

Crosswalk for Climate Literacy: The Essential Principles of Climate Sciences and Excellence in Environmental Education – Guidelines for Learners (K-12)

What is climate science literacy?

Climate Science Literacy is an understanding of your influence on climate and climate’s influence on you and society.

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A climate-literate person:	EE Code	Eighth Grade	Twelfth Grade
➤ understands the essential principles of Earth’s climate system,		See Essential Principles (1-7) below	See Essential Principles (1-7) below
➤ knows how to assess scientifically credible information about climate	1.C 1.D	STRAND 1—Questioning, Analysis and Interpretation Skills C) Collecting information —Learners are able to locate and collect information about the environment and environmental topics. D) Evaluating accuracy and reliability —Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.	STRAND 1—Questioning, Analysis and Interpretation Skills 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. ▪ Adjust information collection strategies to compensate for potential bias in information sources. D) Evaluating accuracy and reliability —Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. ▪ Identify logical errors and spurious statements in everyday situations such as political speeches about the environment or commercial advertising. ▪ Look for and explain flaws such as faulty or misleading use of statistics, misrepresentation

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			<p>of data that is presented graphically, or biased selection of data to support a claim. For example, analyze the public debate over an environmental issue. Examine speeches, advertisements, news releases, and pamphlets put out by groups on various sides of the issue.</p> <ul style="list-style-type: none"> ▪ Explain why some research results are judged to be more credible than are others. Consider factors such as possible sources of bias in interpretation, funding sources, and research procedures
<p>➤ communicates about climate and climate change in a meaningful way</p>	<p>1.G 3.1.D 3.2.A</p>	<p>STRAND 1—Questioning, Analysis and Interpretation Skills G) Drawing conclusions and developing explanations—Learners can develop simple explanations that address their questions about the environment.</p> <p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues D) Working with flexibility, creativity, and openness—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.</p> <p>STRAND 3.2—Decision-Making and Citizenship Skills Guidelines:</p>	<p>STRAND 1—Questioning, Analysis and Interpretation Skills 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.</p> <ul style="list-style-type: none"> ▪ Differentiate between causes and effects and identify when causality is uncertain. ▪ Speak in general terms about their confidence in proposed explanations as well as possible sources of uncertainty and error. Distinguish between error and unanticipated results in formulating explanations. Consider the assumptions of models and measuring techniques or devices as possible sources of error. <p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p>

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		<p>A) Forming and evaluating personal views—Learners are able to identify, justify, and clarify their views on environmental issues and alternative ways to address them.</p>	<p>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.</p> <ul style="list-style-type: none"> ▪ Question, offer alternative explanations, and defend interpretations in group discussions. <p>STRAND 3.2–Decision-Making and Citizenship Skills Guidelines:</p> <p>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.</p> <ul style="list-style-type: none"> ▪ Articulate a position on an environmental issue. Justify the position based on an analysis of information from a variety of sources, personal beliefs and values, and clear reasoning.
<p>➤ is able to make informed and responsible decisions with regard to actions that may affect climate.</p>	<p>3.1.A 3.1.B 3.1.C 3.1.D 3.2.A 3.2.B 3.2.C 3.2.D 4.A 4.B 4.C 4.D</p>	<p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p> <p>A) Identifying and investigating issues—Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.</p> <p>B) Sorting out the consequences of issues—Learners are able to apply their knowledge of ecological and human</p>	<p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p> <p>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.</p> <p>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.</p> <p>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</p>

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		<p>processes and systems to identify the consequences of specific environmental issues.</p> <p>C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and develop action strategies for addressing particular issues.</p> <p>D) Working with flexibility, creativity, and openness—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.</p> <p>STRAND 3.2—Decision-Making and Citizenship Skills</p> <p>A) Forming and evaluating personal views—Learners are able to identify, justify, and clarify their views on environmental issues and alternative ways to address them.</p> <p>B) Evaluating the need for citizen action—Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.</p> <p>C) Planning and taking action—As learners begin to see themselves as citizens taking active roles in their</p>	<p>purposes.</p> <p>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.</p> <p>STRAND 3.2—Decision-Making and Citizenship Skills</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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, including possible intended and unintended consequences of actions.</p> <p>STRAND 4—Personal and Civic Responsibility</p> <p>A) Understanding societal values and principles—</p>

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		<p>communities, they are able to plan for and engage in citizen action at levels appropriate to their maturity and preparation.</p> <p>D) Evaluating the results of actions—Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.</p> <p>STRAND 4—Personal and Civic Responsibility</p> <p>A) Understanding societal values and principles—Learners understand that societal values can be both a unifying and a divisive force.</p> <p>B) Recognizing citizens’ rights and responsibilities—Learners understand the rights and responsibilities of citizenship and their importance in promoting the resolution of environmental issues.</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <p>D) Accepting personal responsibility—Learners understand that their actions can have broad consequences and that they are responsible for those consequences.</p>	<p>Learners know how to analyze the influence of shared and conflicting societal values.</p> <p>B) Recognizing citizens’ rights and responsibilities—Learners understand the importance of exercising the rights and responsibilities of citizenship.</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <p>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.</p>

Guiding principle for informed climate decision:

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<p>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.</p>	<p>2.4.A 2.4.D 2.4.E</p>	<p>STRAND 2.4—Environment and Society A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <ul style="list-style-type: none"> ▪ Explain how human-caused environmental changes cause changes in other places. For example, discuss the effects of building a dam on downstream plant and animal communities as well as on human communities or how climate change might reduce the availability of food, water, and land. <p>D) Technology—Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.</p> <p>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 people in other places around the world experience environmental issues similar to the ones they are concerned about locally.</p> <ul style="list-style-type: none"> ▪ Discuss how the disagreements at the heart of environmental issues make them difficult to resolve. Consider the role of 	<p>STRAND 2.4—Environment and 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.</p> <ul style="list-style-type: none"> ▪ Analyze specific examples of environmental change in terms of qualitative and quantitative costs and benefits for different groups of people and specific species or ecosystems. For example, evaluate the effect of sea level rise and other possible impacts of climate change. <p>D) Technology—Learners are able to examine the social and environmental impacts of various technologies and technological systems.</p> <p>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.</p>

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		understanding, creativity, or compromise in finding solutions to issues such as climate change.	
<p>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.</p>	<p>2.2.C 2.2.D 2.3.A 2.3.B 2.3.C 2.3.D 3.1.B</p>	<p>STRAND 2.2—The Living Environment C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <ul style="list-style-type: none"> ▪ Summarize how abiotic and biotic components in combination influence the structure of an ecosystem. For example, create a map for the local region that shows average temperature and rainfall correlated with local forest, grassland or desert ecosystems. Or discuss the process of soil formation in terms of the interaction of climate, geology, and living organisms. <p>D) Flow of matter and energy—Learners understand how energy and matter flows among the abiotic and biotic components of the environment.</p> <ul style="list-style-type: none"> ▪ Explain how matter is transferred among organisms and between organisms and their environment in these food webs. Describe the role played by organisms in the global carbon cycle. <p>STRAND 2.3—Humans and Their Societies A) Individuals and groups—Learners understand that how individuals perceive the</p>	<p>STRAND 2.2—The Living Environment C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <ul style="list-style-type: none"> ▪ Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change. <p>STRAND 2.3—Humans and 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. D) Global connections—Learners are able to analyze global social, cultural, political, economic, and environmental linkages.</p> <ul style="list-style-type: none"> ▪ Explain regional and national economic

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		<p>environment is influenced in part by individual traits and group membership or affiliation.</p> <ul style="list-style-type: none"> ▪ Explain how group membership—and shared values, beliefs, and assumptions—can influence individuals, impel different reactions to physical and social environments and changes, and cause social change. For example, describe how family, religion, gender, ethnicity, socioeconomic status, and other factors may influence individuals’ values and perceptions about the environment and their communities. <p>B) Culture—As they become familiar with a wider range of cultures and subcultures, learners gain an understanding of cultural perspectives on the environment and how the environment may, in turn, influence culture.</p> <p>C) Political and economic systems—Learners become more familiar with political and economic systems and how these systems take the environment into consideration.</p> <ul style="list-style-type: none"> ▪ Differentiate among public and private goods and services, using environment-related goods and services to illustrate. For example, examine the values and functions of wetlands. Distinguish among public goods, such as groundwater recharge, flood control, and wildlife habitat; and private goods, such as their value for agricultural production or water 	<p>specialization and international trade in terms of uneven distribution of resources and differing costs of producing similar goods (due to factors such as climate, labor costs, and energy costs).</p> <p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p> <p>B) Sorting out the consequences of issues—As students come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.</p>

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		<p>storage, or the value of draining the land for other uses. Discuss difficulties encountered in drawing these distinctions.</p> <ul style="list-style-type: none"> ▪ Identify economic and political features of the local community and state, and describe how environmental decisions can be influenced by these economic and political systems and actors. <p>D) Global connections—Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.</p> <ul style="list-style-type: none"> ▪ Explain international trade in terms of uneven distribution of resources. <p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p> <p>B) Sorting out the consequences of issues—Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.</p>	
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	2.3.D 2.3.E 2.4.A 2.4.C	<p>STRAND 2.3—Humans and Their Societies</p> <p>D) Global connections—Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.</p> <p>E) Change and conflict—Learners</p>	<p>STRAND 2.3—Humans and Their Societies</p> <p>D) Global connections—Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.</p> <p>E) Change and conflict—Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze</p>

