Title: Model Oil Pipeline

By Katie Gavenus, Children of the Spills, http://childrenofthespills.org.

Theme: It is challenging to construct a pipeline to safely transport oil over rugged terrain.

Objectives:

- Students will construct a working model of an oil pipeline.
- Students will cooperate to transport oil from drilling areas to a marine terminal.

Duration: 90 minutes

Age Range: 6th-12th Grade

Materials:

- Pencils
- Scratch paper
- Water
- Food Coloring
- 5 gallon buckets
- Sump pump (optional)
- Rubber hose with fitting for sump pump (optional)
- PVC Piping
- PVC Pipe Fittings
- Duct Tape
- Wood
- Screws
- Screwdrivers
- Wood glue
- Scrap pieces of rubber hose
- Rulers
- Tape Measure
- Absorbent pads, cloth rags, or towels
- Model Oil Pipeline Rubric

Background:

Constructing the Trans Alaska Pipeline System in the 1970s was an incredible endeavor. The pipeline spans 800 miles of rugged Alaskan terrain, much of it above ground due to permafrost. The pipeline crosses 30 major rivers and streams, 3

major fault lines, and 3 mountain ranges. It rises with the land to an altitude of 4,739 feet.

Pipelines are generally constructed of steel or plastic tubes. They may be on land, underground, or under water. In this activity, students work in teams to construct a pipeline to transport "oil" from an "oil field" to a mock marine terminal.

Preparation:

Decide on the location for your oil field, pipeline route, and marine terminal. An outside area is a preferable, but an indoor classroom could also be used. Be sure to find an area with or create varied terrain, included something to simulate mountains and rivers. You will need 1 5-gallon bucket and 1 shallow tub for each group. Place the 5-gallon buckets in the "oil field" area. Each group will use one bucket as their starting point. Distribute the shallow tubs at the far end of the area to be traversed by the pipelines. Each group will use one tub as their ending terminal.

Borrow one or more sump pumps to use in the activity. If you do not have access to pumps, students can also just pour the "oil" into the pipeline, although this is less exciting.

Introduction:

Ask students what they know about the Trans Alaska Pipeline System. Share with students facts about the pipeline. (The pipeline spans 800 miles of rugged Alaskan terrain, much of it above ground due to permafrost. The pipeline crosses 30 major rivers and streams, 3 major fault lines, and 3 mountain ranges. It rises with the land to an altitude of 4,739 feet.) Discuss some of the challenges of constructing a pipeline such as this.

Activities & Procedures:

Divide students into groups of 5-7. Assign each group an oil field starting point (5-gallon bucket) and terminal (shallow tub). Provide them with a copy of the Model Oil Pipeline Rubric.

Explain that students are going to construct a working model of a pipeline to transport mock "oil" from a simulated oil field to a terminal. Between the start and end points, they can choose any route they would like.

Because of permafrost, their pipeline must be elevated above ground at least 2 inches throughout the length of the pipeline. Once the pipeline is completed, they will use a sump pump to push "oil" into the pipeline. Their goal is to successfully transport the oil through the pipeline to the terminal with no leaks.

Show students the materials available to use in construction, but do not allow them to obtain any materials until they have sketched a design for their pipeline.

Students should work together to decide upon the safest route and construction plan for their group's pipeline. Check in with each group to ensure everyone is participating in the challenge.
Once you are content that the group has a solid design plan that everyone has contributed to, allow them 45 minutes to construct the actual pipeline using the materials. Check in with groups as they construct, making sure again that all members are included in the process.

When the pipelines have been completed, fill the 5 gallon buckets with about 4 gallons of water and food coloring to simulate oil. Place absorbent pads, rags, or towels below the pipelines to catch any spills or leaks. Attach a short length of hose to the sump pump and submerge the pump in the water. Run the hose into the beginning of the pipeline, and plug in the sump pump. Have students watch along the pipeline for leaks or spills. If a pipeline is successful, "oil" should flow out the other end into the shallow tub representing the terminal without any leaks or spills along the way. Test all pipelines in this way. If time permits, allow groups 5 minutes to fix any leaks or blockages in their pipeline, and retest.

Wrap-Up:

Once each pipeline has been tested, debrief the experience with students. Ask students to identify the most challenging aspect of constructing a pipeline. What was successful? What was less successful? What would they do differently next time? What did students learn from the experience? Discuss how this compares to the reality of transporting crude oil. What other challenges might come up?

Have students deconstruct their pipelines and rinse out the pieces for re-use.

Evaluation:

Use the Model Oil Pipeline Rubric to evaluate the group projects and assess student understanding.

Model Oil Pipeline

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Construction -Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.
Construction - Care Taken	Great care taken in construction process so that the pipeline is sturdy, functions well, and follows plans accurately.	Constuction was careful and accurate for the most part, but 1-2 details could have been refined for a more functional product.	3-4 details could have been refined for a more functional product. Some evidence that a plan was developed and followed in the cunstruction of the pipeline.	Construction appears careless or haphazard. Many details need refinement for a strong or functional product.

Modification/Testing	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.
Function	Pipeline functions extraordinarily well, holding up under atypical stresses. "Oil" flows easily through pipeline without any leaks.	Pipeline functions well, holding up under typical stresses. "Oil" flows through pipeline with up to one small leak OR oil flows, but not smoothly.	Pipeline functions pretty well, but deteriorates under typical stresses. Pipeline leaks oil OR there is a partial blockage.	Fatal flaws in function of pipeline with complete failure under typical stresses. Oil does not flow AND/OR pipeline leaks profusely AND/OR pipeline collapses.
Group Work	The group functioned exceptionally well. All members listened to, shared with, provided feedback, and supported the efforts of others. The group (all members) was almost always on task!	Thegroup functioned pretty well. Most members listened to, shared with, provided feedback, and supported the efforts of others. The group (all members) was almost always on task!	The group functioned fairly well but was dominated by one or two members. The group (all members) was almost always on task!	Some members of the group were often off task AND/OR were overtly disrespectful to others in the group AND/OR were typically disregarded by other group members.

Model Pipeline

Science As Inquiry and Process: Students develop an understanding of the processes and applications of scientific inquiry.

SA1
Students develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments

The student demonstrates an understanding of the processes of science by:

[5, 6, 7, 8, 9] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating

[5] SA1.2 using quantitative and qualitative observations to create their own inferences and predictions.

Science and Technology: Students develop an understanding of the relationships among science, technology, and society.

SE1 Students develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events.

The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by:

[6] SE1.1 recognizing that technology cannot always provide successful solutions for problems or fulfill every human need

[9] SE1.1 recognizing that the value of any given technology may be different for different groups of people and at different points in time (e.g., different uses of snow machines in different regions of Alaska)

SE2 Students develop an understanding that solving problems involves different ways of thinking, perspectives, and curiosity that lead to the exploration of multiple paths that are analyzed using scientific, technological, and social merits.

The student demonstrates an understanding that solving problems involves different ways of thinking by:

[6] SE2.1 identifying and designing a solution to a problem

[7, 8] SE2.1 identifying, designing, testing, and revising solutions to a local problem

[6, 7] SE2.2 comparing the student's work to the work of peers in order to identify multiple paths that can be used to investigate a question or problem

[8] SE2.2 comparing the student's work to the work of peers in order to identify multiple paths that can be used to investigate and evaluate potential solutions to a question or problem