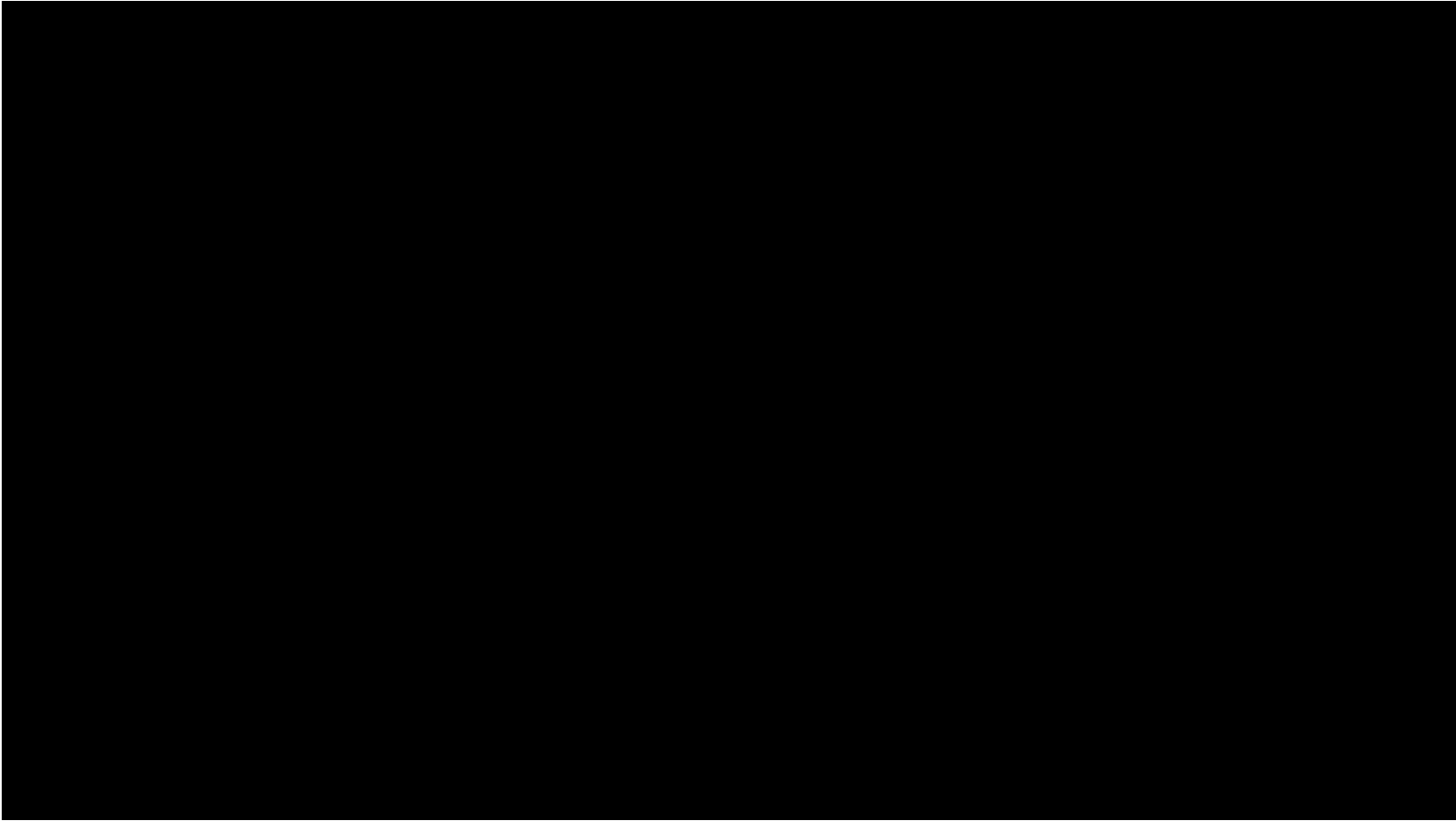




ENERGY: POWERED BY NORTH DAKOTA

**Emily Cash, Director
Great Plains Energy Corridor**

10/7/2016



Energy Curriculum

- 2-week modules
- 4th and 8th grade
- Science, Social Studies, Common Core State Standards
- Offered via **NDSTUDIES.GOV**



Enhancements

- Curriculum booklet
- Two-week lesson plan packages
- Interactive whiteboard lessons



Analytics

- Aug 1, 2015 – Aug 1, 2016 (one school year)

