| **Indiana Dunes**  **Education** | National Park Service  U.S. Department of the Interior  **Indiana Dunes National Lakeshore**  **Education Department** | National Park Service Logo |
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**Secrets of Succession**

**Summary:**

Follow the legacy of early dunes’ scientist Henry Chandler Cowles and hike on the beach over foredunes and through forests. By exploring diverse ecosystems, students will discover the forces that shape the dunes and produce this unique succession of plants.

**Objectives:** students will be able to

1. Describe the plant and animal species which characterize each successional stage of the dunes.
2. Name three ways in which plants and animals in the dunes change the environment, allowing other plants and animals to succeed them.
3. Explain the affect of human and natural erosion on the process of succession.
4. Relate the abiotic measurements to trends in biological communities.
5. Define succession, humus, community, disturbance, adaptation, and glacier.



**What to expect on during your trip:**

1. Group arrives at the West Beach unit.
2. A brief introduction is given, and the moderate to strenuous hike begins. Some flexibility is possible to accommodate physical ability. Let rangers know beforehand if your group has any special needs or requirements.
3. Students will be engaged in exploration activities to learn about the special features in the dunes throughout the 1.5 to 2 hour hike

**Setting:**

West Beach is located in Portage, Indiana; Porter County on County Line Road. The Succession Trail is about 1 mile long and includes walking in sand and on flights of stairs. Restrooms and picnic shelters are available at this site. Other hiking trails are available for use in this area if a group wishes to hike on their own before or after the program

**Grade:**

5th – 12th grade.

**Ratio of students to ranger:**

30 or less is ideal; we will try to accommodate larger groups within reason due to staffing levels. Please provide one adult chaperone for every ten students for safety purposes

**Safety Issues:**

Poison ivy, slivers on boardwalks, seasonal heat or cold, safety on stairs and dunes. Some adults and children may have difficulty walking the trails and climbing the dunes. Bring sunscreen, insect repellant and lots of water when hiking any of the park’s trails. Students should dress for the weather and wear shoes suitable for hiking.

**Background Information:**

**Geology:** The first dunes of Indiana were formed approximately 15,000 years ago when the last of the Ice Age glaciers swept down from the north. As the climate warmed, the movement of the glacier was halted, and a glacial deposit called a moraine was formed. This moraine acted as a dike holding back the water of the melting glacier forming what is now Lake Michigan. Waves, wind and plants have all combined to bring sand to the southern and eastern shores of Lake Michigan and begin the dune building process. The process of dune building that began over 15,000 years ago is still continuing today. Through the dynamic process of succession, a variety of biological communities succeed one another on the dunes of West Beach. Each community changes the physical and biological environment making conditions suitable for the next community.

The shoreline of the new lake first stood at 640 feet elevation, but this was only temporary. The increasing influx of meltwater from the ice to the north soon caused the lake to breach its morainic dam near what is now the southwest part of Chicago. As water passed out of the opening in the moraine and down the DesPlaines and Illinois valleys, the level of ancestral Lake Michigan fell. A new, lower lake level was established when the down-cutting of the DesPlaines River was stabilized by a boulder-rich zone with the Valparaiso Moraine. The new lake level, which stabilized at 620 feet was also only temporary. When the boulder field near southwest Chicago was breached, the lake began to lower again until a third level at 605 feet was reached. This resulted because the down cutting of the Illinois River and its tributaries virtually ceased when the river reached bedrock. This third lake level was to be the last stage of ancestral Lake Michigan.

By this time, the glaciers had completely left the Lake Michigan Basin. A new drainage was opened at the Straits of Mackinac, to the north, which was lower than the outlet at Chicago and continues to be the principal drainage of the lake up to the present.

Geologists refer to the three lake levels of ancestral Lake Michigan as the following: 1) Glenwood at 640 feet elevation; 2) Calumet at 620 feet; and 3) Tolleston at 605 feet.

