

Design a Pipeline Lesson Plan

Consumers Energy's *Design a Pipeline* Lesson Supports the Michigan Grade Level Content Expectations and Common Core State Standards

<i>Third</i>
SCIENCE
Inquiry Analysis and Communication <ul style="list-style-type: none">○ S.IA.03.11 Summarize information from charts and graphs to answer scientific questions○ S.IA.03.12 Share ideas about science through purposeful conversation in collaborative groups○ S.IA.03.13 Communicate and present findings of observations and investigations○ S.IA.03.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences
Inquiry Process <ul style="list-style-type: none">○ S.IP.03.12 Generate questions based on observations○ S.IP.03.13 Plan and conduct simple and fair investigations○ S.IP.03.14 Manipulate simple tools that aid observation and data collection
MATHEMATICS
Solve Measurement Problems <ul style="list-style-type: none">○ M.PS.03.11 Add and subtract money in dollars and cents
SOCIAL STUDIES
Public Discourse, Decision Making, and Citizens Involvement P4.2 Citizen Involvement <ul style="list-style-type: none">○ 3 – P4.2.2 Participate in projects to help or inform others
ENGLISH LANGUAGE ARTS
Reading Standards for Informational Text (RI) Integration of Knowledge and Ideas: <ul style="list-style-type: none">○ RI.3.7—Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur)
Speaking and Listening Standards (SL) Comprehension and Collaboration <ul style="list-style-type: none">○ SL.3.1—Engage effectively in a range of collaborative discussions with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.○ SL.3.3—Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

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Fourth Grade

SCIENCE

Inquiry Analysis and Communication

- S.IA.04.11 Summarize information from charts and graphs to answer scientific questions
- S.IA.04.12 Share ideas about science through purposeful conversation in collaborative groups
- S.IA.04.13 Communicate and present findings of observations and investigations
- S.IA.04.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences

Inquiry Process

- S.IP.04.12 Generate questions based on observations
- S.IP.04.13 Plan and conduct simple and fair investigations
- S.IP.04.14 Manipulate simple tools that aid observation and data collection

SOCIAL STUDIES

Public Discourse, Decision Making, and Citizens Involvement

P4.2 Citizen Involvement

- 4 – P4.2.2 Participate in projects to help or inform others

ENGLISH LANGUAGE ARTS

Reading Standards for Informational Text (RI)

Integration of Knowledge and Ideas:

- RI.4.7-- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

Speaking and Listening Standards (SL)

Comprehension and Collaboration

- SL.4.1--Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Language Standards (L)

Conventions of Standard English

- L.4.1-- Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

For more great lesson plans and other resources visit:
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Fifth Grade

SCIENCE

Inquiry Analysis and Communication

- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence
- S.IA.05.14 Draw conclusions from sets of data from multiple trials of a scientific investigation

Inquiry Process

- S.IP.05.11 Generate scientific questions based on observations, investigations, and research
- S.IP.05.13 Use tools and equipment appropriate to scientific investigation

SOCIAL STUDIES

Public Discourse, Decision Making, and Citizens Involvement

P4.2 Citizen Involvement

- 5 - P4.2.2 Participate in projects to help or inform others

ENGLISH LANGUAGE ARTS

Speaking and Listening Standards (SL)

Comprehension and Collaboration

- SL.5.1—Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Language Standards (L)

Conventions of Standard English

- L.5.1— Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

Lesson Outcome

Students will design their own pipelines in order to create the most cost effective way to deliver natural gas to a customer. Students will be exposed to the concepts of urban planning and designing around existing landmarks as well as gain an appreciation for how natural gas arrives at their homes. Students will also be exposed to the concept of resources being delivered to their house via pipes and wires which are underground.

Rationale / Purpose for Lesson

This lesson will provide students with an appreciation of how resources arrive at their homes and schools. Students will learn how pipelines are designed and the types of difficulties that arise when trying to do so. They will learn what natural gas is, why it can be beneficial, and why it can be dangerous. Students will also gain knowledge of how utility companies work to keep natural gas safe.