- 3,343 Users
- 4,564 Sessions
- 65% United States; 69% North Dakota

**ENERGY: POWERED BY | LEVEL
NORTH DAKOTA | ONE**

- Aug 1, 2015 – Aug 1, 2016 (one school year)

- 9,729 Users
- 6,988 Sessions
- 76% United States; 75% North Dakota

**ENERGY: POWERED BY | LEVEL
NORTH DAKOTA | TWO**



ENERGY: POWERED BY NORTH DAKOTA | LEVEL ONE

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INTRODUCTION TO ND ENERGY

2

PETROLEUM & NATURAL GAS

3

COAL

4

WIND, HYDROPOWER, SOLAR

5

BIOFUELS, GEOTHERMAL, RECOVERED

CAREER INFORMATION

COURSE ACTIVITIES

STANDARDS

TEACHER RESOURCES

ADDITIONAL RESOURCES



BISMARCK
STATE COLLEGE

National Energy
Center of Excellence

WIND >>

SOLAR >>

COAL/NATURAL GAS >>

HYDRO >>

GEOHERMAL >>

RECOVERED HEAT >>

ENERGY FLOW >>

Bismarck State College

1500 Edwards - PO Box 5587

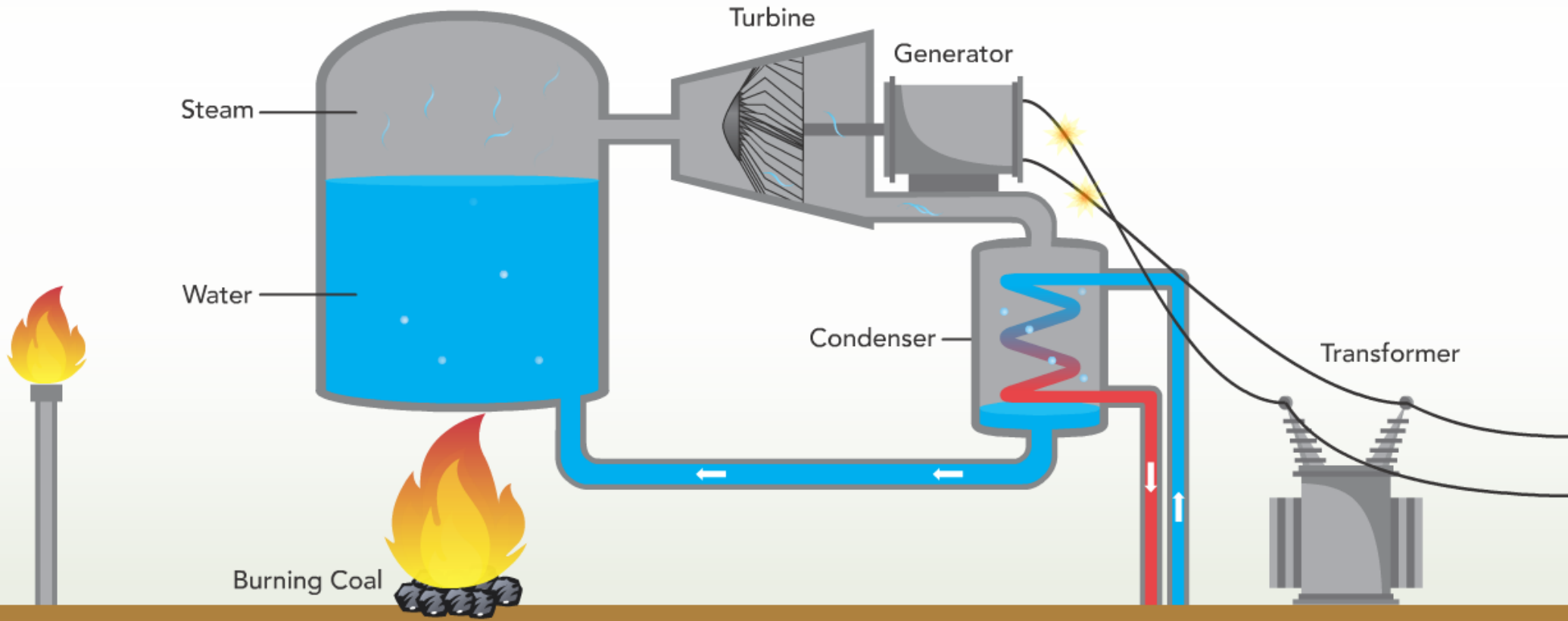
Bismarck, ND 58506

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COAL/NATURAL GAS GENERATION

Instructions : Click on each component to learn more.