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groups of climate refugees.		<p>understand that human social systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment.</p> <p>STRAND 2.4—Environment and Society A) Human/environment interactions – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <ul style="list-style-type: none"> ▪ Explain how human-caused environmental changes cause changes in other places. For example, discuss the effects of building a dam on downstream plant and animal communities as well as on human communities or how climate change might reduce the availability of food, water, and land. <p>C) Resources—Learners understand that uneven distribution of resources influences their use and perceived value.</p> <ul style="list-style-type: none"> ▪ Map and discuss distribution and consumption patterns for specific resources, such as metals, fresh water, or certain types of forests. Note resources that are being rapidly depleted or might be impacted by climate change. 	<p>their effects on the environment.</p> <p>STRAND 2.4—Environment and 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.</p> <ul style="list-style-type: none"> ▪ Analyze specific examples of environmental change in terms of qualitative and quantitative costs and benefits for different groups of people and specific species or ecosystems. For example, evaluate the effect of sea level rise and other possible impacts of climate change. <p>C) Resources—Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.</p>

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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.	2.4.D	STRAND 2.4—Environment and Society D) Technology —Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.	STRAND 2.4—Environment and Society D) Technology —Learners are able to examine the social and environmental impacts of various technologies and technological systems.
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.	2.4.C 2.4.D 3.1.C	STRAND 2.4—Environment and Society C) Resources —Learners understand that uneven distribution of resources influences their use and perceived value. <ul style="list-style-type: none"> ▪ Explain why certain resources (such as oil, coal, or natural gas) have been key to the development of human societies, and identify resources that were critical to development at different times in history. Consider the implications of switching from carbon-intensive to renewable energy sources. D) Technology —Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.	STRAND 2.4—Environment and Society C) Resources —Learners understand that the importance and use of resources change over time and vary under different economic and technological systems. <ul style="list-style-type: none"> ▪ Describe how changes in technology alter the use of resources. Illustrate with examples such as the ability to harvest timber on steep slopes using helicopters or building technologies that incorporate nontraditional or recycled materials, or use of renewable energy resources. D) Technology —Learners are able to examine the social and environmental impacts of various technologies and technological systems. STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues 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

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<p>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.</p>	<p>2.4.A 2.4.B 2.4.D 2.4.E</p>	<p>STRAND 2.4—Environment and Society A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. B) Places—Learners begin to explore the meaning of places both close to home and around the world. <ul style="list-style-type: none"> ▪ Analyze physical and human characteristics of places and make inferences about how and why these characteristics have developed and changed over time. D) Technology—Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies. <ul style="list-style-type: none"> ▪ Analyze how the ability to develop and use technology gives humans great influence over the environment and ability to adapt to environmental changes such as rising sea levels and new climate conditions. 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 people in other places around the world experience</p>	<p>for particular purposes.</p> <p>STRAND 2.4—Environment and 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. B) Places—Learners understand “place” as humans endowing a particular part of the Earth with meaning through their interactions with that environment. D) Technology—Learners are able to examine the social and environmental impacts of various technologies and technological systems. 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.</p>

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		<p>environmental issues similar to the ones they are concerned about locally.</p> <ul style="list-style-type: none"> ▪ Discuss how the disagreements at the heart of environmental issues make them difficult to resolve. Consider the role of understanding, creativity, or compromise in finding solutions to issues such as climate change. 	
<p>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.</p>	<p>2.3.C 2.3.D 2.4.A 3.1.A 3.1.B 3.2.B 3.2.C 3.2.D 4.C 4.D</p>	<p>STRAND 2.3—Humans and Their Societies</p> <p>C) Political and economic systems— Learners become more familiar with political and economic systems and how these systems take the environment into consideration.</p> <ul style="list-style-type: none"> ▪ Identify ways in which governments and economic systems work to protect the environment and distribute natural resources. Give examples of laws, incentives, and penalties that affect people's behavior toward the environment and each other. <p>D) Global connections—Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.</p> <ul style="list-style-type: none"> ▪ Describe ways in which the global environment is affected by individual and group actions, as well as by government policies and actions having to do with energy use and other forms of consumption, waste disposal, resource 	<p>STRAND 2.3—Humans and Their Societies</p> <p>C) Political and economic systems—Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.</p> <p>D) Global connections—Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.</p> <p>STRAND 2.4—Environment and Society</p> <p>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.</p> <p>STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues</p> <p>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.</p>

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		<p>management, industry, and population.</p> <ul style="list-style-type: none"> ▪ Explain how an environmental change in one part of the world can have consequences for other places. For example, develop a map or another visual presentation that shows the effects of acid rain or nuclear fallout in places distant from the source of the pollution. <p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <ul style="list-style-type: none"> ▪ Describe intended and unintended environmental and social consequences associated with the changing use of technologies. Consider consequences that may be positive as well as negative. For example, discuss particular irrigation methods, different ways of generating electrical power, or the use of synthetic pesticides. ▪ Explain how human-caused environmental changes cause changes in other places. For example, discuss the effects of building a dam on downstream plant and animal 	<p>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.</p> <p>STRAND 3.2—Decision-Making and Citizenship Skills</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>STRAND 4—Personal and Civic Responsibility</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <p>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.</p>

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		<p>communities as well as on human communities or how climate change might reduce the availability of food, water and land.</p> <p>STRAND 3— Skills for Understanding and Addressing Environmental Issues STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues A) Identifying and investigating issues— Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.</p> <ul style="list-style-type: none"> ▪ Clearly articulate and define environmental issues. For example, describe the history and origins of the issue, actions that have been taken to address the issue, the apparent effects of these actions, and the current situation. <p>B) Sorting out the consequences of issues—Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.</p> <ul style="list-style-type: none"> ▪ Analyze issues by looking at trade-offs that have been made. For example, 	

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		<p>consider where various human activities (such as landfills, highways, chemical factories, or hazardous waste incinerators) are located and their effects on different places and different segments of the population.</p> <ul style="list-style-type: none"> ▪ Speculate about the effects of a proposed state or local environmental regulation. For example, consider effects on different sectors of the economy, neighborhoods, public health, particular plant and animal species and communities, and overall environmental quality. <p>STRAND 3.2—Decision-Making and Citizenship Skills B) Evaluating the need for citizen action— Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.</p> <ul style="list-style-type: none"> ▪ Identify different forms of action that citizens can take in the economic, political, and legal spheres, as well as actions aimed at directly improving or maintaining some part of the environment or persuading others to take action. 	

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		<ul style="list-style-type: none"> ▪ Speculate about the likely effects of specific actions on society and the environment, and the likelihood these actions will resolve a specific environmental issue. <p>D) Evaluating the results of actions— Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.</p> <p>STRAND 4—Personal and Civic Responsibility</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <ul style="list-style-type: none"> ▪ Explain the ways in which citizen action and public opinion influence environmental policy decisions. ▪ Describe how individuals and groups act within society to create change, meet individual needs and promote the common good. Illustrate with examples from environmental issues. ▪ Describe ways in which their actions have made a difference. Use examples that begin in the classroom and the home, and extend beyond to encompass the broader communities in which students begin to see possibilities for 	

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Humans can take actions to reduce climate change and its impacts.		EE Code	Eighth Grade	Twelfth Grade
			<p>action.</p> <p>D) Accepting personal responsibility— Learners understand that their actions can have broad consequences and that they are responsible for those consequences.</p> <ul style="list-style-type: none"> ▪ Analyze some of the effects that their actions (and the actions of their families, social groups, and communities) have on the environment, other humans, and other living beings. ▪ Describe actions in terms of their effects that reach into the future. 	

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	1. The sun is the primary source of energy for Earth's climate system.	EE Code	Eighth Grade	Twelfth Grade
1. A	<p>Sunlight reaching the Earth can heat the land, ocean, and atmosphere. Some of that sunlight is reflected back to space by the surface, clouds, or ice. Much of the sunlight that reaches Earth is absorbed and warms the planet.</p>	<p>2.1.A 2.1.C</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Relate physical processes and 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p> <ul style="list-style-type: none"> ▪ Relate different types of climate to processes such as the transfer of heat energy, cloud formation, wind and ocean currents,

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	1. The sun is the primary source of energy for Earth's climate system.	EE Code	Eighth Grade	Twelfth Grade
			<p>patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship.</p> <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> ▪ Trace the flow of energy in examples that encompass several different transfers and transformations of energy. For example, trace the path of energy in the creation and consumption of fossil fuels. ▪ Describe how atmospheric gases alter how much solar energy is absorbed or radiated. 	<p>atmospheric circulation patterns, and the cycling of water. Explain how positive feedback loops can affect climate.</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p> <ul style="list-style-type: none"> ▪ Explain the dynamic relationship between greenhouse gases, solar energy absorption and radiation, and climate.
1. B	When Earth emits the same amount of energy as it absorbs, its energy budget is in balance, and its average temperature remains stable.	2.1.C	<p>STRAND 2.1—The Earth as a Physical System</p> <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p> <ul style="list-style-type: none"> ▪ Use the laws of thermodynamics to explain why natural systems need a certain amount of energy input to maintain their organization.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	1. The sun is the primary source of energy for Earth's climate system.	EE Code	Eighth Grade	Twelfth Grade
			<p>the motion of objects.</p> <ul style="list-style-type: none"> Trace the flow of energy in examples that encompass several different transfers and transformations of energy. For example, trace the path of energy in the creation and consumption of fossil fuels. 	
1. C	<p>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.</p>	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> Relate physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>
1. D	<p>Gradual changes in Earth's rotation and orbit around the Sun change the intensity of sunlight received in our planet's polar and equatorial regions. For at least the last 1 million years, these changes occurred in 100,000-year cycles that produced ice ages and the shorter warm</p>	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> Consider historical evidence of 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	1. The sun is the primary source of energy for Earth's climate system.	EE Code	Eighth Grade	Twelfth Grade
	periods between them.		<p>changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change.</p> <ul style="list-style-type: none"> ▪ Relate physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. 	
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.	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Relate physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. For example, create a model that shows how seasonal change is affected by the Earth/sun relationship. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>

