Environmental Science Institute
The University of Texas at Austin

Life on a Human-Dominated Earth

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This file contains suggestions for how to incorporate the material for this CD-ROM into curriculum using the Texas Essential Knowledge and Skills for Science.

§112.2. Science, Kindergarten.

(7) Science concepts. The student knows that many types of change occur. The student is expected to:

(A) observe, describe, and record changes in size, mass, color, position, quantity, time, temperature, sound, and movement; [Slides 14-17, 20, 23, 37, 39 – What changes do these graphs describe (population, food production, contaminant levels, etc.)? What quantities do they describe, and how are these quantities compared?]

(8) Science concepts. The student knows the difference between living organisms and nonliving objects. The student is expected to:

(A) identify a particular organism or object as living or nonliving; and [Slides 3-9 – What are ecosystem services? What ecosystem services are supplied by living objects? Which ecosystem resources are supplied by non-living objects?]

(9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(B) give examples of how living organisms depend on each other; and [Slide 5 – What living organisms that humans depend on are depicted in this slide? Slides 3-9 - What other resources do the living things around us provide to help us survive? Slide 18 – Why does the clearing of land for agriculture cause the extinction of so many different species of plants and animals? Slide 35 – How do the different species of rice growing in China depend on each other to prevent disease?]

(C) identify ways that the Earth can provide resources for life. [Slides 3-9 What are ecosystem services?]

§112.3. Science, Grade 1.

(8) Science concepts. The student distinguishes between living organisms and nonliving objects. The student is expected to:

(A) group living organisms and nonliving objects [Slides 3-9 – What are ecosystem services? What ecosystem services are supplied by living objects? Which ecosystem resources are supplied by non-living objects?]; and

(B) compare living organisms and nonliving objects [How are the resources we get from living objects different from the resources we get from nonliving objects? How are they the same?].

(9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(A) identify characteristics of living organisms that allow their basic needs to be met; and [Slides 11, 14 – What are the basic needs of human beings? How do we get the food and energy we need? Slide 18 – What is biological diversity? Slides 23-24 - How does maintaining biological diversity help more organisms meet their needs?]

(B) compare and give examples of the ways living organisms depend on each other for their basic needs. [Slides 5, 6 – What living organisms that humans depend on are depicted in this slide? Slides 3-9 - What other resources do the living things around us provide to help us survive? Slide 18 – Why does the clearing of land for agriculture cause the extinction of so many different species of plants and animals? Slide 35 – How do the different species of rice growing in China depend on each other to prevent disease?]

§112.4. Science, Grade 2.

(5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:

(A) classify and sequence organisms, objects, and events based on properties and patterns; and [Slide 14 – What pattern does this graph show in global food production? How long did it take for global food production to double? When did this happen? What is this event called? Why was increased food production necessary? Slides 15-16 – What pattern in destruction of natural habitat occurred during the same time period? What pattern in use of fertilizers also occurred during this time period? Are these patterns related? How can we know?]

(9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(B) compare and give examples of the ways living organisms depend on each other and on their environments [Slide 5 – What living organisms that humans depend on are depicted in this slide? Slides 3-9 - What other resources do the living things around us provide to help us survive? Slide 18 – Why does the clearing of land for agriculture cause the extinction of so many different species of plants and animals? Slide 35 – How do the different species of rice growing in China depend on each other to prevent disease?].

(10) Science concepts. The student knows that the natural world includes rocks, soil, water, and gases of the atmosphere. The student is expected to:

(B) identify uses of natural resources. [Slides 3-9 – What are ecosystem services? What natural resources provide these services? Slide 11 – What two basic needs does the earth supply to humans? What natural resources supply food? What natural resources supply energy? Slide 26 – How does Dr. Tilman suggest we could grow and pay for crops in a way that uses natural resources more effectively?, Slides 28-29 – What natural resources do we use that cause pollution? How can we use biodiversity to reduce pollution?]

§112.5. Science, Grade 3.

(8) Science concepts. The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live. The student is expected to:

(A) observe and describe the habitats of organisms within an ecosystem [Slides 15-18 – What has happened to natural habitats as a result of increased agriculture?];

(B) observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, or space [Slide 19 – What happens to aquatic ecosystems when phosphorous and nitrogen from fertilizers gets into lakes and streams?]

(C) describe environmental changes in which some organisms would thrive, become ill, or perish; and [Slide 20 – What changes cause the growth of exotic, non-native weedy species and the loss of native species? How does this affect the biodiversity of the ecosystem?]

(D) describe how living organisms modify their physical environment to meet their needs such as beavers building a dam or humans building a home. [Slides 6,

11, 14, 18, 22, 30, CD cover – These slides show landscapes shaped by humans. Have students compare these pictures to pictures of natural landscapes, identifying both the patterns in human developed landscapes and the patterns in natural landscapes. Discuss the functionality of these patterns (crop circles vs. forest canopies, etc.)]

(9) Science concepts. The student knows that species have different adaptations that help them survive and reproduce in their environment. The student is expected to:

(A) observe and identify characteristics among species that allow each to survive and reproduce; and [Slide 38 – Even bacteria develop immunities (to antibiotics) in order to survive.]

(B) analyze how adaptive characteristics help individuals within a species to survive and reproduce. [Slide 12 – Do humans survive by adapting to their environment or by adapting their environment to themselves? As a species, how do humans adapt to their environment (consider the different varieties of grain grown in different parts of the world, slides 33, 35, or the different professions we choose, slide 24)? How do these adaptations contribute to biological diversity in humans? Slide 24 – Why is biological diversity important among humans, and what does it contribute to society?]

§112.6. Science, Grade 4.

(5) Science concepts. The student knows that complex systems may not work if some parts are removed. The student is expected to:

(B) predict and draw conclusions about what happens when part of a system is removed [Slides 19-20 - What happens when native species of plants are removed or displaced and replaced by crops or weedy species? Slides 24, 27, 30, 33, What happens when the biodiversity of an ecosystem is decreased?].

(8) Science concepts. The student knows that adaptations may increase the survival of members of a species. The student is expected to:

(A) identify characteristics that allow members within a species to survive and reproduce; [Slide 38 – Even bacteria develop immunities (to antibiotics) in order to survive.]

(B) compare adaptive characteristics of various species; and [Slides 19, 20 – Compare the adaptations of native prairie vegetation and Quack Grass weeds that allow native prairie vegetation to survive in native conditions, and Quack Grass to survive with high nitrogen content in soil.]

(C) identify the kinds of species that lived in the past and compare them to existing species. [Slides 2, 6, 41 contain images of animals that lived in North America until about 8 or 9 thousand years ago]

(10) Science concepts. The student knows that certain past events affect present and future events. The student is expected to:

(A) identify and observe effects of events that require time for changes to be noticeable including growth, erosion, dissolving, weathering, and flow [Slide 14, How much time has it taken for global food production to double? Slide 20 – How long did it take for non-native, weedy species to crowd out native species in this experiment? How long is this compared to the time it takes to grow and harvest a crop of corn (less than a year)?]

§112.7. Science, Grade 5.

(6) Science concepts. The student knows that some change occurs in cycles. The student is expected to:

(A) identify events and describe changes that occur on a regular basis such as in daily, weekly, lunar, and seasonal cycles [Slide 20 – Are the changes documented in this experiment due to seasonal cycles? Why or why not? What does it mean when changes in plant growth don't follow a seasonal cycle?];

(B) identify the significance of the water, carbon, and nitrogen cycles; and [Slide 12 – What percent of total water on Earth's surface is usable? Slide 20 – How does Dr. Tilman describe the Nitrogen cycle on earth, and how nitrogen addition affects the natural nitrogen cycle? Slides 28-29 – How does the use of oil and gas for fuel affect the Carbon cycle? How do changes in diversity affect the carbon cycle?]

(9) Science concepts. The student knows that adaptations may increase the survival of members of a species. The student is expected to:

(A) compare the adaptive characteristics of species that improve their ability to survive and reproduce in an ecosystem; [Slides 19 & 20 – Compare the adaptations of native prairie vegetation and Quack Grass weeds that allow native prairie vegetation to survive in native conditions, and Quack Grass to survive with high nitrogen content in soil.]

