Title - Energy in Wind

ideally done after students are familiar with geology units and the rock cycle

Audience - K-2, Formal to Informal Education, Teachers to Naturalists, students and their families, Iowa citizens

Lesson Description - Create your own wind tunnel to investigate the interactions between wind energy and sediment.

***Big Ideas / Big Questions* - Iowa Core, NGSS and Earth Science Literacy** http://www.earthscienceliteracy.org/document.html

1. **The Earth changes over space and time / Why does the Earth Change, Why is it important to track these changes?**
2. **These Earth Changes occur at different scales (space and time, large to small)**
3. **Human actions are capable of changing the Earth's surface at different scales (small to large) / How do human activities change the Earth's natural systems?**

Time Needed to Complete - One or two 50 minute class sessions

Iowa Science Standards -

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happens quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. * [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	Sustainability Implications & Practices
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. ● Ask questions based on observations to find more information about the natural and/or designed world. (K-2- ETS1-1) ● Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2- ETS1-1)	**ESS1.C:** The History of Planet Earth Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1) **ESS2.A**: Earth Materials and Systems Wind and water can change the shape of the land. (2-ESS2-1)	**Patterns** in the natural world can be observed. (2-ESS2-2),(2-ESS2-3) **Stability and Change** Things may change over different scales: space - (small or large) and time (slow or rapid) and (2-ESS1-1),(2-ESS2-1)	**Grade 2 HUMAN Interactions stds?**
Students will… **Identify the big idea and big questions.**	**Students will** **Observe how the Earth changes over time.**	**Students will** **Identify the changes they observe**	**Students will** **Apply knowledge to create sustainable practices**

Student Objectives 1. I can make wind move faster or slower

I-can statements 2. I can move sediment with wind

3. I understand that it takes less energy to move smaller sediment and more energy to move larger sediment

Resources:

Paper (construction or writing.. suggest different colors, densities and/or textures) ,

Glue

Scotch or Duct tape

Straws of different diameters ,

Wind tunnel (shoe box, Tupperware, cereal box)

Evidence of Learning Students will engineer a wind tunnel, conduct experiments and document the effect of wind energy variability on 'sediment' of differing sizes and densities.

5-E Format

Engagement/ Excitement	Open discussion of Wind/energy's contributions to changes on Iowa's surface. Set up, place students into groups of two to three. 1. Provide each group a sediment kit (different pieces of colored paper of differing densities), have discussion (#1) with them abou sediment, what is it, how it forms, why it is important (would ideally relate back to a previous rock cycle/ 'geology' activity) 2. Potential primer video 'hooks' A. https://youtu.be/PJiPmlinKx4 B. https://youtu.be/h8hm8xVoUgw C. https://youtu.be/eyjHpbYiRs4 D. https://youtu.be/ZvAi_piQKNo E.. https://youtu.be/wSXvcveNSTQ
Exploration	1. Work with the students to create sediment from the pieces of paper, tape, glue or other readily available classroom supplies. 2. Hold discussion #1, have the student groups talk about/characterize their sediment. Are they all the same? different? How so? 3. Have a series of pre-constructed cardboard wind tunnels/chutes of varying widths est. open table to 20cm to 5cm, the tunnels h should be around 8cm. 4.Hold discussion #2, ask students how their sediment will move through the the different tunnels, using normal breath, large diameter straws, narrow diameter straws. 5.. Wind tunnel and density balls experimentation. Discussion and application of the scientific method. A good opportunity to intro applied STEM, mathematics, graphing, trial and error, communication of scientific data/models.
Explanation	1. Examples of paper crushed into small pieces, approximately the diameter of a quarter to half dollar, round objects/balls (to save time you could pre-construct the density balls) Recommended paper varies from composition, resume, construction, photo (increasing thicknesses/densities). For the objects that are to represent the dense particles, you may want to place something heavy in the center, e.g. a replacement eraser. **The goal is to end up with similar sized balls of different densities.** Ideally, balls of different densities will also be expressed by color (e.g. light yellow, medium blue, dense green). The colored balls of differing densities, may be used as analogies to natural rocks of differing densities (e.g. light limestone, medium sandstone, dense Iron ore).

	*You could begin discussion #1 with mineral samples the same size with different densities (e.g. light calcite, medium quartz, dense galena). Minerals have specific atomic structures and chemical compositions, leading to specific physical properties such as densities. Those mineral properties then pass on those properties to rocks. The objective of discussion one, the mineral show and tell and the density balls is to instill in students the concept of minerals/mineral properties, differing densities that are pasted on to rocks/sediment. 2. If the class has a lot of time, the students could engineer and construct the 'wind-tunnels'. The easiest way to build the wind tunnels would be to start with a shoebox then use scissors, ruler, tape/glue to cut wind tunnels to the specified widths (20 cm and 5cm). Hold discussion #2 asking the students to think how the newly constructed wind tunnels may influence the density balls' movement under the force of wind. 3. Run the experiments, have students test and record/draw how their sediment behaves in the different tunnels. Depending on your class size and the dynamic of your classroom, this can be done in bigger or smaller groups. For example you could have 10 or groups running the experiment? Break the class into two or three groups of 10 and join in a group experiment/discussion using the group of 10's sediment. Use 'normal' breath to move the sediment using the various 'environments'. 4. Discussion of how wind interacts with the Earth's surface to enact change slow to fast. Use Google Earth to show engage studen rural Iowa's wind breaks, or how vegetation stabilizes landscapes (compare Iowa to a desert area, Northern Nebraska.)
Evaluation	At the end of the week have the student draw what they remember. A. Differences in density balls and wind tunnels B. Variables that affect slow vs fast moving sediment/density balls.
Enrichment/ Elaboration/ Extension	A. Develop a contest, that uses developing knowledge to see which student/team can build the most and/or least effective wind tunnel. a. What would happen if the top of the shoebox was lowered? Covered? should the cover be transparent? b. What happens if the inside of the tunnel is covered with sand paper? c. What if the tunnel is placed on an ascending or descending plane? d. What would happen if the wind tunnel experiment was done outside with wind? B. How does the wind tunnel activity translate to Iowa's surface? C. How will the different sediment types/sizes move through natural setting (A) vs chute setting (C)? Are there other factors than size that might affect how sediment moves through each setting? D. Would the same principles apply to water and sediment?

Rubric

‘Criteria’	Almost never 1	Rarely 2	Occasionally 3	Frequently 5	Almost Always 6
Understanding Wind power	Student does not correlate setting with changes in wind power potential	Student is aware that wind power does change things- does not know specifics	Student is able to correlate wind power and change in a basic understanding.	Student is able to verbally explain the correlation between wind power and change.	Student demonstrates knowledge of constricted settings and the increases and decrease in wind power
Understanding densities and their movement	Student does not attribute changes in natural or engineered density to interactions with	Student is aware that densities matter, but can’t give any detail around the topic.	Student has a great understanding of density matters, but is unable to provide an example.	Student understands differing physical properties/densities occurs in nature and impacts interaction with natural forces and can give one example.	Student understands differing physical properties/densities occurs in nature and impacts interaction with natural forces and are able to give many examples.
Application	Student cannot apply developing knowledge	Student can apply very basic knowledge.	Student can apply a moderate amount of knowledge.	Student can able knowledge to a scenario with some information.	Student is able to apply developing knowledge to decrease or increase wind energy

Potential online resources

NASA - https://www.grc.nasa.gov/WWW/K-12/BGA/Dan/wind_tunnel_act.htm

NASA - https://www.grc.nasa.gov/WWW/K-12/freesoftware_page.htm

NOAA - https://scijinks.gov/tornado-simulation/