	Climate Literacy: The Essential Principles of Climate Sciences (2009)	Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	2. Climate is regulated by complex interactions among components of the Earth system.	EE Code	Eighth Grade	Twelfth Grade
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.	2.1.A 2.1.C	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. <p>C) Energy – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> ▪ Explain how solar energy contributes to the movement of global air masses, the hydrological cycle and ocean currents. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p> <ul style="list-style-type: none"> ▪ Relate different types of climate to processes such as the transfer of heat energy, cloud formation, wind and ocean currents, atmospheric circulation patterns, and the cycling of water. Explain how positive feedback loops can affect climate. ▪ Use examples such as the El Niño effect or the Santa Ana winds to illustrate how changes in wind patterns or ocean temperatures can affect weather in different parts of the world. <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p>
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	2.1.A 2.1.B 2.1.C	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners understand the major physical processes that</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	2. Climate is regulated by complex interactions among components of the Earth system.	EE Code	Eighth Grade	Twelfth Grade
	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.		<p>understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. <p>B) Changes in matter—Learners understand the properties of the substances that make up objects or materials found in the environment.</p> <ul style="list-style-type: none"> ▪ Consider the relationship between ocean and atmospheric chemistries. <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> ▪ Explain how solar energy contributes to the movement of global air masses, the hydrological cycles and ocean currents. 	<p>shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.</p> <ul style="list-style-type: none"> ▪ Relate different types of climate to processes such as the transfer of heat energy, cloud formation, wind and ocean currents, atmospheric circulation patterns, and the cycling of water. Explain how positive feedback loops can affect climate. ▪ Use examples such as the El Niño effect or the Santa Ana winds to illustrate how changes in wind patterns or ocean temperatures can affect weather in different parts of the world. <p>B) Changes in matter—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p>

	Climate Literacy: The Essential Principles of Climate Sciences (2009)	Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	2. Climate is regulated by complex interactions among components of the Earth system.	EE Code	Eighth Grade	Twelfth Grade
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.	2.1.C	STRAND 2.1—The Earth as a Physical System C) Energy —Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects. <ul style="list-style-type: none"> Describe how atmospheric gases alter how much solar energy is absorbed or radiated. 	STRAND 2.1—The Earth as a Physical System C) Energy —Learners apply their knowledge of energy and matter to understand phenomena in the world around them. <ul style="list-style-type: none"> Explain the dynamic relationship between greenhouse gases, solar energy absorption and radiation, and climate.
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.	2.1.B 2.1.C 2.2.D	STRAND 2.1—The Earth as a Physical System B) Changes in matter —Learners understand the properties of the substances that make up objects or materials found in the environment. <ul style="list-style-type: none"> Consider the relationship between ocean and atmospheric chemistries. C) Energy —Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make	STRAND 2.1—The Earth as a Physical System B) Changes in matter —Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena. <ul style="list-style-type: none"> Explain everyday chemical reactions such as burning fossil fuels, photosynthesis, or the creation of smog in terms such as the release or consumption of energy, the products of these reactions, and how these products may be involved in further chemical reactions and/or affect biogeochemical cycles. Explain the chemical components of biological processes such as photosynthesis,

	Climate Literacy: The Essential Principles of Climate Sciences (2009)	Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	2. Climate is regulated by complex interactions among components of the Earth system.	EE Code	Eighth Grade	Twelfth Grade
			<p>connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> Explain how the process of life is based on the conversion, utilization, storage and transfer of energy. For example, create a visual display that shows how plants or animals use energy, where that energy comes from, and where it goes. <p>STRAND 2.2—The Living Environment D) Flow of matter and energy—Learners understand how energy and matter flow among the abiotic and biotic components of the environment.</p> <ul style="list-style-type: none"> Explain how matter is transferred among organisms and between organisms and their environment in these food webs. Describe the role played by organisms in the global carbon cycle. 	<p>respiration, nitrogen fixation, or decomposition, and how biological and physical processes fit in the overall process of biogeochemical cycling.</p> <ul style="list-style-type: none"> Explain why elements cycle through the biosphere at different rates, describing influences on reaction rates. (Oxygen and nitrogen cycle quickly, for example, while phosphorus tends to be released from its immobile form more slowly, depending upon factors such as soil acidity.) <p>STRAND 2.2—The Living Environment 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.</p> <ul style="list-style-type: none"> Trace the flow of matter and energy through living systems, and between living systems and the physical environment, identifying feedback loops. For example, show how oxygen is released to the atmosphere by the interaction of plants, animals, and non-living matter in the global carbon cycle. Or use the carbon cycle to explain the existence of fossil energy sources.
2.E	Airborne particulates, called “aerosols,” have a complex effect on Earth’s energy balance: they	2.1.C	<p>STRAND 2.1—The Earth as a Physical System C) Energy—Learners begin to</p>	<p>STRAND 2.1—The Earth as a Physical System C) Energy—Learners apply their knowledge of</p>

	Climate Literacy: The Essential Principles of Climate Sciences (2009)	Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	2. Climate is regulated by complex interactions among components of the Earth system.	EE Code	Eighth Grade	Twelfth Grade
	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.		grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects. <ul style="list-style-type: none"> ▪ Describe how atmospheric gases alter how much solar energy is absorbed or radiated. 	energy and matter to understand phenomena in the world around them.
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.	2.1.A 2.1.B 2.1.C		STRAND 2.1—The 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. B) Changes in matter —Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena. C) Energy —Learners apply their knowledge of energy and matter to understand phenomena in the world around them.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (NAAEE 2010)		
CL Code	3. Life on Earth depends on, is shaped by, and affects climate.	EE Code	Eighth Grade	Twelfth Grade
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.	2.2.A 2.2.C	<p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.</p> <ul style="list-style-type: none"> ▪ Understand that some animals and plants have adapted to extreme environmental conditions. Give examples of adaptations that are behavioral (for example, the migration of Canada geese and other birds) and physical (such as the physical structures that enable desert animals and plants to exist on minimal amounts of water). Understand that organisms may be vulnerable to rapid or significant environmental changes. <p>C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <ul style="list-style-type: none"> ▪ Summarize how abiotic and biotic components in combination influence the structure of an ecosystem. For example, create a map for the 	<p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <ul style="list-style-type: none"> ▪ Discuss the relationship of habitat changes to plant and animal populations. Consider such factors as variations in habitat size, fragmentation, and fluctuation in conditions such as pH, oxygen, temperature, available light, or precipitation. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes. <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <ul style="list-style-type: none"> ▪ Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (NAAEE 2010)		
CL Code	3. Life on Earth depends on, is shaped by, and affects climate.	EE Code	Eighth Grade	Twelfth Grade
			local region that shows average temperature and rainfall correlated with local forest, grassland or desert ecosystems. Or discuss the process of soil formation in terms of the interaction of climate, geology, and living organisms.	
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.	2.1.A 2.1.C	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> ▪ Describe how atmospheric gases alter how much solar energy is absorbed or radiated. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (NAAEE 2010)		
CL Code	3. Life on Earth depends on, is shaped by, and affects climate.	EE Code	Eighth Grade	Twelfth Grade
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.	2.2.A 2.2.B 2.2.C	<p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.</p> <ul style="list-style-type: none"> Understand that some animals and plants have adapted to extreme environmental conditions. Give examples of adaptations that are behavioral (for example, the migration of Canada geese and other birds) and physical (such as the physical structures that enable desert animals and plants to exist on minimal amounts of water). Understand that organisms may be vulnerable to rapid or significant environmental changes. <p>B) Heredity and evolution—Learners have a basic understanding of the importance of genetic heritage.</p> <ul style="list-style-type: none"> Define extinction, cite 	<p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <ul style="list-style-type: none"> Discuss the relationship of habitat changes to plant and animal populations. Consider such factors as variations in habitat size, fragmentation, and fluctuation in conditions such as pH, oxygen, temperature, available light, or precipitation. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes. <p>B) Heredity and evolution—Learners understand the basic ideas and genetic mechanisms behind biological evolution.</p> <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <ul style="list-style-type: none"> Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (NAAEE 2010)		
CL Code	3. Life on Earth depends on, is shaped by, and affects climate.	EE Code	Eighth Grade	Twelfth Grade
			<p>evidence of extinction, and identify some of its causes.</p> <p>C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <ul style="list-style-type: none"> ▪ Summarize how abiotic and biotic components in combination influence the structure of an ecosystem. For example, create a map for the local region that shows average temperature and rainfall correlated with local forest, grassland or desert ecosystems. Or discuss the process of soil formation in terms of the interaction of climate, geology, and living organisms. 	
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.	2.4.A	<p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions—Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <ul style="list-style-type: none"> ▪ Explain how human-caused environmental changes cause 	<p>STRAND 2.4—Environment and Society</p> <p>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.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (NAAEE 2010)		
CL Code	3. Life on Earth depends on, is shaped by, and affects climate.	EE Code	Eighth Grade	Twelfth Grade
			changes in other places. For example, discuss the effects of building a dam on downstream plant and animal communities as well as on human communities or how climate change might reduce the availability of food, water and land.	
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.	2.2.D	<p>STRAND 2.2—The Living Environment</p> <p>D) Flow of matter and energy—Learners understand how energy and matter flow among the abiotic and biotic components of the environment.</p> <ul style="list-style-type: none"> ▪ Explain how matter is transferred among organisms and between organisms and their environment in these food webs. Describe the role played by organisms in the global carbon cycle. 	STRAND 2.2—The Living Environment 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.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	4. Climate varies over space and time through both natural and man-made processes.	EE Code	Eighth Grade	Twelfth Grade
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.	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices). ▪ Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	4. Climate varies over space and time through both natural and man-made processes.	EE Code	Eighth Grade	Twelfth Grade
			glaciers as evidence of climate change.	
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.	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> Relate physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. For example, create a model that shows how seasonal change is affected by the Earth/sun relationship. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>
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	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> Relate physical processes 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>

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CL Code	4. Climate varies over space and time through both natural and man-made processes.	EE Code	Eighth Grade	Twelfth Grade
	variability. They do not represent climate change.		and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. For example, create a model that shows how seasonal change is affected by the Earth/sun relationship.	
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.	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change. 	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p>
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	2.1.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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,</p>

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	1,300 years. Average temperatures have increased markedly in the past 50 years, especially in the North Polar Region.		<p>Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change. 	to characteristics of the Earth.
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.	2.1.A 2.1.B 2.1.C	STRAND 2.1—The Earth as a Physical System A) Processes that shape the Earth —Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock 	STRAND 2.1—The 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. B) Changes in matter —Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena. C) Energy —Learners apply their knowledge of energy and matter to understand phenomena in the world around them.

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CL Code	4. Climate varies over space and time through both natural and man-made processes.	EE Code	Eighth Grade	Twelfth Grade
			<p>formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices).</p> <ul style="list-style-type: none"> ▪ Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change. <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p> <ul style="list-style-type: none"> ▪ Describe how atmospheric gases alter how much solar energy is absorbed or radiated. ▪ Explain how solar energy contributes to the movement of global air masses, the hydrological cycle and ocean currents. 	

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CL Code	4. Climate varies over space and time through both natural and man-made processes.	EE Code	Eighth Grade	Twelfth Grade
4.G	Natural processes that remove carbon dioxide from the atmosphere operate slowly when compared to the processes that are now adding it to the atmosphere. Thus, carbon dioxide introduced into the atmosphere today may remain there for a century or more. Other greenhouse gases, including some created by humans, may remain in the atmosphere for thousands of years.	2.1.A 2.1.B		STRAND 2.1—The 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. B) Changes in matter —Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling.	EE Code	Eighth Grade	Twelfth Grade
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	2.1.A 2.1.B 2.1.C	STRAND 2.1—The Earth as a Physical System A) Processes that shape the Earth —Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to	STRAND 2.1—The 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

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling.	EE Code	Eighth Grade	Twelfth Grade
	understood and predicted through careful, systematic study.		<p>explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices). ▪ Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change. <p>B) Changes in matter—Learners understand the properties of the substances that make up objects or materials found in the environment.</p> <p>C) Energy—Learners begin to grasp</p>	<p>and long-term, to characteristics of the Earth.</p> <p>B) Changes in matter—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
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			formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.	
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.	1.C	STRAND 1—Questioning, Analysis and Interpretation Skills C) Collecting information— Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources.	STRAND 1—Questioning, Analysis and Interpretation Skills 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.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	1.F	STRAND 1—Questioning, Analysis and Interpretation Skills F) Working with models and simulations— Learners understand many of the uses and limitations of models.	STRAND 1—Questioning, Analysis and Interpretation Skills F) Working with models and simulations— Learners are able to create, use, and evaluate models to understand environmental phenomena.

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	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.			
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	3.1.A 3.1.B 3.1.C 3.1.D	STRAND 3— Skills for Understanding and Addressing Environmental Issues STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues A) Identifying and investigating	STRAND 3— Skills for Understanding and Addressing Environmental Issues STRAND 3.1—Skills for Analyzing and Investigating Environmental Issues A) Identifying and investigating issues— Learners apply their research and analytical skills to investigate environmental issues

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CL Code	5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling.	EE Code	Eighth Grade	Twelfth Grade
	projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.		<p>issues—Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.</p> <p>B) Sorting out the consequences of issues—Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.</p> <p>C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and develop action strategies for addressing particular issues.</p> <p>D) Working with flexibility, creativity, and openness—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.</p>	<p>ranging from local issues to those that are regional or global in scope.</p> <p>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.</p> <p>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.</p> <p>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.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	6. Human activities are impacting the climate system.	EE Code	Eighth Grade	Twelfth Grade
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. ²	2.1.A 2.4.A	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth— Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> ▪ Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices). <p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p>	<p>STRAND 2.4—Environment and Society</p> <p>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.</p>

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2010)		
CL Code	6. Human activities are impacting the climate system.	EE Code	Eighth Grade	Twelfth Grade
6.B	Emissions from the widespread burning of fossil fuels since the start of the Industrial Revolution have 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.	2.4.A	STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.	STRAND 2.4—Environment and 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.
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.	2.3.D 2.4.A	STRAND 2.3—Humans and Their Societies D) Global connections —Learners become familiar with ways in which the world’s environmental, social, economic, cultural, and political systems are linked. STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times	STRAND 2.3—Humans and Their Societies D) Global connections —Learners are able to analyze global, social, cultural, political, economic, and environmental linkages. STRAND 2.4—Environment and 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.
6.D	Growing evidence shows that changes in many physical and	2.2.A 2.2.C	STRAND 2.2—The Living Environment	STRAND 2.2—The Living Environment

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CL Code	6. Human activities are impacting the climate system.	EE Code	Eighth Grade	Twelfth Grade
	biological systems are linked to human-caused global warming. ³ 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.	2.4.A	<p>A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.</p> <p>C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions—Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times</p>	<p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <ul style="list-style-type: none"> ▪ Discuss the relationship of habitat changes to plant and animal populations. Consider such factors as variations in habitat size, fragmentation, and fluctuation in conditions such as pH, oxygen, temperature, available light, or precipitation. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes. <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <ul style="list-style-type: none"> ▪ Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change.

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CL Code	6. Human activities are impacting the climate system.	EE Code	Eighth Grade	Twelfth Grade
				STRAND 2.4—Environment and 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.
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.	2.4.A	STRAND 2.4—Environment and Society A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times	STRAND 2.4—Environment and 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.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2009)		
CL Code	7. Climate change will have consequences for the Earth system and human lives.	EE Code	Eighth Grade	Twelfth Grade
7.A	Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the oceans warm, is	2.1.A 2.3.D 2.4.A	STRAND 2.1—The Earth as a Physical System A) Processes that shape the	STRAND 2.1—The Earth as a Physical System A) Processes that shape the Earth— Learners

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	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.		<p>Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <ul style="list-style-type: none"> Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices). <p>STRAND 2.3—Humans and Their Societies D) Global connections—Learners become familiar with ways in which the world’s environmental, social, economic, cultural, and political systems</p>	<p>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.</p> <p>STRAND 2.3—Humans and Their Societies D) Global connections—Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.</p> <p>STRAND 2.4—Environment and 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.</p> <ul style="list-style-type: none"> Analyze specific examples of environmental change in terms of qualitative and quantitative costs and benefits for different groups of people and specific species or ecosystems. For example, evaluate the effect of sea level rise and other possible impacts of climate change.

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			are linked. STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.	
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.	2.1.A 2.4.A 2.4.B 2.4.C 2.4.E	STRAND 2.1—The Earth as a Physical System A) Processes that shape the Earth —Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. B) Places —Learners begin to explore the meaning of places both close to home and around	STRAND 2.1—The 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. STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that people depend on, change, and are affected by the environment. B) Places —Learners understand that places differ in their physical and human characteristics. C) Resources —Learners understand the basic concepts of resource and resource distribution. E) Environmental issues —Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

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			<p>the world.</p> <p>C) Resources—Learners understand that uneven distribution of resources influences their use and perceived value.</p> <p>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 people in other places around the world experience environmental issues similar to the ones they are concerned about locally.</p>	
7.C	<p>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.²</p>	<p>2.1.A 2.2.A 2.2.C 2.4.A 2.4.C</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>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.</p> <p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p>

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			<p>adapted to live in particular environments.</p> <p>C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions—Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <p>C) Resources—Learners understand that uneven distribution of resources influences their use and perceived value.</p>	<p>STRAND 2.4—Environment and Society</p> <p>A) Human/environment interactions—Learners understand that people depend on, change, and are affected by the environment.</p> <p>C) Resources—Learners understand the basic concepts of resource and resource distribution.</p>
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.	<p>2.1.B</p> <p>2.2.A</p> <p>2.2.C</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>B) Changes in matter—Learners understand the properties of the substances that make up objects or materials found in the environment.</p> <p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand that biotic</p>	<p>STRAND 2.1—The Earth as a Physical System</p> <p>B) Changes in matter—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.</p> <ul style="list-style-type: none"> ▪ Explain everyday chemical reactions such as burning fossil fuels, photosynthesis, or the creation of smog in terms such as the release or consumption of energy, the products of these reactions, and how these products may be involved in further

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			<p>communities are made up of plants and animals that are adapted to live in particular environments.</p> <p>C) Systems and connections— Learners understand major kinds of interactions among organisms or populations of organisms.</p>	<p>chemical reactions and/or affect biogeochemical cycles.</p> <p>STRAND 2.2—The Living Environment</p> <p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <ul style="list-style-type: none"> ▪ Discuss the relationship of habitat changes to plant and animal populations. Consider such factors as variations in habitat size, fragmentation, and fluctuation in conditions such as pH, oxygen, temperature, available light, or precipitation. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes. <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <ul style="list-style-type: none"> ▪ Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change.

Climate Literacy: The Essential Principles of Climate Sciences (2009)		Excellence in Environmental Education Guidelines for Learners (K-12) (2009)		
CL Code	7. Climate change will have consequences for the Earth system and human lives.	EE Code	Eighth Grade	Twelfth Grade
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.	2.2.A 2.2.C	STRAND 2.2—The Living Environment A) Organisms, populations, and communities —Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. C) Systems and connections —Learners understand major kinds of interactions among organisms or populations of organisms.	STRAND 2.2—The Living Environment A) Organisms, populations, and communities —Learners understand basic population dynamics and the importance of diversity in living systems. C) Systems and connections —Learners understand the living environment to be comprised of interrelated, dynamic systems.
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.	2.4.A 2.4.E	STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. 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 people in other places around the world experience environmental issues similar to the ones they are concerned about locally.	STRAND 2.4—Environment and Society A) Human/environment interactions —Learners understand that people depend on, change, and are affected by the environment. E) Environmental issues —Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

