INDIANA DUNES EDUCATION

National Park Service
U.S. Department of the Interior

Indiana Dunes National Park
Education Department

A Grain of Truth

Summary:

Observe howling winds and powerful waves creating, shaping, eroding and moving sand dunes. Hike approximately one mile along beach and foredune trails to see and learn about the processes of glaciation, erosion, and dune building. Take time to sit and use your senses to experience the beauty of the dunes. The specific activities and interpretive techniques used will be adapted to the experience and abilities of the group and special circumstances that may exist on the day of the program.

Objectives: students will be able to:

1. Describe the role of glaciers in the formation of Lake Michigan.

2. Explain how waves, wind, and plants help form and shape the dunes.

3. Describe what they observed, heard and felt while exploring the dunes and beach.

4. Give examples of how humans can help protect the dunes.

5. List at least three plants found on the dunes.

Setting:

At West Beach for 1.5 hrs. The trail is about one mile in length and requires stair climbing. Restrooms and picnic shelters are available. The beach is life-guarded during the summer.

Age/grade:

4th-12th grade

Ratio of students to ranger:

30 is ideal; groups can be large to staffing limitations.

Safety issues:

Poison ivy, seasonal excessive heat or cold, safety on stairs.

What to expect during your field trip:

Group arrives at West Beach for the program.The program is completely outside. Students will be engaged in exploration activities to learn about the special features in the dunes. After the conclusion, the group is welcome to have lunch in the nearby picnic shelter.

Background Information:

GEOLOGY OF THE DUNES: 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 southward 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 melting ice to the north soon caused the lake to breach its moranic dam near what is now the southwest part of Chicago. As water passed out of the opening in the moraine and down the Des Plaines and Illinois valleys, the level of Ancestral Lake Michigan fell. A new, lower lake level was established when the down-cutting of the Des Plaines 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 resulted because the downcutting 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 Strait 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:

Glenwood: 640 feet   Calumet: 620 feet   Tolleston: 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 mean average level of Lake Michigan over the past 100 years is about 585 feet elevation.

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.

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.

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

"Dune Journey", pg. 98 (3^{rd}-6^{th} grade)

"Sand Study", pg. 105 (3^{rd}-6^{th} grade)

"Moving Sand", pg. 110 (4^{th}-8^{th} grade)

Other possible activities:

Activity 1) Students pretend they are a grain of sand and write a story on how they would travel across Lake Michigan to West Beach or Mt. Baldy.

Activity 2) Students study a map 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.

Activity 3) Students make a list and discuss the uses of sand by humans.

Activity 4) Students make a poster which urges people to protect the dunes of Indiana.

Activity 5) Students research one of the common plants of the dunes listed below. They should find out what it looks like, what kind of plant it is (tree, shrub or flower) and if it has any special adaptations for survival.

Vocabulary and Common Plant Listing:

adaptation – something that a plant or animal has or does that enables it to survive.

beach – the sandy, pebbly, or rocky shore of a body of water.

decompose – to cause chemical disintegration of organic matter

dune – a ridge or hill of wind-blown sand.

glacier – a large body of ice moving slowly down a slope or valley or spreading outward on a land surface. Usually carrying, pushing, or depositing loose rock and other debris and eroding land forms along the way. The perennial snowfield, on which falling snow is converted to a granular icy mass through the pressure of successive snowfalls and through the freezing of seasonal melt water becomes solid ice, and flows plastically downward to form the body of the glacier. This grows or shrinks according to whether snowfall exceeds the rate of melting or not.

panne – a pond that is located within a dune complex.

rhizome – a rootlike, usually horizontal stem growing under or along the ground that sends out roots from its lower surface and leaves or shoots from its upper surface.

sand – loose, granular, gritty particles of worn or disintegrated rock, finer than gravel and coarser than dust.

Plants common to the dunes:

Beach Community:

Bugseed
Russian thistle
Seaside spurge
Sea-rocket
Winged pigweed

Foredune Community:

Artic Bearberry
Common milkweed
Cottonwood tree
Fragrant sumac
Hairy puccoon
Hop tree
Horse mint
Jack pine
Little Bluestem grass
Marram grass
Pasture rose
Poison ivy
Prickly pear
Riverbank grape
Sand cherry
Sand cress
Sand thistle
Wormwood

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

Assessment:

Grading for Class reflection writing assignment:

<u>Writing and organization-</u> **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.

<u>Grammar & Spelling-</u> **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.

<u>Facts and content-</u> **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.

<u>National Park Service theme</u> - **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.

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.

Indiana:

4th Grade: Science

Earth and Space Science

- **4.ESS.3** 2016 - Describe how geological forces change the shape of the land suddenly and over time.
- **4.ESS.4** 2016 - Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.

Life Science

- **4.LS.2** 2016 - Use evidence to support the explanation that a change in the environment may result in a plant or animal will survive and reproduce, move to a new location, or die.

5th Grade: Science

Earth and Space Science

- **5.ESS.3** 2016 - Investigate ways individual communities within the United States protect the Earth's resources and environment.

Life Science

- **5.LS.1** 2016 - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- **5.LS.2** 2016 - Observe and classify common Indiana organisms as producers, consumers, decomposers, or predator and prey based on their relationships and interactions with other organisms in their ecosystem.

