coastal areas as wind, waves, and currents in rivers and the ocean move sediments. 2.D) Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by surf. Sand is redistributed by waves and coastal currents seasonally. 2.E) Tectonic activity, sea level changes, and force of waves influence the physical structure and landforms of the coast. 3.A) The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems. 3.C) The El Niño Southern Oscillation causes important changes in global weather patterns because it changes the way heat is released to the atmosphere in the Pacific. 3.D) Most rain that falls on land originally evaporated from the tropical ocean. 3.F) The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water. 3.G) Changes in the ocean's circulation have produced large, abrupt changes in climate during the last 50,000 years. 6.F) Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm

	onto low-lying land and to contaminate coastal fresh water sources and beginning to submerge coastal facilities and barrier islands. Sea-level rise increases the risk of damage to homes and buildings from storm surges such as those that accompany hurricanes. 7.B) Climate plays an important role in the global distribution of freshwater resources. Changing precipitation patterns and temperature conditions will alter the distribution and availability of freshwater resources, reducing reliable access to water for many people and their crops. Winter snowpack and mountain glaciers that provide water for human use are declining as a result of global warming.	surges).
B) Changes in matter— Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.	2.D) The abundance of greenhouse gases in the atmosphere is controlled by biogeochemical cycles that continually move these components between their ocean, land, life, and atmosphere reservoirs. The abundance of carbon in the atmosphere is reduced through seafloor accumulation of marine sediments and accumulation of plant biomass and is increased through deforestation and the burning of fossil fuels as well as through other processes. 2.E) Airborne particulates, called "aerosols," have a complex effect on Earth's energy balance: they can cause both cooling, by reflecting incoming sunlight back out to space, and warming, by absorbing and releasing heat energy in the atmosphere. Small solid and liquid particles can be lofted into the atmosphere through a variety of natural and manmade processes, including volcanic eruptions, sea spray, forest fires, and emissions generated through human activities. 2.F) The interconnectedness of Earth's systems means that a significant change in any one component of the climate system can influence the equilibrium of the entire Earth system. Positive feedback loops can amplify these effects and trigger abrupt changes in the climate system. These complex interactions may result in climate change that is more rapid and on a larger scale than projected by current climate models. 7.D) The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere. Increasing carbon dioxide levels in the atmosphere is	1.E) Most of Earth's water (97%) is in the ocean. Seawater has unique properties: it is saline, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. The salt in seawater comes from eroding land, volcanic emissions, reactions at the seafloor, and atmospheric deposition. 2.A) Many earth materials and geochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks. 3.A) The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems. 3.E) The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere. 3.F) The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water. 4.A) Most of the oxygen in the atmosphere originally came from the activities of photosynthetic organisms in the ocean.

	causing ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part.	
C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.	2.B) Covering 70% of Earth's surface, the ocean exerts a major control on climate by dominating Earth's energy and water cycles. It has the capacity to absorb large amounts of solar energy. Heat and water vapor are redistributed globally through density-driven ocean currents and atmospheric circulation. Changes in ocean circulation caused by tectonic movements or large influxes of fresh water from melting polar ice can lead to significant and even abrupt changes in climate, both locally and on global scales. 2.C) The amount of solar energy absorbed or radiated by Earth is modulated by the atmosphere and depends on its composition. Greenhouse gases—such as water vapor, carbon dioxide, and methane—occur naturally in small amounts and absorb and release heat energy more efficiently than abundant atmospheric gases like nitrogen and oxygen. Small increases in carbon dioxide concentration have a large effect on the climate system. 2.E) Airborne particulates, called "aerosols," have a complex effect on Earth's energy balance: they can cause both cooling, by reflecting incoming sunlight back out to space, and warming, by absorbing and releasing heat energy in the atmosphere. Small solid and liquid particles can be lofted into the atmosphere through a variety of natural and manmade processes, including volcanic eruptions, sea spray, forest fires, and emissions generated through human activities. 2.F) The interconnectedness of Earth's systems means that a significant change in any one component of the climate system can influence the equilibrium of the entire Earth system. Positive feedback loops can amplify these effects and trigger abrupt changes in the climate system. These complex interactions may result in climate change that is more rapid and on a larger scale than projected by current climate models.	3.A) The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems. 3.B) The ocean absorbs much of the solar radiation reaching Earth. The ocean loses heat by evaporation. This heat loss drives atmospheric circulation when, after it is released into the atmosphere as water vapor, it condenses and forms rain. Condensation of water evaporated from warm seas provides the energy for hurricanes and cyclones. 3.C) The El Niño Southern Oscillation causes important changes in global weather patterns because it changes the way heat is released to the atmosphere in the Pacific. 3.F) The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.