Resources / Materials Required

- Print off one pipeline grid and one pipeline rules sheet per two students
- Markers and colored pencils

Anticipatory Set

Start the lesson by having students take two minutes to write down all of the things they can think of that use energy in their house. Have students share their answers and ask if students know what type of energy is used in each appliance. Students often equate energy to electricity so most answers will likely be electric appliances and light bulbs. Be sure to discuss natural gas and what it does in their homes and in your school. Furnaces and hot water heaters are two of the most common users of natural gas. Natural gas in its natural state is colorless, odorless, and a true gas so it cannot be touched. Natural gas travels to your home through underground pipes. Natural gas does not have an odor, so before it makes its way to your home, Consumers Energy adds a special chemical called mercaptan to make it smell bad (like rotten eggs). This makes natural gas easily recognizable if there is ever a leak because without the added smell, we would not know the gas is there.

Procedures

1. Pair off students and give them one sheet of pipeline grid paper, one set of rules, three different colored pencils, and one marker.
2. Discuss the Pipeline Rules with the class, answer any questions that may arise
 - a. Be sure to emphasize that a pipe in a square that has water in it is considered going under a lake and a pipe in the same square as a road is considered going under the road.
 - i. Explain to your students that putting a pipe near or under a road or lake is more expensive, even if they don't touch them directly
3. Instruct students to design three separate pipelines and calculate the cost of each pipeline.
4. Once they have the cost for each of the three pipelines, have them determine which pipeline is most cost effective and trace that pipeline with their marker.
5. Once all groups have determined their best pipeline option have each group come to the board, one at a time and draw out their pipeline on a pipeline grid projected onto the board. If projection is unavailable, a blank pipeline grid can be used and each group can be designated a specific color.
6. Have other students in the class do calculations on the cost of this pipeline in order to double check the work of the group who is presenting.
7. Once a cost is confirmed by the rest of the class ask if any other groups have a design that costs less and have that group repeat steps 5-7
 - a. If no groups have designed a less expensive option see if any students have a design of equal value.
 - b. For two designs of equal value, or slightly different costs, have student's debate reasons why their design is a better option than the other groups.
 - i. More environmentally friendly, fewer working hours, etc.