At each of these lake stages, beaches and their accompanying foredunes are preserved. The transition to modern day Lake Michigan was a gradual one involving numerous rises and falls of the lake level. Even today the lake level is not fixed, as can be seen by a two to three foot rise during the past several years. The average level of Lake Michigan over the past 100 years is about 578 feet above sea level.

Succession: Sand dunes start as bare sand, then become dunes with grass helping to hold them in place. Over time, shrubs and trees are able to take root. As more time passes, a full forest, also called a climax forest, is able to grow at the back edge of a dune system. The change in ecosystems that takes place over time is called succession.

During succession, a series of changes occurs in the ecological community that inhabits a region. Succession happens because the activities of living organisms and abiotic factors change the conditions of a region so that it becomes more inhabitable by a different group of organisms. In sand dunes, an example of the changing communities is beach, foredune, interdunal pond, forested back dune. If marram grass takes root on a beach, its roots will begin to trap sand, causing small dunes to form. This then sets the stage for additional plant and animal life to inhabit the dunes. A progression of plant communities is found on the dunes along the south shore of Lake Michigan.

Moving from beach to oak forest in the dunes, the amount of sunlight decreases. This is due to the community plant composition. Near the lake, sun-tolerant cottonwoods and grasses are found. In the oak forest are found shade-tolerant oak, witch hazel, and other broad-leaved trees and shrubs. Sunlight, evaporation, and transpiration decrease from beach to oak forest, while the amount of moisture available to the soil increases. Since there is a greater quantity of organic material in the soil progressing from beach to oak forest, the soil is more capable of holding moisture.

The vegetation controls the amount of sunlight striking the ground. As the plants grow, they create shade, which modifies the light and moisture conditions on the ground. Trees are sometimes observed with unusual bent or twisted growth patterns resulting from their competition for available sunlight.

Dune grasses have adapted ways to reproduce and spread. They may have underground runners and the ability to shoot up new stems to prevent sand burial. Others produce enormous quantities of seeds which travel by wind. In the foredunes, a greater part of the plant is underground. This enables plants to capture and hold sand in place to build dunes.

**Prerequisite Classroom Activities:**

Prior to your visit to Indiana Dunes National Lakeshore, please take a moment to read through the information listed below. We suggest that you do one or more of the described activities with your class in order to prepare them for the lessons and experiences they will have during their field trip. If there is a special topic or area that you want the ranger to cover during the presentation, please contact the park’s scheduling office, and every effort will be made to accommodate your request.

**Activity 1:** Practice data collection with your group to prepare them for their field experience at the park. Use data such as height, shoe size, hair color, eye color, etc. After recording the data, break into small groups to summarize their findings. Each group should present their conclusions orally to the class.

**Activity 2:** Use field guides around the school to become familiar with using them. Research the organisms listed on the **attached student data sheet** and try to determine any special adaptations those organisms might have to help them survive in the five different successional stages of the dunes.

**Activity 3:** Ask each student to dig up and bring into class a plant from his or her yard along with a small amount of the soil from which it came. Make sure to dig up the roots as well as the other plant parts. Study the various parts of the plant and especially notice the roots. Students should describe the soil sample. Discuss how different soil types require different root structures for plants.

**Activity 4:** Study various soil types common to your area. Soil surveys of your county should be available from your local soil conservation service office. These provide detailed soil descriptions, aerial photos and many other types of information. Pay particular attention to information pertaining to soil formation. You may want to allow some freedom to allow the students to find their town or their house on the photos.

**Activity 5:** Students examine a map or atlas of the world and find other areas which have sand dunes. Compare the differences and similarities between these areas and the southern shore of Lake Michigan. Have students work in groups to research a park and present their findings to the class. Beginning in the United States, students can research the differences and similarities between our Indiana dunes with those found at the following national parks:

* Sleeping Bear Dunes National Lakeshore—www.nps.gov/slbe
* Great Sand Dunes National Monument and Preserve—www.nps.gov/grsa
* White Sands National Monument—www.nps.gov/whsa
* Pictured Rocks National Lakeshore—www.nps.gov/piro
* Cape Cod National Seashore—www.nps.gov/caco

**Vocabulary:**

**ABIOTIC –** Non living.

**ADAPTATION –** Change in an organism or its parts that fits it better for the conditions of its environment.

**CLIMAX COMMUNITY** - The final, most mature and stable community (sere) possible under existing environmental conditions.