(B) analyze and describe adaptive characteristics that result in an organism's unique niche in an ecosystem; and [Slide 38 – Even bacteria develop immunities (to antibiotics) in order to survive]

(B) draw conclusions about "what happened before" using data such as from tree-growth rings and sedimentary rock sequences; and [Slide 6 – How did people dine

9,000 years ago? What sort of clues do scientists use to discover how people hunted and lived in the past?]

(C) identify past events that led to the formation of the Earth's renewable, non-renewable, and inexhaustible resources [Slide 14 - What major event or development does Dr. Tilman discuss as related to a loss of biodiversity on the earth?].

§112.22. Science, Grade 6.

(A) identify some changes in traits that can occur over several generations through natural occurrence and selective breeding; [Slide 32 – Why is natural genetic variation important?]

(12) Science concepts. The student knows that the responses of organisms are caused by internal or external stimuli. The student is expected to:

(A) identify responses in organisms to internal stimuli such as hunger or thirst; [Slide 31 – Irish Potato Famine as a result of hunger. How do humans respond to hunger?]

(B) identify responses in organisms to external stimuli such as the presence or absence of heat or light; and [Slide 24 – How do plants respond to environmental conditions such as biodiversity?]

(C) identify components of an ecosystem to which organisms may respond. [Slide 9 – How do humans use the ecosystem to our benefit? Slide 12 – How do we affect the ecosystem?]

§112.23. Science, Grade 7.

(5) Science concepts. The student knows that the equilibrium of a system may change. The student is expected to:

(A) describe how systems may reach an equilibrium such as when a volcano erupts; [Slide 28, 29—How do forests contribute to atmospheric equilibrium?] [Slide 18—How does agriculture affect the equilibrium of an area?]

(B) observe and describe the role of ecological succession in maintaining an equilibrium in an ecosystem. [Slide 21, 24—How does biodiversity help maintain equilibrium in a system?]

(10) Science concepts. The student knows that species can change through generations and that the instructions for traits are contained in the genetic material of the organisms. The student is expected to:

(B) compare traits of organisms of different species that enhance their survival and reproduction; [Slide 19 & 20—Compare the adaptations of native prairie vegetation and Quack Grass weeds that allow native prairie vegetation to survive in native conditions, and Quack Grass to survive with high nitrogen content in soil.]

(11) Science concepts. The student knows that the responses of organisms are caused by internal or external stimuli. The student is expected to:

(B) identify responses in organisms to external stimuli found in the environment such as the presence or absence of light. [Slide 24—How do plants respond to environmental conditions such as biodiversity?]

(12) Science concepts. The student knows that there is a relationship between organisms and the environment. The student is expected to:

(A) identify components of an ecosystem;

(B) observe and describe how organisms including producers, consumers, and decomposers live together in an environment and use existing resources [Slide 3-11 - What do humans produce? What do they consume? Slide 9 – What organisms help us decompose our waste? Slide 36 – What are the consequences of producing more material than natural decomposers can consume?];

(C) describe how different environments support different varieties of organisms [Slide 12 – What types of organisms do farms support? How is the biological diversity of a field of corn different from that of a rain forest? Slides 24, 29, 33, 35 - How does diversity in an environment help sustain life?; and

(14) Science concepts. The student knows that natural events and human activity can alter Earth systems. The student is expected to:

(A) describe and predict the impact of different catastrophic events on the Earth; [Slide 12, 18, & 30--How do humans contribute to natural disasters, and how do they affect us?]

(C) make inferences and draw conclusions about effects of human activity on Earth's renewable, non-renewable, and inexhaustible resources. [Slide 33 & 39—How long can we sustain food production as the human population increases at current rates? Slides 3, 4, 6, 10, 18 – When we think of non-renewable resources, we often think of fossil fuels or precious metals. What other resources do we use which are limited not so strictly by how much but by how often and how

carefully we use them? What resources do we now consider scarce that were once abundant (when fewer people occupied the earth)? Could biological diversity itself also be considered a resource? Consider the fate of an ecosystem lacking biological diversity. What are the costs of losing diversity? Can we measure the economic cost of these losses?]