How Petroleum and Natural Gas are Recovered in North Dakota

- ▶ Billions of barrels of oil and natural gas are trapped in rock far below the surface of the Williston Basin.
 - ▶ For many years, oil companies knew about this supply but were unable to get the oil out.
 - ▶ In 2006, the first successful Bakken well was drilled in North Dakota using horizontal drilling and **hydraulic fracturing**.
 - **Hydraulic fracturing** ↪, or **fracking**, is the process of using pressurized water to fracture, or crack, deep underground rock so that trapped petroleum can be released.
 - Horizontal wells are drilled in order to reach the pockets of trapped oil.
 - Water makes up about 90 percent of the fracking fluid, and sand makes up about 9.5 percent. The other half-percent consists of chemical additives.
 - Some of the water used in hydraulic fracturing is cleaned of chemical and rock debris and is then used to frack additional wells. This is an enormous cost-saver.
 - North Dakota is one of nearly 20 states that requires oil companies to list on a public website – www.fracfocus.org – the chemicals used in the fracking process.




Marathon Animation of Hydraulic Fracturing: This 7-minute video explains the process of hydraulic fracturing.

Video courtesy of Marathon Oil.



Fossil Fuels

What petroleum and natural gas are:

- ▶ **Petroleum**  is a flammable liquid mixture of hydrocarbons and other organic compounds found beneath the surface of the earth.
- ▶ Petroleum is commonly called *crude oil* or *oil*.
- ▶ **Natural gas** is a gaseous mixture of hydrocarbons, primarily methane, a colorless, odorless, flammable gas.
 - ▶ A hydrocarbon is a combination of hydrogen and carbon molecules.
- ▶ Natural gas and petroleum are fossil fuels that are often found together.
- ▶ Natural gas is the cleanest-burning fossil fuel.
- ▶ Petroleum and natural gas are fossil fuels. The other fossil fuel is coal. In North Dakota, oil and gas are found primarily in rocks that are 300 to 500 million years old. Lignite (a type of coal) in North Dakota is roughly 62 million years old. The North Dakota Geological Survey estimates that oil in the Bakken Formation began forming 70 million years ago.

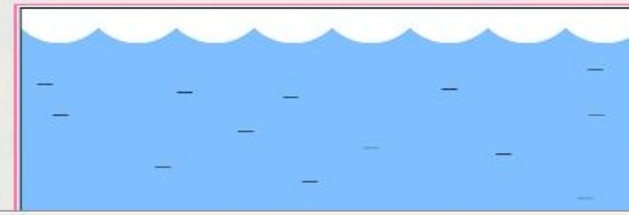


Bakken Oil: A worker holds a small container of Bakken oil.

Photo courtesy of MBI Energy Services.

How fossil fuels were formed:

- ▶ Fossil fuels were created by anaerobic (without oxygen) decay of organic matter deep below the surface of the earth.
- ▶ Petroleum and natural gas were created from miniscule aquatic organisms such as zooplankton and algae. (Coal primarily formed from plants that grew on land.)
 - ▶ The enormous weight and pressure, together with very high heat, "cooked" the marine organisms into the liquid called **petroleum**.
 - ▶ As the heat increased, **natural gas** was created.







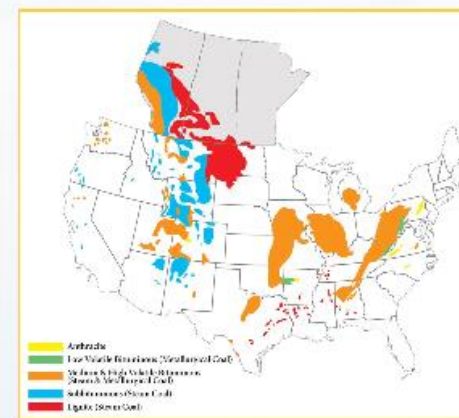
Locating Coal and Mining Challenges

Where coal is found:

- ▶ Western North Dakota contains about 351 billion (351,000,000,000) tons of lignite.
- ▶ The largest lignite mines are in Mercer, McLean, and Oliver counties, near Beulah, Underwood, and Center.
- ▶ The Freedom Mine near Beulah is the largest lignite mine in the world.

