Title: Build an Oil Tanker

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Theme: It is challenging to safely construct, operate, and navigate an oil tanker.

Objectives:

- Students will build an oil tanker using design requirements.
- Students will test their abilities to navigate their oil tanker through treacherous waters.

Duration: 75-90 minutes, in two days

Age Range: 8-12th Grade

Materials:

- Pencils
- Scratch paper
- Duct Tape
- Cardboard
- Garbage Bags
- Caulking
- Food Coloring (or small floating objects such as ping pong balls)
- Pool or body of water
- Personal Flotation Devices
- Oars or paddles
- Items for obstacle course (hoops, ice, beach balls, lane dividers, rocks, etc.)
- Manila folders
- Large bucket of water or kiddie pool
- Build an Oil Tanker Rubric

Background:

In this activity, students work in teams to design and construct an oil tanker that can safely navigate through an obstacle course. Students will learn about the requirements for operating oil tankers in Prince William Sound.

For a more advanced lesson, incorporate kits from SeaPerch or have students build their own remotely operated tankers with model boat engines.

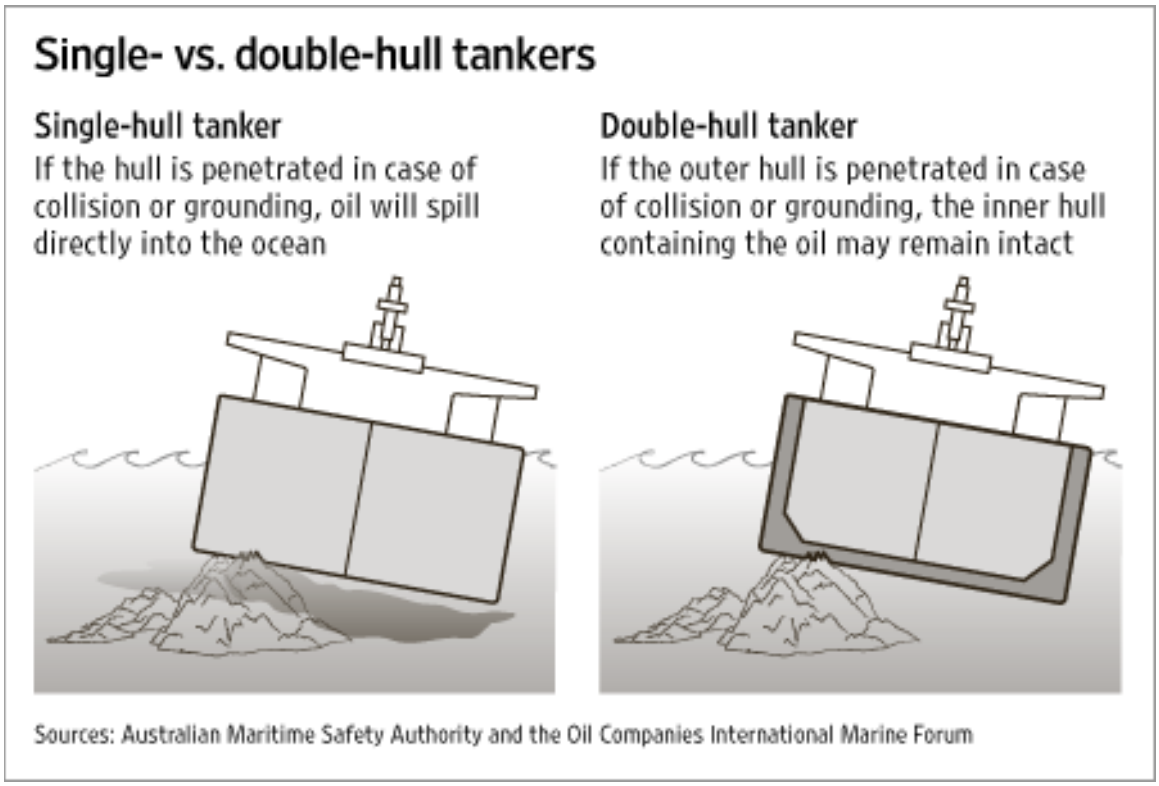
Preparation:

Decide on the location for your testing and obstacle course. If you will be using a pool, speak with the pool director about your lesson and decide what to use for simulated oil: water with food coloring, small floating objects, or something else. Also discuss objects that can be used for the obstacle course. If possible, set up the obstacle course ahead of time.

Prepare a large bucket of water or small kiddie pool for students to use to test their prototypes before constructing their final tankers.

Introduction:

Explain to students that their challenge is to construct a tanker that can safely transport oil and a crew. The course will be 50 feet long, and will involve various obstacles that will need to be navigated around. Show them the image below of a double- vs. single-hull tanker.



Activities & Procedures:

Divide students into groups of 2-4. Provide them with a copy of the Build an Oil Tanker Rubric and explain the project rules:

- All crew must be aboard the tanker (unless you are constructing an ROV)
- 5 gallons of "oil" must be safely navigated from the beginning terminal to the end terminal

- Only cardboard, plastic bags, tape, and caulk may be used to construct the tanker

Provide each group with materials for tanker construction. Encourage students to use scratch paper to sketch out designs, and to build and test manila-folder prototypes. They can test their prototypes in a kiddie pool or large bucket of water. As they work on their tanker, remind them to come get 5 gallons of "oil" (either water with food coloring or small floating objects) that needs to be stored within the tanker.

When all tankers are completed, move to the pool/body of water for testing. If you are not testing in a pool, all participants need to wear Personal Flotation Devices while on the water. Set up the obstacle course with items such as beach balls, lane dividers, hula hoops weighted down, large chunks of ice, rocks, etc.

Launch the first tanker and test the crew's ability to navigate the obstacle course. Unless you are using SeaPerch or model boat motors, the tanker will be propelled by human power – the crewmembers should board the tanker and attempt to paddle it through the obstacle course. If this lesson is taking place in anything other than a pool, make sure all participants wear PFDs. Make note of any obstacles the first tanker hits, and watch closely for leaking "oil." Repeat with the remaining tankers.

Wrap-Up:

Once everyone has dried off, debrief the experience with students. Ask students to identify the most difficult aspects of constructing their tanker. Is this realistic? Identify the tankers that were most and least successful. What characteristics made them so successful (or not so successful)? Ask students whether or not it was easy to navigate a tanker. Was this a realistic simulation? Review the rules for operating a tanker in Prince William Sound (http://www.evostc.state.ak.us/facts/prevention.cfm). Discuss the requirements for escort tugs. Based on their experience navigating in the pool, do students think escort tugs are a good idea?

Evaluation:

Use the Build an Oil Tanker Rubric to evaluate the group projects and assess student understanding.

Build an Oil Tanker

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 tanker 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 tanker.	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	Tanker functions extraordinarily well, holding up under atypical stresses. Tanker successfully navigates course.	Tanker functions well, holding up under typical stresses, but does not avoid all obstacles in course.	Tanker functions pretty well, but deteriorates under typical stresses. Tanker leaks "oil" or cannot maneuver well.	Fatal flaws in function of tanker with complete failure under typical stresses. Tanker sinks.
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.

Build an Oil Tanker

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

[7] SE1.1 describing how public policy affects the student's life (e.g., public waste disposal)

[8] SE1.1 describing how public policy affects the student's life and participating diplomatically in evidence-based discussions relating to the student's community

[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

[9] SE2.1 questioning, researching, modeling, simulating, and testing a solution to a 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