§112.24. Science, Grade 8.

(6) Science concepts. The student knows that interdependence occurs among living systems. The student is expected to:

(C) describe interactions within ecosystems. (slide 13 – use this to demonstrate how humans and our expanding population effect our environment; slide 12 – use this to provide more relevant and interesting facts to tie in various concepts with a real world application, e.g. nitrogen fixation; slides 19, 20, 29 – use to show chemical reactions, photosynthesis, in plants)

(11) Science concepts. The student knows that traits of species can change through generations and that the instructions for traits are contained in the genetic material of the organisms. The student is expected to:

(A) identify that change in environmental conditions can affect the survival of individuals and of species; [slide 18 - discuss how massive growth in agriculture can lead to extinction of certain species of plants; slide 30 – discuss how the Irish Potato Famine can demonstrate the importance of biodiversity.]

(B) distinguish between inherited traits and other characteristics that result from interactions with the environment; and [slide 5 – discuss how changing the natural diversity can effect the plants in the changed area. If we limit the natural diversity to improve certain species, while neglecting others, what can happen to this environment?]

(12) Science concepts. The student knows that cycles exist in Earth systems. The student is expected to:

(C) predict the results of modifying the Earth's nitrogen, water, and carbon cycles. [Slide 3 – discuss how our interactions with our environment are negatively effecting our environment and its resources, and also discuss how preservation, and purification of these resources can in turn effect the resources and us.]

(14) Science concepts. The student knows that natural events and human activities can alter Earth systems. The student is expected to:

(B) analyze how natural or human events may have contributed to the extinction of some species; and [Slide 18 - discuss how massive growth in agriculture can lead to extinction of certain species of plants]

(C) describe how human activities have modified soil, water, and air quality. [Slides 4, 5 – discuss the benefits to keeping such a resource (soil) healthy, and how damaging its loss would be; slide 26 – haw what other kinds of incentives can we give farmers to encourage them to conserve the resources in their land?]

§112.42. Integrated Physics and Chemistry.

(8) Science concepts. The student knows that changes in matter affect everyday life. The student is expected to:

(E) research and describe the environmental and economic impact of the end-products of chemical reactions. (Slide 12 – use this to provide more relevant and interesting facts to tie in various concepts with a real world application, i.e. nitrogen fixation; slides 19, 20, 29 – use to show chemical reactions, photosynthesis, in plants; slide 28 – real world example of how widespread CO_2 emissions are)

§112.43. Biology.

(4) Science concepts. The student knows that cells are the basic structures of all living things and have specialized parts that perform specific functions, and that viruses are different from cells and have different properties and functions. The student is expected to:

(D) identify and describe the role of bacteria in maintaining health such as in digestion and in causing diseases such as in streptococcus infections and diphtheria [Slides 3, 9 What role do bacteria play in ecosystem services?].

(8) Science concepts. The student knows applications of taxonomy and can identify its limitations [What is biological diversity? Slides 14-20 – How have the agricultural practices described as the "Green Revolution" affected biological diversity? What might be the future effects of continuing these practices? Slides 22-24 - How does taxonomic diversity affect ecosystem development according to experiments by Dr. Tilman and his associates? How did they come to these conclusions? Why is biological diversity important? What historical example does Dr. Tilman cite to emphasize the importance of biological diversity in agricultural crops (30)?]

(9) Science concepts. The student knows metabolic processes and energy transfers that occur in living organisms. The student is expected to:

(D) analyze the flow of matter and energy through different trophic levels and between organisms and the physical environment [Slides 19, 20, 27-29 How has human domination of global ecosystems altered the flow of energy in the environment? Obviously humans are part of the environment and the ecosystem, and affect the flow of energy in the universe, but what are the aspects of human domination of the earth that endanger the stability of ecosystems and their capacity to sustain life? Do we need to modify our civilization practices to ensure sustainability?].

(11) Science concepts. The student knows that organisms maintain homeostasis. The student is expected to:

(D) summarize the role of microorganisms in maintaining and disrupting equilibrium including diseases in plants and animals and decay in an ecosystem [Slides 3, 9, 30, 35 – How are microorganisms used in ecosystem services? How is the spread of disease associated with biological diversity?].