**COMMUNITY** - A group of plants and animals which thrive and work together in a specific area.

**ECOSYSTEM -** Interacting communities and abiotic components

**GLACIER** - A sheet of moving ice which lasts through the yearly dry period. Continental glaciers, such as the one which produced Lake Michigan, were a mile thick and covered Indiana Dunes 12,000 years ago. When they melted, this formed the shoreline of ancient Lake Chicago (present day Lake Michigan).

**HABITAT –** The place or environment where a plant or animal normally or naturally lives and grows

**MORAINE** - Rock material of variable size deposited in a ridge by retreating glaciers at their sides (lateral moraine – Sleeping Bear Dunes) or front (terminal moraine – Indiana Dunes area).

**PRIMARY SUCCESSION** - The change in vegetation and animal life over time which naturally occurs as one community is replaced by others. Primary succession begins on barren soil.

**SECONDARY SUCCESSION** - The change in vegetation and animal life in a community which occurs after a human disturbance or a major event such as a fire, flooding, or volcanic event. Secondary succession occurs on formerly vegetated areas.

**SERAL STAGE** - A community in a successional series. The entire sequence of communities is known as a sere.

**SUCCESSION** - The changes in vegetation and animal composition over time through which one population or community is replaces by others in the same location. The process produces a sequence in community types from pioneer stages to a mature or climax community, unless the process is interrupted. The process of succession is often interrupted.

**Indiana Content Standards:**

The *Secrets of Succession* program can assist teachers in meeting the following Indiana standards.

**Fifth Grade**

Process Standards

# The Nature of Science

* Make predictions and formulate testable questions.
* Plan and carry out investigations-often over a period of serveral lessons-as a class,in small groups or independently.
* Perform investigations using appropriate tools and techniques that will extend the senses.
* Use measurement skills and apply appropriate units when collecting data.
* Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models thorough oral and written reports.
* Identify simple patterns in data and propose explanations to account for the patterns.
* Compare the results of an investigation with the prediction.

Content Standard 3

# Life Science.

Core Standard**:** Observe, describe and ask questions about how changes in one part of an ecosystem create changes in other parts of the ecosystem.

**SCI.5.3.1 2010**

Observe and classify common Indiana organisms as producers, consumers, decomposers, predator and prey

based on their relationships and interactions with other organisms in their ecosystem.

**SCI.5.3.2 2010**

Investigate the action of different decomposers and compare their role in an ecosystem with that of producers

and consumers.

**Sixth Grade**

Process Standards

# The Nature of Science

* Make predictions and testable questions based on research and prior knowledge.
* Collect quantitiative data with appropriate tools or technologies and use appropriate units to label numerical data.
* Keep accurate records in a notebook during investigations.
* Compare the results of an experiment with the prediction.
* Compare the results of an investigation with the prediction.
* Communicate findings through oral and written reports by using graphs, charts, maps and models.

Content Standard 3

Life Science.

Core Standard: Describe that all organisms, including humans, are part of complex systems found in all biomes (i.e., freshwater, marine, forest, desert, grassland, dune and tundra)..

**SCI.6.3.1 2010**

Describe specific relationships (i.e., predator and prey, consumer and producer, and parasite and host) between

Organisms and determine whether these relationships are competeitive or mutually beneficial.

**SCI.6.3.2 2010**

Describe how changes caused by organisms in the habitat where they live can be beneficial or detrimental to themselves or to native platns and animals.

**SCI.6.3.3 2010**

Describe how certain biotic and abiotic factors—such as predators, quantity of light and water,

range of temperature and soil composition—can limit the number of organisms an ecosystem can

support.