Challenges of coal production:

- ▶ Surface mining temporarily changes the landscape.
- ▶ After the coal has been removed, the mined area needs to be **reclaimed** .
 - ▶ The rocks and dirt are returned to the area, the topsoil and subsoil are replaced, and the area is replanted.
 - Mining companies must prove that the reclaimed land is as good as or better than it was before coal was removed.
 - It costs mining companies from \$30,000 to \$60,000 to reclaim one **acre**  of land.
 - Between 1,500 and 2,000 acres of land are disturbed and reclaimed in North Dakota each year.



US Coal Deposits: North Dakota's supply of lignite coal is enough to last more than 800 years.

Map courtesy of Lignite Energy Council.



During Mining Activity: - [Image 1 of 2] - Aerial view photos show the



Where Coal is Found

- ▶ The North Dakota Geological Survey estimates that western North Dakota contains about 1.3 trillion (1,300,000,000,000) tons of lignite.
 - ▶ This is the largest deposit of lignite in North America.
 - ▶ An estimated 25 billion tons are recoverable, enough to last more than 800 years at the current rate of consumption.
 - ▶ While North Dakota's 25 billion tons of recoverable lignite reserves are only 10 percent of the US coal reserves, it accounts for more than 80 percent of the US lignite reserves of 30 billion tons (World Energy Council 2007).
 - ▶ According to the World Energy Council, there are 150 billion tons of lignite reserves in the world. North Dakota contains almost 20 percent of the world's lignite reserves, and Australia is the only country, at 37 billion tons, that contains more.
- ▶ Four mining companies extract about 30 million tons of lignite annually in North Dakota.
- ▶ The largest mines are in Mercer, McLean, and Oliver counties, near Beulah, Underwood, and Center.
 - ▶ **Freedom Mine**, north of Beulah, is the largest lignite mine in the US.
 - Freedom Mine produces about 50,000 tons of lignite per day, or 15 million tons per year.
 - This mine supplies Antelope Valley Station and Leland Olds Station for electricity generation and Great Plains Synfuels Plant for coal gasification.
 - The 13 to 20 foot seam of coal is located 50 to 150 feet below the surface.
 - In order to uncover the coal, more than 100 million yards of earth (more than in the Garrison Dam) is moved each year.
 - The lignite contains 37 percent water and 7.5 percent ash.



Lignite Coal Map and Legend: North Dakota's supply of lignite coal is enough to last more than 800 years.

Map courtesy of Lignite Energy Council.

Dragline Trivia (Freedom Mine)

- ▶ Each dragline:
 - ▶ weighs 13 million pounds;
 - ▶ stands 215 feet tall (as tall as 17th floor of the ND Capitol);
 - ▶ has a boom 340 feet long (approximate length of a

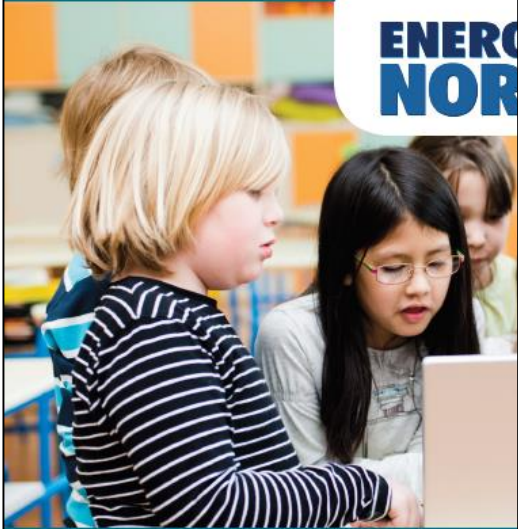




ENERGYND
great plains energy corridor

Great Plains Energy Corridor
Bismarck State College
1200 Schafer Street
Bismarck, ND 58501

Do you have questions about the curriculum? Do you want to order a set of the **ENERGY: Powered by North Dakota** curriculum books free of charge? Contact project lead Emily McKay at emily.mckay@bismarckstate.edu or 701-224-2410.



**ENERGY
NORTH DAKOTA**

ONLINE CURRICULUM LAUNCHED FOR 4TH AND 8TH GRADE



NDstudies.gov

An in-depth look at North Dakota's energy resources has recently been added to the North Dakota Studies curriculum for 4th and 8th grade students. The **ENERGY: Powered by North Dakota** curriculum, was developed through a partnership between the North Dakota EmPower Commission and Bismarck State College's Great Plains Energy Corridor. The curriculum was funded through the North Dakota Industrial Commission's Lignite Research and Oil and Gas Research Programs and donations from energy industry stakeholders. The curriculum is web-based and covers various sectors of North Dakota's energy economy, including coal, petroleum, biofuels and other renewable energy sources.