(12) Science concepts. The student knows that interdependence and interactions occur within an ecosystem. The student is expected to:

(A) analyze the flow of energy through various cycles including the carbon, oxygen, nitrogen, and water cycles [Slides 15-20, 28-30 - What changes does Dr. Tilman cite in global levels or usage of Nitrogen, Phosphorous, and Carbon? How has human domination of global ecosystems altered these cycles? Slide 17, 20 – How is nitrogen cycled through ecosystems? Slide 19 – How is Phosphorous cycled through ecosystems? Slides 28, 29 – Carbon?] ;

(C) compare variations, tolerances, and adaptations of plants and animals in different biomes [Slides 23, 24, 30, 35 - How does maintaining biological diversity help increase the tolerance of an ecosystem? Slides 31-32 – Why is it important to understand how organisms naturally adapt to changing conditions?];

(D) identify and illustrate that long-term survival of species is dependent on a resource base that may be limited [Slides 3, 4, 6, 10, 18 – When we think of non-renewable resources, we often think of fossil fuels or precious metals. What other resources do we use which are limited not so strictly by how much but by how often and how carefully we use them? What resources do we now consider scarce that were once abundant (when fewer people occupied the earth)? Could biological diversity itself also be considered a resource? Consider the fate of an ecosystem lacking biological diversity. What are the costs of losing diversity? Can we measure the economic cost of these losses?]; and

(E) investigate and explain the interactions in an ecosystem including food chains, food webs, and food pyramids [Slides 33-37 - How has our need for mass production of crops such as corn, wheat, and rice, and our need for the mass production of animal products affected our use of ecosystem resources? Do we use these resources efficiently? How many pounds of grain does it take to produce one pound of meat? How does this ratio affect the environmental cost of producing meat?].

(13) Science concepts. The student knows the significance of plants in the environment. The student is expected to:

(A) evaluate the significance of structural and physiological adaptations of plants to their environments [Slides 5, 32-33 – What is the agricultural significance of genetic variation in plant species? How are these variations preserved? What is the purpose and effect of maintaining genetic variations?]; and

(B) survey and identify methods of reproduction, growth, and development of various types of plants [Slides 32-33 – How are scientists trying to preserve the natural genetic diversity of plants? What obstacles do they face in their pursuit?].

§112.44. Environmental Systems.

(4) Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to:

(C) evaluate the impact of human activity such as methods of pest control, hydroponics, organic gardening, or farming on ecosystems [Slides 14-20, 26, 29, 34, 35 – What agricultural practices can lead to loss of biological diversity in an ecosystem? Slide 20 - Many of the elements that can harm an ecosystem are elements that occur in the environment even without human interference. What analogy does Dr. Tilman use to articulate the impact of human dominance over the nitrogen budget?];

(D) predict how the introduction, removal, or reintroduction of an organism may alter the food chain and affect existing populations [Slides 6, How does the introduction of humans to an ecosystem affect the food chain and existing populations of that ecosystem?]; and

(E) predict changes that may occur in an ecosystem if biodiversity is increased or reduced [Slides 22-24, 29-30, 33-38 - What examples does Dr. Tilman present of the effects of biodiversity on ecosystems? Slides 22-24 - What do the results of his research indicate about the effects of biodiversity on nutrient cycling, productivity, stability, and incidence of disease in an ecosystem?].

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(A) summarize methods of land use and management [Slides 5-9, 26-30, 35 – How is land use and management related to biological diversity? What land use and management methods or practices lead to the destruction on biological diversity?];

(B) identify source, use, quality, and conservation of water [Slides 2, 19, 23 - How has human domination of global ecosystems affected our access to clean air and water?;

(C) document the use and conservation of both renewable and non-renewable resources [Are ecosystem services and biological diversity a renewable resource, a non-renewable resource, or possible both? Slides 25, 26, 28-29, 32, 35 – How can we invest in and preserve ecosystem services and biological diversity?];

(E) analyze and evaluate the economic significance and interdependence of components of the environmental system [Slides 22-24, 29 – What components of the environmental system benefit from maintaining biological diversity? Slide 18 - What are the impacts of loss of natural ecosystems? Slide 23 – What are the characteristics of an efficient environmental system? Slides 2-11 – What components of the environmental system provide ecosystem services?]; and

(F) evaluate the impact of human activity and technology on land fertility and aquatic viability [Slides 12, 18 – How do humans dominate the ecosystems of the globe? Slides 11, 39-40, When and why has this become such an important issue for world leaders?].