Core Standard: Understand that the major source of enery for ecosystems is light produced by major nuclear reactions in the sun.

**SCI.6.3.4 2010**

Recognize that plants use energy from the sun to make sugar by the process of photosynthesis

**SCI 6.3.5 2010**

Describe how all animals, including humans, meet their energy needs by consuming other organisms, breaking down their structures, and using the materials to grow and function.

**Sixth - Eighth Grade**

Reading Standards for Literacy in Science

Key Ideas and Details

**6-8.RS.2**

Determine the central ideas of conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

**6-8.RS.3**

Follow precisely a multistep procedure when carrying out experiments or taking measurements.

Craft and Structure

**6-8.RS.6**

Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experimkent in a text.

**6-8.RS.8**

Distinguish among facts, reasoned judgment based on research findings and speculaiton in a text.

Writing Standards for Literacy in Science

*Students need to be able to use writing as a key means to defend and assert claims, showing what they know about a subject and conveying what they have experienced, imagined, thought, and felt. They must be adept at gathering information, evaluating sources and citing material accurately, reporting fidings from their research and analysis of sources in clear manner.*

Text Types and Purposes

# 6-8.WS.1

Write arguments to focus on discipline-specific content.

b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

**6-8.WS.3**

Note: Students’ narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts.

Research to Build and Present Knowledge

**6-8.WS.9**

Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

# 6-8.WS.10

Write routinely over extendd time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific taskes, purposes, and audiences.

Process Standard

Reading for Literacy in Science

Key Ideas and Details

**6-8.RS.2**

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

**6-8.RS.3**

Follow precisely a multistep procedure when carrying out experiments or taking measurements.

**6-8.RS.6**

Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas

**6-8.RS.8**

Distinguish among facts, reasoned judgment based on research findings and speculation in a text.

Process Standards

Writing for Literacy in Science

Text Types and Purposes

**6-8.WS.1**

Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. Provide a concluding statement or section that follows from and supports the argument presented.

**6-8.WS.3**

Note: Students’ narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In science, students must be able to write precise enough descriptions of the step-by-step procedures they use in the investigations that others can replicate them and (possible) reach the same results.

Range of Writing

# 6-8.WS.10

Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

**Seventh Grade**

Process Standards

The Nature of Science

* Make predictions and testable questions based on research and prior knowledge.
* Collect quantitiative data with appropriate tools or technologies and use appropriate units to label numerical data.
* Keep accurate records in a notebook during investigations.
* Compare the results of an experiment with the prediction.
* Compare the results of an investigation with the prediction.
* Communicate findings through oral and written reports by using graphs, charts, maps and models.
* Content Standards

Standard 1:PhysicalScience

Core Standard: Explain that energy cannot be created or destroyed but instead can only be changed from one form into another or transferred from place to place.

# 7.1.2

Describe and give examples of how energy can be transferred from place to place and transformed from one form to another through radiation, convention and conduction.

**7.1.3**

Recognize and explain how different ways of obtaining, transforming and distributing energy have different environmental consequences.

# Science

Standard 2: Earth and Space Systems

Core Standard: Describe how earth processes have shaped the topography of the earth and have made it possible to measure geological time.

**SCI.7.2.6** **2010**

Describe physical and chemical characteristics of soil layers and how they are influenced by the process of soil formation (including the action of bacteria, fungi, insects and other organisms).

**SCI.7.2.7 2010**

Use geological features such as karst topography and glaciation to explain how large-scale physical processes have shaped he land.

**Eight Grade**

***\*****Students in eighth grade study the water cycle and the role of the sun’s energy in driving this process . . .* ***\*****Students study the physical properties of natural and engineered materials.* ***\*****Within this study students employ the key principles of the nature of science and the design process.*

# Process Standards

The Nature of Science

* Make predictions and develop testable questions based on research and prior knowledge.
* Plan and carry out investigation—often over a period of several class lessons—as a class, in small groups or independently.
* Collect quantitative data with appropriate tools or technologies and use appropriate units to label numerical data.
* Incorporate variable that can be changed, measured or controlled.
* Use the principles of accuracy and precision when making measurements.
* Test predictions with multiple trials.
* Keep accurate records in a notebook during investigations.
* Communicate findings through oral and written reports by using graphs, charts maps and models.
* Process Standards

The Design Process.

* Identify a need or problem to be solved.
* Brainstorm potential solutions.
* Select a solution to the need or problem.

Content Standards

Science

Standard 2: Earth and Space Systems

Core Standard**:** Explain how the sun’s energy heats the air, land and water and drives the processes that result in wind, ocean currents and the water cycle.

# 8.2.2

Describe and model how water moves through the earth’s crust, atmosphere and oceans in a cyclic way as a liquid, vapor and solid.

**SCI.8.2.5 2010**

Describe the conditions that cause Indiana weather and weather-related events such as tornadoes, lake effect snow, blizzards, thunderstorms and flooding.

**SCI.8.2.6 2010**

Identify, explain and discuss some effects human activities (e.g., air, soil, light, and noise and water pollution) have on the biosphere.

Core Standard: Describe how human activities have changed the land, water, and atmosphere.

**SCI.8.2.7 2010**

Recognize that some of Earth’s resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

**SCI.8.2.8 2010**

Explain that human activities, beginning with the earliest herding and agrcultural activities, have drastically changed the environment and have affected the capacity of the environment to support native species. Explain current efforts to reduce and eliminate these impacts and encourage sustainability.

Standard 3: Life Science

Core Standard Explain how a particular environment selects for traits that increase the likelihood of survival and reproduction by individuals bearing those traits.

**SCI.8.3.8 2010**

Examine traits of individuals within a population of organisms that may give them an advantage in survival and reproduction in given environments or when the environments change.

**SCI.8.3.9 2010**

Describe the effect of environmental changes on populations of organisms when their adaptive characteristics put them at a disadvantage for survival. Describe how extinction of a species can ultimately result from a disadvantage.

**High School**

**9-10th Grades**

Process Standards

Earth and Biology Science

Earth Space: Reading Standards for Literacy in Science

Key Ideas and Details

**9-10.RS.1**

Cite specific textual evidence to support analysis of science texts, attending to the precise *details* of

explanations or descriptions.

**9-10.RS.2**

Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurte summary of the text.

Craft and Structure

**9-10.RS.4**

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to grades 9-10 texts and topics.

**9-10.RS.5**

Analyze the structure of the relationships among concepts in a text, including relationships among key terms.

Integration of Knowledge and Details

**9-10.RS.9**

Compare and contrast findings pressented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Earth Space:

Writing Standards for Literacy in Science

Text Types and Purposes

**9-10.WS.1**

Write arguments focused on *discipline-specific content.*

c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

e. Provide a concluding statement or section that follows from or supports the augument presented.

Production and Distribution of Writing

**9-10.WS.4**

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Research to Build and Present Knowledge

**9-10.WS.7**

Conduct short as well as more sustained research projects to answer a question (including a self-generated

question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Range of Writing

**9-10.WS.10**

Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or day or two) for a ranger of discipline-specific tasks, purposes, and audiences.

Content Standards

Earth Science

Standard 1: The Universe

Core Standard: Describe the age, origin and evolution of our solar systm and describe the characteristics of objects in the solar system.

**ES.2.3**

Recognize that the sun is the main source of external energy for the Earth. Describe the cycles of solar energy and some of their impacts on the Earth.

Standard 3: The Earth and Space Science I

The Earth

Core Standard: Recognize and describe that earth sciences address planet-wide

interacting systems (e.g., the oceans, the air solid ground, and life on Earth) and

interactions with the solar system.

**SCLES.3.1** **2010**

Understand that the Earth system contains fixed amount of each stable chemical element and that each element

moves among reservoirs in the solid earth, oceans, atmosphere and living organisms as part of biogeochemical

cycles (i.e., nitrogen, water, carbon, oxygen and phosphorus cycles), which are driven by energy from within the earth and from the sun.

