



Secrets of Succession

Summary

Follow the legacy of early dunes scientist Henry Chandler Cowles and hike from 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, community, sere, climax community, primary and secondary succession, moraine, and glacier (during pre-visit work).



What to Expect during Your Field 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 throughout the two hour, mile-long trail to learn about the special features of the dunes.

Setting: West Beach is located in Portage, Indiana. The Succession Trail is about one mile long and includes walking in sand and on steep 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. A trail map will be provided upon request. Portions of the trail are wheelchair accessible, and two sand wheelchairs are available for use at this location.

Grade: 6th-12th grade

Ratio of Students to Ranger: 30 (or less) to 1; up to 120 students may be accommodated if 4 rangers available. Please provide one adult chaperone for every ten students for safety purposes.

Safety Issues: Poison ivy, slivers on boardwalks, seasonal heat or cold, safety, stairs, and dune climbs can be problematic. Some adults and children may have difficulty walking the trails and climbing the dunes. Bring sunscreen, insect repellent, and lots of water when hiking any of the park's trails. Students should dress for the weather and wear shoes suitable for hiking.

For More Information: See the park's education website at www.nps.gov/indu/forteachers/. Contact the park's scheduling office at (219) 926-7561, ext. 243.

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 to begin the dune building process. The process of dune building that began so long ago continues 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 high, 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 Valpariaso 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 was caused by the downcutting of the Illinois River. 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. Today, this drainage is still the principal drainage of the lake.

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) Tollestonat 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 evidenced by a two to three foot rise during the past several years. The mean average level of Lake Michigan over the past 100 years is about 585 feet.

Succession: 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 grow. Shade-tolerant oak, witchhazel, and other broad-leaved trees and shrubs grow in the oak forest. 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 sometimes have unusual bent or twisted growth patterns, which results 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. 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

Great Lakes in My World

The attached activities are from the “Great Lakes in My World” curriculum guide, produced by the Alliance for the Great Lakes. You can find more information about the curriculum guide and how to order it on the Alliance’s website: www.greatlakes.org.

Indoor Dunes, pages 120-127 (6th–8th grade)

Succession Circles, pages 133-136 (6th–8th grade)

Dune Decisions, pages 137-140 (4th–8th grade)

Dune Mining Debate, pages 141-148 (6th–8th grade)

Vocabulary

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

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).

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 that occurs after a human disturbance or a major event such as a fire, flooding, or volcanic event. Secondary succession occurs on formerly vegetated areas.

SERIAL 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 replaced 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.

Follow-up Activity

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 suggest that each essay contain the following elements. **Use the rubric on the next page 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 dunes and biological succession
- 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

Rubric for student reflection writing assignment.

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

Illinois Content Standards

The *Secrets of Succession* program can assist teachers in meeting the following Illinois Standards in science.

State Goal 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

Know and apply the concepts, principals and processes of scientific inquiry.

11.A.2b Collect data for investigations using scientific process skills including observing, estimating and measuring.

State Goal 12: Understand the fundamental concepts, principals and interconnections of the life, physical and earth/space sciences.

Know and apply concepts that explain how living things function, adapt and change.

12.A.2a Describe simple life cycles of plants and animals and the similarities and differences in their offspring.

Know and apply concepts that describe how living things interact with each other and with their environment

12.B.2a Describe relationships among various organisms in their environments (e.g., predator/prey, parasite/host, food chains and food webs).

12.B.2b Identify physical features of plants and animals that help them live in different environments (e.g., specialized teeth for eating certain foods, thorns for protection, insulation for cold temperature).

12.B.3a Identify and classify biotic and abiotic factors in an environment that affect population density, habitat and placement of organisms in an energy pyramid.

12.B.3b Compare and assess features of organisms for their adaptive, competitive and survival potential (e.g., appendages, reproductive rates, camouflage, defensive structures).

12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms.

12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction.

Know and apply concepts that describe the features and processes of the Earth and its resources.

12.E.2a Identify and explain natural cycles of the Earth's land, water and atmospheric systems (e.g., rock cycle, water cycle, weather patterns).

12.E.2b Describe and explain short-term and long-term interactions of the Earth's components (e.g., earthquakes, types of erosion).

12.E.5 Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations).

State Goal 13: Understand the relationships among science, technology and society in historical and contemporary contexts.

Know and apply the accepted practices of science.

13.A.2c Explain why keeping accurate and detailed records is important.

13.A.3c Explain what is similar and different about observational investigations.

Know and apply concepts that describe the interaction between science, technology and society.

13.B.2a Explain how technology is used in science for a variety of purposes (e.g., sample collection, storage and treatment; measurement; data collection, storage and retrieval; communication of information).

13.B.2e Identify and explain ways that technology changes ecosystems (e.g., dams, highways, buildings, communication networks, power plants).

13.B.2f Analyze how specific personal and societal choices that humans make affect local, regional and global ecosystems (e.g., lawn and garden care, mass transit).

13.B.3c Describe how occupations use scientific and technological knowledge and skills.

13.B.3d Analyze the interaction of resource acquisition, technological development and ecosystem impact (e.g., diamond, coal or gold mining; deforestation).

13.B.3e Identify advantages and disadvantages of natural resource conservation and management programs).

Student Fact Sheet

ORGANISM LISTS FOR EACH COMMUNITY FOUND IN THE DUNES:

UNDISTURBED UPPER BEACH

PLANTS

sea rocket
bugseed
cocklebur
winged pigweed
seaside spurge

ANIMALS

ring-billed gull
herring gull
carrion flies
raccoons
sanderlings
spotted sandpipers
robber flies
tiger beetles

FOREDUNE – COTTONWOOD COMMUNITY

PLANTS

marram grass
sand reed grass
prickly pear cactus
sand thistle
cottonwood trees
little bluestem
sand cress
sand cherry
horsemint
goldenrod
hoary puccoon
milkweed
evening primrose
poison ivy
riverbank grape
bittersweet

ANIMALS

velvet ant
white tiger beetle
white grasshopper
digger wasp
ant lion
field sparrow
snout beetle
killdeer
short-tailed shrew
deer mice
six-lined race runner
fowler's toad

JACK PINE COMMUNITY

PLANTS

jack pine
common juniper
red-osier dogwood
arctic bearberry
hop tree
riverbank grapes
poison ivy
bittersweet
solomon's seal

ANIMALS

burrowing spider
black ant
six-lined race runner
blue racer
garter snakes
bronze tiger beetle
pitch moth
great horned owl
evening grosbeak
chickadee
pine siskin
red crossbill

BLACK OAK COMMUNITY

PLANTS

witch hazel
black oak
basswood
sassafras
virginia creeper

ANIMALS

raccoon
skunk
red and grey squirrel
chipmunk
woodchuck
cottontail rabbit
white-tailed deer
scarlet tanager
brown thrasher
wood thrush
millipede
centipede

INTERDUNAL PONDS

PLANTS

sedges
common cattail
bulrush
st. john's wort
stiff Aster
purple gerardia
rose pink
kalm's lobelia
yellow horned bladderwort
ladies' tresses

ANIMALS

water treader
water strider
water boatman
whirligig beetle
damselfly
dragonfly
painted turtle