(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:

(C) evaluate the depletion of non-renewable resources and propose alternatives [Slides 3, 4, 6, 10, 18 – When we think of non-renewable resources, we often think of fossil fuels or precious metals. What other resources do we use which are limited not so strictly by how much but by how often and how carefully we use them? What resources do we now consider scarce that were once abundant (when fewer people occupied the earth)? Could biological diversity itself also be considered a resource? Consider the fate of an ecosystem lacking biological diversity. What are the costs of losing diversity? Can we measure the economic cost of these losses?]; and

(8) Science concepts. The student knows that environments change. The student is expected to:

(A) analyze and describe the effects on environments of events such as fires, hurricanes, deforestation, mining, population growth, and municipal development [Slide 27 – What did New York City do to avoid losing its ecosystem service of water purification? Why was this ecosystem service in danger? What were the economic and environmental impacts of their decision?]

§112.46. Aquatic Science.

(5) Science concepts. The student knows the relationships within and among the aquatic habitats and ecosystems in an aquatic environment. The student is expected to:

(C) identify the interdependence of organisms in an aquatic environment such as a pond, river, lake, ocean, or aquifer, and the biosphere; and [slides 3, 27 – prime example of how us, humans, depend on an aquatic environment]

(6) Science concepts. The student knows the roles of cycles in an aquatic environment. The student is expected to:

(A) identify the role of various cycles such as carbon, nitrogen, water, and nutrients in an aquatic environment; [Slide 12 – identify possible variables that can effect an aquatic environment, and all of its components, living and nonliving.]

(C) collect and evaluate global environmental data using technology. [Slide 27 - Discuss how such data collected by NASA can aid scientists in a wide variety of research areas.]

(7) Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:

(C) predict adaptations of an organism prompted by environmental changes; and [slide 31 – discuss how the Irish Potato Famine is an example of poor adaptation of this potato due to people interrupting the natural biodiversity.]

(8) Science concepts. The student knows that aquatic environments change. The student is expected to:

(A) predict effects of chemical, organic, physical, and thermal changes on the living and nonliving components of an aquatic ecosystem; [slides 3, 27 – Discuss how urbanization of the area surrounding this water resource effected the various components of this ecosystem.]

(B) analyze the cumulative impact of natural and human influence on an aquatic system; [Slides 3, 27 – discuss how New York successfully balanced urban and natural needs of this resource. However, other places, such as Africa, and in South America, do not make such accommodations – what other influences are involved when taking on such a project?]

(C) identify and describe a local or global issue affecting an aquatic system; and [Slides 3, 27 – discuss how New York successfully balanced urban and natural needs of this resource.]

(D) analyze and discuss human influences on an aquatic environment including fishing, transportation, and recreation. [Slides 3, 27 – discuss how much of the potable water can be affected by urbanization of the area.]

(10) Science concepts. The student knows the origin and use of water in a watershed. The student is expected to:

(B) research and identify the types of uses and volumes of water used in a watershed; and [Slides 3, 27 – discuss how much of the potable water can be affected by urbanization of the area. What else can be done to improve the water quality and quantity? What part of the water shed would you see the most of an impact while implementing changes? Which part would be the most important?]

(C) identify water quantity and quality in a local watershed. [Slides 3, 27 – discuss how much of the potable water can be affected by urbanization of the area. What else can be done to improve the water quality and quantity?]

§112.47. Physics.

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:

(C) organize, analyze, evaluate, make inferences, and predict trends from data; (Sides 14, 15, 16, 20, 23, 24, 37, and 39 interpret data on graphs)

(E) graph data to observe and identify relationships between variables; and (Slides 14–16, 19, 23-24, 37 and 39)

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; (Side 21 list of possible example hypotheses for experiments)

(C) evaluate the impact of research on scientific thought, society, and the environment; (Side 21– how do questions like these, and this kind of research interests, help us?)

(7) Science concepts. The student knows the laws of thermodynamics. The student is expected to:

(B) evaluate different methods of heat energy transfer that result in an increasing amount of disorder. [Side 28– discuss how changes in CO_2 distribution can effect global temperatures. Relate to how heat can be transmitted, absorbed, and reflected, and what kind of an effect this heat/light has the surfaces it reaches.]

(8) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:

(C) interpret the role of wave characteristics and behaviors found in medicinal and industrial applications. [Side 28– how can you manipulate light and the various surfaces to reproduce this diagram. Discuss how such a diagram is helpful to an ecologist]

§112.49. Geology, Meteorology, and Oceanography.

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; (Slides 18 21– What questions are scientists trying to answer about biodiversity and ecosystem resources? What hypotheses do they formulate based on these questions? Slides 23-24- What methods have Dr. Tilman and his fellow researchers used to test their hypotheses? To what conclusions has their research led them? What questions still remain unanswered?]

(C) evaluate the impact of research on scientific thought, society, and the environment [Slides 20, 26, 28, 29, 32, 35 - How have findings such as Dr. Tilman's changed our ideas and practices regarding the conservation and use of natural resources? How might this research affect the efforts of future scientists?];

(4) Science concepts. The student knows the Earth's unique characteristics and conditions. The student is expected to:

(B) analyze conditions on Earth that enable organisms to survive [What conditions does Dr. Tilman describe as essential to life on earth? What factors threaten the earth's capacity to support life? How has human domination of ecosystems affected the earth's capacity to support life?].

(5) Science concepts. The student knows about the formation and history of the Earth. The student is expected to:

(A) research and describe the historical development of scientific theories of the Earth's formation [Describe the historical development of the concept ecosystem services. Which scientists does Dr. Tilman cite as being responsible for this development? When did experiments first develop to test scientists' ideas about ecosystem services and biodiversity? What ideas and practices have changed as a result of this knowledge?]; and

(9) Science concepts. The student knows the role of natural energy resources. The student is expected to:

(B) analyze issues regarding the use of fossil fuels and other renewable, non-renewable, or alternative energy resources [Slides 3, 4, 6, 10, 18 – When we think of non-renewable resources, we often think of fossil fuels or precious metals. What other resources do we use which are limited not so strictly by how much, but by how often and how carefully we use them? What resources do we now consider scarce that were once abundant (when fewer people occupied the earth)? Slide 11 – How might biological diversity be considered an energy resource, or how does it contribute to our energy needs (i.e. food)? Is biological diversity a renewable or non-renewable resource?]; and

(10) Science concepts. The student knows the interactions that occur in a watershed. The student is expected to:

(B) analyze the impact of floods, droughts, irrigation, and industrialization on a watershed [Slide 19 – What are the environmental effects of increased fertilization? Slides 15, 16 - Where, when, and why has increased fertilization occured? What are the effects of irrigation on water supply? Slide 14 – If the results of irrigation and industrialization are so clearly harmful to the earth's ecosystems, why do people continue to clear land for these purposes? How might the benefits of irrigation and industrialization be weighed against the environmental impacts of such activities? Slides 22-25, 28-29, 32, 35 – Are there ways to continue producing the food and energy needed to sustain human life without threatening the earth's capacity to sustain life? Why is this necessary?]; and

(12) Science concepts. The student knows the characteristics of the atmosphere. The student is expected to:

(B) analyze the range of atmospheric conditions that organisms will tolerate including types of gases, temperature, particulate matter, and moisture [Slide 20 – Why does nitrogen pollution cause loss of diversity in an ecosystem? Slide 19 - What effect does phosphorous have on freshwater ecosystems? Slide 28-29 – How might we use the capacity of oceans and forests to store carbon?; and

(C) determine the impact on the atmosphere of natural events and human activity [Slides 12, 28-29 Which human activities contribute to elevated levels of CO_2 in the earth's atmosphere? How can we use natural processes to help curb the rise of CO_2 levels? Why is it important to do this?].