**SCLES.3.2** **2010**

Demonstrate the possible effects of atmospheric changes brought about by natural and human-made processes.

**SCLES.3.3 2010**

Identify and differentiate between renewable and nonrenewable resources present within Earth’s systems.

Describe the possible long-term consequences that increased human consumption has places on natural processes that renew some resources.

Core Standard: Examine the interrelationships between society and the planet-wide interacting systems and understand the basic physical and chemical laws that control these interactions.

# SCLES.3.4 2010

Recognize that fundamental physical and chemical laws control past, present and future dynamic interactions

between and within Earth systems.

Standard 4: The Atmosphere and Hydrosphere

Core Standard: Understand the structure and circulation of Earth’s atmosphere and hydrosphere And explain how natural and human factors may interact with these processes.

**ES.4.1**

Examine the origins, structure, composition, and function of Earth’s atmosphere. Include the role of living organisms in the production and cycling of atmospheric gases.

**ES.4.2**

Describe the relationships among evaporation, preciptitation, ground water, surface water, and glacial systems in the water cycle. Discuss the effect of human interactions with the water cycle.

Core Standard: Understand that both weather and climate involve the tranfer of matter and energy throughout the atmosphere and hydrosphere, driven by solar energy and gravity.

**ES.4.3**

Explain the importance of heat trasfer between and within the atmosphere, land masses, and bodies of water.

Standard 5: The Solid Earth

Core Standard: Understand the structural and compositional layers of the earth, its magnetic field, and how this knowledge is ased on data from diret and indiret observation

**SCI.ES.5.1 2010**

Describe the large-scale, compositional layers of the Earth.

**SCLES.5.3 2010**

Compare and contrast the properties of rocks and minerals. Explain the uses of rocks and minerals, particularly

those found in Indiana, in daily life.

**SCI.ES.5.4 2010**

Illustrate the various processes involved in the rock cycle and discuss the conservation of matter during formation, weathering, sedimentation and reformation

Core Standard: Understand how the processes of rock formation, weathering, sedimentation, and reformation continually shape the surface of the Earth.

**ES.5.6**

Understand the role of changing sea level and climate in the formation fo the sedimentary rocks of Indiana.(note: we use lake level in our program)

**ES.5.7**

Explain how sea level changes over time have exposed continental shelves, created and destroyed in land seas,and shaped the surface of the land. (note: we use lake level changes over time have exposed the old lake bottom or created sand dune ridges)

Standard 6: Earth Processes

Core Standard: Understand the cyclical nature of processes that modify the Earth and how humans interact with these cycles.

**ES.6.1**

Investigate and discuss how humans affect and are affected by geological systems and processes.

**ES.6.2**

Differentiate among the processes of weathering, erosion, transportation of materials, deposition and soil formation.

Content standards

Biology

Standard 3: Matter Cycles and Energy Transfer

Core Standard: Diagram how matter and energy cycle through an ecosystem.

**B.3.4**

Describe hwo matter cycles through an ecosystem by way of food chains and food webs and how organisms convert that matter into a variety of organic molecules to be used in part in their own cellular structures.

**B.3.5**

Describe how energy from the sun fowls through an ecosystem by way of food chains and food webs and how only a small portion of that enery is used by individual organisms while the majority is lost as heat.

Standard 4: Biology

Interdependence

Core Standard: Describe the relationship between living and nonliving componets of ecosystems and describe how that relationship is in flux due to natural changes and human actions.

**SCI.B.4.1 2010**

Explain that the amount of life environments can support is limted by the available energy, water, oxygen and minerals and by the ability of ecosystems to recycle the remains of dead organisms.

**SCI.B.4.2 2010**

Describe how human activities and natural phenomena can change the flow and of matter and energy in an ecosystem and how those changes impact other species.