Closure

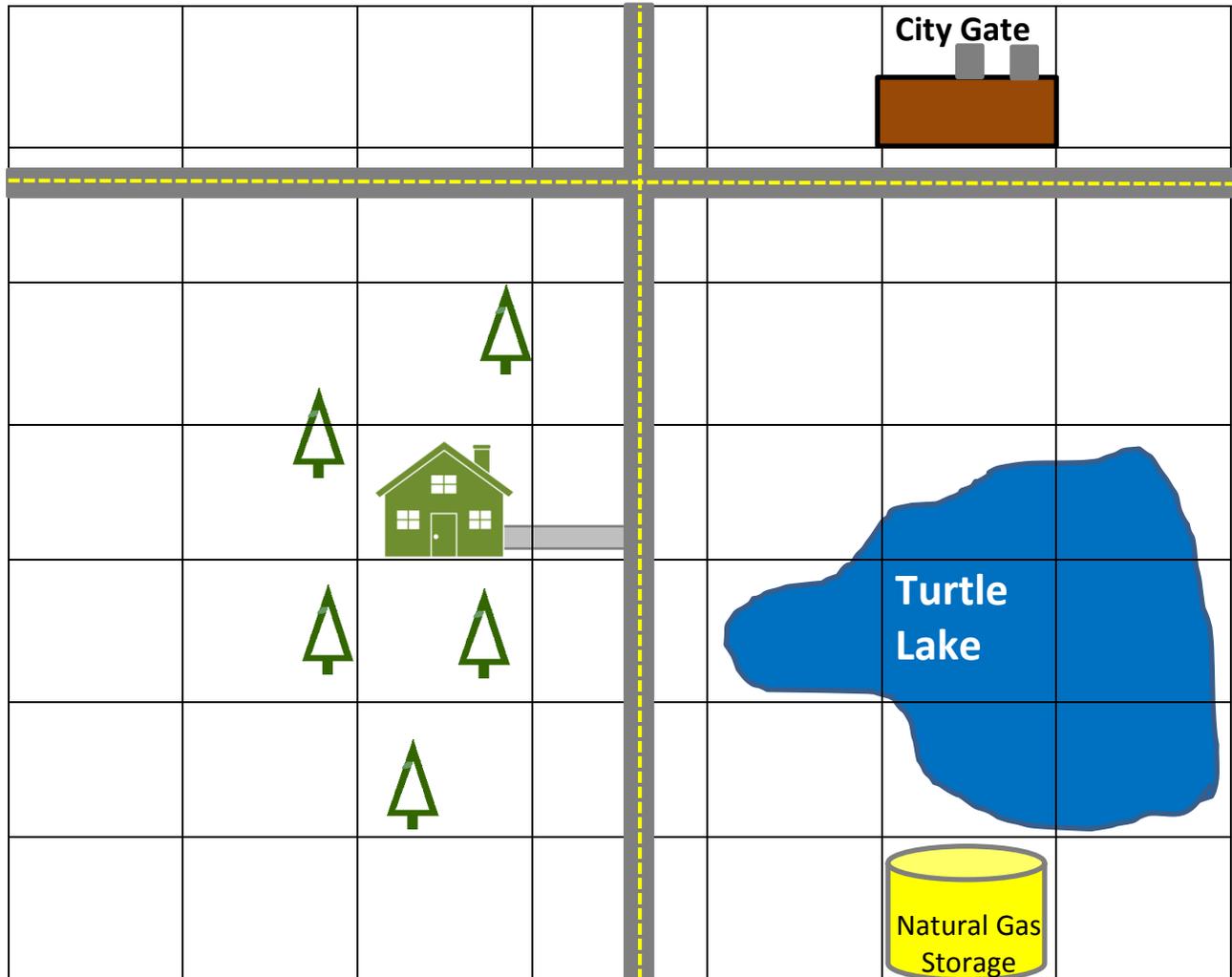
1. Discuss with students what other utilities travel to their homes and schools via pipes (and also wires above and underground)
 - a. Electricity (Wires)
 - b. Water
 - c. Cable/Phone/Internet
 - d. Sewer

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2. This process for designing pipelines is done for all of the resources that come to our homes
3. We need to be aware that certain things that are underground can be dangerous when digging. To stay safe when digging underground, advise students to call MISS Dig three days ahead of time at 811 for free to have the underground utilities marked.
4. Why do we have other utilities marked by MISS Dig when digging?
 - a. Consumers Energy and other utility companies don't want their lines to be damaged because they can cause power outages, loss of service, costly repairs, and even hurt or kill someone.
5. If we do smell natural gas we want to remember the 3Rs
 - a. Recognize the natural gas leak.
 - b. React to the leak by telling an adult and leaving the area. Remember to not use your car or anything electronic that can make a spark.
 - c. Report the leak to Consumers Energy by calling 1-800-477-5050 or by calling 911.

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Pipeline Grid



1 square = 1 square mile = costs \$1,000 to lay pipe

Pipeline Rules:

- **The gas pipeline must go from Natural Gas Storage, to the City Gate, to the customer's house.**
 - The City Gate is the distribution station local to your house or school. The city gate is where Consumers Energy adds mercaptan, which makes natural gas smell like rotten eggs
- **If your pipe goes through any part of a square, you have to pay for that whole square.**
- **You cannot cut diagonally through the squares.**
 - Pipes are designed to change directions at 90 degree angles so they can only run side to side and up and down
- **You cannot run more than one natural gas pipe through the same square.**
- **Anytime you pass under a lake square it costs an extra \$2,000.**
- **Anytime you pass under a road square it costs an extra \$3,000.**
- **Avoid the barriers (like the drive-way or trees) because residents prefer as few disturbances to these areas as possible.**
 - Going through one square of obstacles is allowed but more than one may cause the resident to question your design