"The energy industry is already an interesting topic, but using an online platform gives us the chance to incorporate videos, photos, maps and graphics that make the material interactive and, I hope,

really interesting for students," said Emily McKay, the energy curriculum project manager. "Students will be able to watch a time-lapse video of drilling an oil well, zoom in on a US map of solar energy potential, and click through an animation of how water through a hydro dam produces electricity."

The Energy Curriculum Project idea sprouted more than two years ago in the Workforce Subcommittee of the EmPower North Dakota Commission. The commissioners, appointed by North Dakota Governor Jack Dalrymple, represent all of the state's energy industries and were keenly aware of the need to get young students interested in energy.

"North Dakota is changing the landscape of energy production in the United States. We are a state rich in natural resources and innovation, and it's surprising how few students have an understanding of how important the energy economy is to

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activities, career information, and teacher resources. The curriculum is located at NDstudies.gov.

Teachers exploring renewable energy in the classroom now have access to hands-on materials and lessons plans through the Suitcase Exhibits for North Dakota (S.E.N.D.), a program of the State Historical Society of North Dakota.

Valley City State University developed the trunk for K-12 classroom use, which offers hands-on experiences for learners of all ages. Through the trunk components and online educational materials, students learn:

- Electrical generation, electricity and magnetism, electric motor construction, physics concepts
- Integrative STEM practices, Engineering Design, artistry
- Renewable and sustainable energy practices, resources

HANDS-ON ENERGY KITS AVAILABLE FOR TEACHERS



Students use turbine. Photo

A comprehensive use is available at the eight

SEND trunk at no cost through the eight

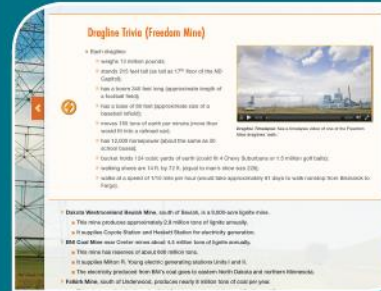
ENERGY CURRICULUM USED IN CROSS-CURRICULAR PROJECT



Students from Liberty Elementary visit the Falkirk Mine near Underwood, N.D. Photo by Michael Jacobson.

Examples from ENERGY

Cool grade-level trivia for math problems at any grade level! <http://tiny.cc/draglinetrivia>



www.1

After seeing the **ENERGY: Powered by North Dakota** curriculum, Liberty Elementary School teachers Michael Jacobson, Nicole Schaff, Alicia Overbeck and Jana Detwiler saw an opportunity for a cross-curricular project for their 100 fourth grade students. The Bismarck elementary emphasizes school-wide project-based learning and by pairing **ENERGY: Powered by North Dakota** with the **Habitats of North Dakota**, students answered a driving question: "How can we as citizens of North Dakota harvest energy while protecting animals and habitat?"

Students started the project with a trip to Great River Energy's Coal Creek Station and neighboring North American Coal Corporation's Falkirk Mine. After seeing the facilities firsthand, Jacobson said, the students were ready to jump into the project.

"The students thought the tour was awesome! It got them excited about what they might be able to do as an adult and provided real

world applications of what they learn in class," Jacobson said.

Liberty fourth-graders made a list of their top five habitats, and students formed small groups based on their interests and figured out what they needed to know and do to answer their driving question. Not a question that could be "Googled," it required collaboration and critical thinking across multiple subjects – reading, science, social studies, and math. After reading about their chosen habitat and animals in North Dakota, it naturally led students to the resources and content on the energy curriculum website.

"The energy curriculum provided videos that gave them first-hand knowledge from the experts. They were analyzing the maps online and in the booklet to identify their resource and where it was located in the state," Jacobson said. "Everything was right at their fingertips."

Each group formed their own business to develop a North

Dakota energy resource while protecting their chosen habitat and combined with other groups to form a cooperative. The end product was a VoiceThread presentation that was delivered by the students to local energy experts, who helped students consider other factors with the resource. After students edited their presentations to incorporate feedback and troubleshoot technical glitches (another real world application!), students presented their final work to their families at the North Dakota Heritage Center.

"We got so many people involved with the tour, speakers and experts, that the students felt like it was really important and more than just a grade," Jacobson said. "Project-based learning was new for us, but this project was a very dynamic way to get each student involved and let them show us [teachers] what they are capable of. How cool it is as a teacher to just step back and see them run with it."



2016 Chairman's Stewardship Award from Interstate Oil & Gas Compact Commission

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