**SCI.B.4.3 2010**

Describe the consequences of introducing non-native species into an ecosystem and identify the impact it may have on that ecosystem.

**B.4.4**

Describe how climate, the pattern of matter and energy flow, the birth and death of new organisms, and the interaction between those organisms contribute to the long-term stability of an ecosystem.

Standard 8: Evolution

Core Standard: Describe how modern evolutionary theory provides an

explanation of the history of ilfe on earth and the similarities among organisms that exist today.

**B.8.5**

Describe how organisms with benefical traits are more likely to survive, reproduce, and pass on their genetic information due to genetic variations, environmental forces and reproductive pressures.

**B.8.7**

Describe the modern scientific theory of the origins and history of life on earth and evaluate the evidence that supports it.

**Extension or Follow-up Activity**

Class reflection paper or writing sample:

Ask each student to write a short essay, letter or story about what they learned on their field trip to Indiana Dunes National Lakeshore. Rangers love receiving mail from their students. Send the ranger the packet of essays from your class (or a copy of them), and your ranger will send your class a certificate from the dunes. Send your essays to:

Indiana Dunes National Lakeshore

1100 N. Mineral Springs Road

Porter, IN 46304

Attn: Your ranger’s name or just Education Department

If you are using this essay as a class assignment for a grade, we would like to suggest that each essay contain the following elements. Use the rubric below to score them.

\* The name of the park and the location of their field trip—for example: Douglas Center, Indiana Dunes National Lakeshore

\* Three facts they learned on the field trip about the habitats of the dunes.

\* A brief explanation of why Indiana Dunes is unique and therefore a national park.

\* At least two things the student can do to help take care of his or her national park.

\* Fill in the blank of this statement and provide an explanation:

I would like to learn more about \_\_\_\_\_\_\_\_\_\_ at Indiana Dunes.

\*\*\* For advanced groups, add the following element:

Tell the park rangers if you would like to bring your families and friends to the dunes and if so what would you do here and where would you go.

**Assessment:**

**Grading for Class reflection writing assignment:**

1. **Writing and organization**- ***4 points*** the writing sample is very well written and organized by the elements provided. It has a strong introduction, middle and conclusion. ***3 points*** the writing sample is well written and organized by the elements provided. It includes an introduction, middle and conclusion. ***2 points*** the writing sample is choppy and is not well organized. It lacks an introduction or conclusion. ***1 point***the writing sample is very short and unorganized.
2. **Grammar & Spelling-** ***4 points*** Mistakes in spelling and grammar are minor or non-existent. ***3 points*** Mistakes in spelling and grammar are minimal—about 4-5. ***2 points*** mistakes in spelling and grammar are numerous—5-10. ***1 point*** mistakes in spelling and grammar are more than 10**.**
3. **Facts and content**- ***4 points*** the writing sample demonstrates the student’s learning on the dunes program and includes three or more facts provided by the park staff. ***3 points*** the writing sample demonstrates the student’s learning and includes only two facts provided by the park staff. ***2 points*** the writing sample does not demonstrate much learning and only includes one fact provided by the park staff.***1 point*** the writing sample does not demonstrate any learning and does not include any facts provided by the park staff.
4. **National Park Service theme** - ***4 points*** the writing sample clearly demonstrates the student’s understanding of the role of the NPS in preserving the dunes by explaining why Indiana Dunes is such a unique treasure.***3 points*** the writing sample mentions the NPS and its role in preserving the Indiana Dunes. ***2 points*** the writing sample mentions the NPS and Indiana Dunes. ***1 point*** the writing sample does not mention anything about the NPS or its role at Indiana Dunes
5. **Stewardship-** ***4 points*** the writing sample lists three things the student can do to assist in taking care of the Indiana Dunes. ***3 points*** the writing sample lists two things the student can do to assist in taking care of the Indiana Dunes. ***2 points*** the writing sample lists one thing the student can do to assist in taking care of the Indiana Dunes. ***1 point*** the writing sample does not list anything about what the student can do to take care of the Indiana Dunes.