EE Learner Guidelines (12th Grade Level)	Climate Literacy Principles	Ocean Literacy Principles
2.2: Living Environment		
A) Organisms, populations, and communities— Learners understand basic population dynamics and the importance of diversity in living systems.	3.A) Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish. 3.C) Changes in climate conditions can affect the health and function of ecosystems and the survival of entire species. The distribution patterns of fossils show evidence of gradual as well as abrupt extinctions related to climate change in the past. 6.D) Growing evidence shows that changes in many physical and biological systems are linked to human-caused global warming. Some changes resulting from human activities have decreased the capacity of the environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience. 7.D) The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere. Increasing carbon dioxide levels in the atmosphere is causing ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part. 7.E) Ecosystems on land and in the ocean have been and will continue to be disturbed by climate change. Animals, plants, bacteria, and viruses will migrate to new areas with favorable climate conditions. Infectious diseases and certain species will be able to invade areas that they did not previously inhabit.	3.E) The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere. 4.B) The first life is thought to have started in the ocean. The earliest evidence of life is found in the ocean. 5.A) Ocean life ranges in size from the smallest virus to the largest animal that has lived on Earth, the blue whale. 5.B) Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles. 5.C) Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land. 5.D) Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land. 5.E) The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean. 5.F) Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert. 5.G) There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms

		to support life. 5.H) Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution and diversity of organisms. 5.I) Estuaries provide important and productive nursery areas for many marine and aquatic species.
B) Heredity and evolution—Learners understand the basic ideas and genetic mechanisms behind biological evolution.		4.B) The first life is thought to have started in the ocean. The earliest evidence of life is found in the ocean. 5.D) Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.	3.A) Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish. 3.B) The presence of small amounts of heat-trapping greenhouse gases in the atmosphere warms Earth's surface, resulting in a planet that sustains liquid water and life. 3.C) Changes in climate conditions can affect the health and function of ecosystems and the survival of entire species. The distribution patterns of fossils show evidence of gradual as well as abrupt extinctions related to climate change in the past. 6.D) Growing evidence shows that changes in many physical and biological systems are linked to human-caused global warming. Some changes resulting from human activities have decreased the capacity of the environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience. 7.D) The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere. Increasing carbon dioxide levels in the atmosphere is causing ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part. 7.E) Ecosystems on land and in the ocean have been and will continue to be disturbed by climate change. Animals,	3.E) The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere. 5.D) Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land. 5.G) There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life. 5.I) Estuaries provide important and productive nursery areas for many marine and aquatic species.

	plants, bacteria, and viruses will migrate to new areas with favorable climate conditions. Infectious diseases and certain species will be able to invade areas that they did not previously inhabit.	
D) Flow of matter and energy—Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.	2.D) The abundance of greenhouse gases in the atmosphere is controlled by biogeochemical cycles that continually move these components between their ocean, land, life, and atmosphere reservoirs. The abundance of carbon in the atmosphere is reduced through seafloor accumulation of marine sediments and accumulation of plant biomass and is increased through deforestation and the burning of fossil fuels as well as through other processes. 3.E) Life—including microbes, plants, and animals and humans—is a major driver of the global carbon cycle and can influence global climate by modifying the chemical makeup of the atmosphere. The geologic record shows that life has significantly altered the atmosphere during Earth's history.	4.A) Most of the oxygen in the atmosphere originally came from the activities of photosynthetic organisms in the ocean. 5.D) Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land. 5.G) There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

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2.3: Humans & their Societies		
A) Individuals and groups— Learners understand the influence of individual and group actions on the environment, and how groups can work to promote and balance interests.		
B) Culture—Learners understand cultural perspectives and dynamics and apply their understanding in context.		
C) Political and economic systems—Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.		6.E) Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

D) Global connections— Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.	GP.B) Reducing human vulnerability to the impacts of climate change depends not only upon our ability to understand climate science, but also upon our ability to integrate that knowledge into human society. Decisions that involve Earth's climate must be made with an understanding of the complex interconnections among the physical and biological components of the Earth system as well as the consequences of such decisions on social, economic, and cultural systems. GP.C) The impacts of climate change may affect the security of nations. Reduced availability of water, food, and land can lead to competition and conflict among humans, potentially resulting in large groups of climate refugees. GP.G) Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainable built environments. 3.D) A range of natural records shows that the last 10,000 years have been an unusually stable period in Earth's climate history. Modern human societies developed during this time. The agricultural, economic, and transportation systems we rely upon are vulnerable if the climate changes significantly. 6.C) Human activities have affected the land, oceans, and atmosphere, and these changes have altered global climate patterns. Burning fossil fuels, releasing chemicals into the atmosphere, reducing the amount of forest cover, and rapid expansion of farming, development, and industrial activities are releasing carbon dioxide into the atmosphere and changing the balance of the climate system. 6.D) Growing evidence shows that changes in many physical and biological systems are linked to human-caused global warming. Some changes resulting from human activities have decreased the capacity of the	6.A) The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.

	environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience. 7.A) Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the oceans warm, is causing sea level to rise. Seawater is beginning to move onto low-lying land and to contaminate coastal fresh water sources and beginning to submerge coastal facilities and barrier islands. Sea-level rise increases the risk of damage to homes and buildings from storm surges such as those that accompany hurricanes. 7.B) Climate plays an important role in the global distribution of freshwater resources. Changing precipitation patterns and temperature conditions will alter the distribution and availability of freshwater resources, reducing reliable access to water for many people and their crops. Winter snowpack and mountain glaciers that provide water for human use are declining as a result of global warming.	
E) Change and conflict— Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze their effects on the environment.		

EE Learner Guidelines (12th Grade Level)	**Climate Literacy Principles**	**Ocean Literacy Principles**
2.4: Environment & Society		
A) Human/environment interactions—Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.	GP.A) Climate information can be used to reduce vulnerabilities or enhance the resilience of communities and ecosystems affected by climate change. Continuing to improve scientific understanding of the climate system and the quality of reports to policy and decision-makers is crucial. GP.B) Reducing human vulnerability to the impacts of climate change depends not only upon our ability to understand climate science, but also upon our ability to integrate that knowledge into human society. Decisions that involve Earth's climate must be made with an	6.A) The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health. 6.D) Much of the world's population lives in coastal areas. 6.E) Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches,

	understanding of the complex interconnections among the physical and biological components of the Earth system as well as the consequences of such decisions on social, economic, and cultural systems. GP.C) The impacts of climate change may affect the security of nations. Reduced availability of water, food, and land can lead to competition and conflict among humans, potentially resulting in large groups of climate refugees. GP.G) Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainable built environments. 3.D) A range of natural records shows that the last 10,000 years have been an unusually stable period in Earth's climate history. Modern human societies developed during this time. The agricultural, economic, and transportation systems we rely upon are vulnerable if the climate changes significantly. 4.G) Natural processes driving Earth's long-term climate variability do not explain the rapid climate change observed in recent decades. The only explanation that is consistent with all available evidence is that human impacts are playing an increasing role in climate change. Future changes in climate may be rapid compared to historical changes. 6.A) The overwhelming consensus of scientific studies on climate indicates that most of the observed increase in global average temperatures since the latter part of the 20th century is very likely due to human activities, primarily from increases in greenhouse gas concentrations resulting from the burning of fossil fuels. 6.B) Emissions from the widespread burning of fossil fuels since the start of the Industrial Revolution have	shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean. 6.F) Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).

	increased the concentration of greenhouse gases in the atmosphere. Because these gases can remain in the atmosphere for hundreds of years before being removed by natural processes, their warming influence is projected to persist into the next century. 6.C) Human activities have affected the land, oceans, and atmosphere, and these changes have altered global climate patterns. Burning fossil fuels, releasing chemicals into the atmosphere, reducing the amount of forest cover, and rapid expansion of farming, development, and industrial activities are releasing carbon dioxide into the atmosphere and changing the balance of the climate system. 6.D) Growing evidence shows that changes in many physical and biological systems are linked to human-caused global warming. Some changes resulting from human activities have decreased the capacity of the environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience. 6.E) Scientists and economists predict that there will be both positive and negative impacts from global climate change. If warming exceeds 2 to 3°C (3.6 to 5.4°F) over the next century, the consequences of the negative impacts are likely to be much greater than the consequences of the positive impacts. 7.A) Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the oceans warm, is causing sea level to rise. Seawater is beginning to move onto low-lying land and to contaminate coastal fresh water sources and beginning to submerge coastal facilities and barrier islands. Sea-level rise increases the risk of damage to homes and buildings from storm surges such as those that accompany hurricanes. 7.F) Human health and mortality rates will be affected to different degrees in specific regions of the world as a result of climate change. Although cold-related deaths are predicted to decrease, other risks are predicted to rise. The incidence and geographical range of climate-sensitive infectious diseases—such as malaria, dengue fever, and tick-borne diseases—will increase. Drought-reduced crop yields, degraded air and water quality, and increased	

	hazards in coastal and low-lying areas will contribute to unhealthy conditions, particularly for the most vulnerable populations.	
B) Places—Learners understand "place" as humans endowing a particular part of the Earth with meaning through their interactions with that environment.	GP.F) Humans can adapt to climate change by reducing their vulnerability to its impacts. Actions such as moving to higher ground to avoid rising sea levels, planting new crops that will thrive under new climate conditions, or using new building technologies represent adaptation strategies. Adaptation often requires financial investment in new or enhanced research, technology, and infrastructure. 7.B) Climate plays an important role in the global distribution of freshwater resources. Changing precipitation patterns and temperature conditions will alter the distribution and availability of freshwater resources, reducing reliable access to water for many people and their crops. Winter snowpack and mountain glaciers that provide water for human use are declining as a result of global warming.	
C) Resources—Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.	7.B) Climate plays an important role in the global distribution of freshwater resources. Changing precipitation patterns and temperature conditions will alter the distribution and availability of freshwater resources, reducing reliable access to water for many people and their crops. Winter snowpack and mountain glaciers that provide water for human use are declining as a result of global warming.	1.H) Although the ocean is large, it is finite and resources are limited. 6.B) From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
D) Technology—Learners are able to examine the social and environmental impacts of various technologies and technological systems.	GP D) Humans may be able to mitigate climate change or lessen its severity by reducing greenhouse gas concentrations through processes that move carbon out of the atmosphere or reduce greenhouse gas emissions. GP. E) A combination of strategies is needed to reduce greenhouse gas emissions. The most immediate strategy is conservation of oil, gas, and coal, which we rely on as fuels for most of our transportation, heating, cooling, agriculture, and electricity. Short-term strategies involve switching from carbon-intensive to renewable energy sources, which also requires building new infrastructure for alternative energy sources. Long-term strategies involve innovative research and a fundamental change in the way humans use energy. GP.F) Humans can adapt to climate change by reducing	

	their vulnerability to its impacts. Actions such as moving to higher ground to avoid rising sea levels, planting new crops that will thrive under new climate conditions, or using new building technologies represent adaptation strategies. Adaptation often requires financial investment in new or enhanced research, technology, and infrastructure.	
E) Environmental issues—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that these scales and issues are often linked.		

EE Learner Guidelines (12th Grade Level)	**Climate Change Principles**	**Ocean Literacy Principles**
Strand 3 – Skills for Understanding Environmental Issues		
3.1: Skills for Analyzing & Investigating		
A) Identifying and investigating issues— Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope.	5.E) Scientists have conducted extensive research on the fundamental characteristics of the climate system and their understanding will continue to improve. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.	
B) Sorting out the consequences of issues— Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems.	GP.B) Reducing human vulnerability to the impacts of climate change depends not only upon our ability to understand climate science, but also upon our ability to integrate that knowledge into human society. Decisions that involve Earth's climate must be made with an understanding of the complex interconnections among the physical and biological components of the Earth system 5.E) Scientists have conducted extensive research on the fundamental characteristics of the climate system and their understanding will continue to improve. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change. 6.E) Scientists and economists predict that there will be both positive and negative impacts from global climate	

	change. If warming exceeds 2 to 3°C (3.6 to 5.4°F) over the next century, the consequences of the negative impacts are likely to be much greater than the consequences of the positive impacts. 7.C) Incidents of extreme weather are projected to increase as a result of climate change. Many locations will see a substantial increase in the number of heat waves they experience per year and a likely decrease in episodes of severe cold. Precipitation events are expected to become less frequent but more intense in many areas, and droughts will be more frequent and severe in areas where average precipitation is projected to decrease.	
C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.	GP.E) A combination of strategies is needed to reduce greenhouse gas emissions. The most immediate strategy is conservation of oil, gas, and coal, which we rely on as fuels for most of our transportation, heating, cooling, agriculture, and electricity. Short-term strategies involve switching from carbon-intensive to renewable energy sources, which also requires building new infrastructure for alternative energy sources. Long-term strategies involve innovative research and a fundamental change in the way humans use energy. 5.E) Scientists have conducted extensive research on the fundamental characteristics of the climate system and their understanding will continue to improve. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.	
D) Working with flexibility, creativity, and openness—While environmental issues investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry.	5.E) Scientists have conducted extensive research on the fundamental characteristics of the climate system and their understanding will continue to improve. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.	
3.2: Decision-making and Citizenship Skills		
A) Forming and evaluating personal views—Students are able to communicate, evaluate, and justify their own views on environmental issues and alternative ways to address them.		

B) Evaluating the need for citizen action— Learners are able to decide whether action is needed in particular situations and whether they should be involved.		
C) Planning and taking action—Learners know how to plan for action based on their research and analysis of an environmental issue. If appropriate, they take actions that are within the scope of their rights and consistent with their abilities and responsibilities as citizens.		
D) Evaluating the results of actions—Learners are able to evaluate the effects of their own actions and actions taken by other individuals and groups.	GP.G) Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainable built environments.	

EE Learner Guidelines (12th Grade Level)	**Climate Literacy Principles**	**Ocean Literacy Principles**
Strand 4: Personal and Civic Responsibility		
A) Understanding societal values and principles—Learners know how to analyze the influence of shared and conflicting societal values.		6.G) Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.
B) Recognizing citizens' rights and responsibilities— Learners understand the importance of exercising the rights and responsibilities of citizenship.		6.G) Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.
C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.		6.G) Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

D) Accepting personal responsibility— Learners understand that their actions can have broad consequences and accept responsibility for recognizing those effects and changing their actions when necessary.		6.G) Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.