6th Grade: Science

Life Science

- **6.LS.1** 2016 - Investigate and describe how homeostasis is maintained as living things seek out their basic needs of food, water, shelter, space, and air.
- **6.LS.2** 2016 - Describe the role of photosynthesis in the flow of energy in food chains, energy pyramids, and food webs. Create diagrams to show how the energy in animals' food used for bodily processes was once energy from the sun.
- **6.LS.3** 2016 - Describe specific relationships (predator/prey, consumer/producer, parasite/host) and symbiotic relationships between organisms. Construct an explanation that predicts why patterns of interactions develop between organisms in an ecosystem.

- **6.LS.4** 2016 - Investigate and use data to explain how changes in biotic and abiotic components in each habitat can be beneficial or detrimental to native plants and animals.
- **6.LS.5** 2016 - Research invasive species and discuss their impact on ecosystems.

7th Grade: Science

Earth and Space Science

- **7.ESS.1** 2016 - Identify and investigate the properties of minerals. Identify and classify a variety of rocks based on physical characteristics from their origin and explain how they are related using the rock cycle. (i.e. Sedimentary, igneous, and metamorphic rocks)
- **7.ESS.2** 2016 - Construct a model or scale drawing (digitally or on paper), based on evidence from rock strata and fossil records, for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
- **7.ESS.4** 2016 - Construct an explanation, based on evidence found in and around Indiana, for how large-scale physical processes, such as Karst topography and glaciation, have shaped the land.

8th Grade: Science

Life Science

- **8.ESS.2** 2016 - Create a diagram or carry out a simulation to describe how water is cycled through the earth's crust, atmosphere and oceans. Explain how the water cycle is driven by energy from the sun and the force of gravity.
- **8.LS.5** 2016 - Explain how factors affecting natural selection (competition, genetic variations, environmental changes, and overproduction) increase or decrease a species' ability to survive and reproduce.

High School Biology

Interdependence

- **B.3.**2 2016 - Design, evaluate, and refine a model which shows how human activities and natural phenomena can change the flow of matter and energy in an ecosystem and how those changes impact the environment and biodiversity of populations in ecosystems of different scales, as well as, how these human impacts can be reduced.
- **B.3.3** 2016 - Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of

organisms in stable conditions, and identify the impact of changing conditions or introducing non-native species into that ecosystem.

Energy Transfer

- **B.2.3** 2016 - Use mathematical and/or computational representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Earth and Space Science The Solid Earth

- **ES.5.3** 2016 - Construct a model that demonstrates the difference between weathering, erosion, transportation of material, deposition, and new soil and sedimentary rock formation. Differentiate between types of physical and chemical weathering.
- **ES.5.5** 2016 - Create a timeline detailing the processes that have occurred in Indiana to create mostly sedimentary bedrock. Explain how changing sea levels, climate, and glaciation have shaped Indiana geology.

Environmental Science Environmental Policy

- **Env.4.2** 2016 -Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment.

Natural and Anthropogenic Resource Cycles

- **Env.8.1** 2016 - Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world, and explain how natural resources influence relationships among nations.
- **Env.8.2** 2016 -Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.

Illinois:

4th Grade: Science

From Molecules to Organisms: Structures and Processes

- **4-LS1-1** 2017 - Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Earth's Systems

- **4-ESS2-1** 2017 - Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

5th Grade: Science

Energy

- **5-PS3-1** 2017 - Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

From Molecules to Organisms: Structures and Processes

- **5-LS1-1** 2017 - Support an argument that plants get the materials they need for growth chiefly from air and water.

Ecosystems: Interactions, Energy, and Dynamics

- **5-LS2-1** 2017 - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Earth and Human Activity

- **5-ESS3-1** 2017 - Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Middle School: Science

Molecules to Organisms: Structures and Processes

- **MS-LS1-5** 2017 - Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Ecosystems: Interactions, Energy, and Dynamics

- **MS-LS2-1** 2017 - Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- **MS-LS2-2** 2017 - Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- **MS-LS2-3** 2017 - Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- **MS-LS2-4** 2017 - Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
- **MS-LS2-5** 2017 - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

<u>Earth's Systems</u>

- **MS-ESS2-2** 2017 - Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **MS-ESS2-4** 2017 - Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

<u>Earth and Human Activity</u>

- **MS-ESS3-3** 2017 - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*
- **MS-ESS3-5** 2017 - Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

HIGH SCHOOL

Life Sciences

<u>Ecosystems: Interactions, Energy, and Dynamics</u>

- **HS-LS2-1** 2017 - Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **HS-LS2-2** 2017 - Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- **HS-LS2-3** 2017 - Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- **HS-LS2-4** 2017 - Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

- **HS-LS2-5** 2017 - Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- **HS-LS2-6** 2017 - Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- **HS-LS2-7** 2017 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- **HS-LS2-8** 2017 - Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

<u>Biological Evolution: Unity and Diversity</u>

- **HS-LS4-5** 2017 - Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- **HS-LS4-6** 2017 - Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

Earth and Space Sciences <u>Earth and Human Activity</u>

- **HS-ESS3-1** 2017 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-2** 2017 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
- **HS-ESS3-3** 2017 - Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-4** 2017 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
- **HS-ESS3-5** 2017 - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
- **HS-ESS3-6** 2017 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity