LESSON: Culminating Task: Planning a Pipeline	GRADE: 8 STRAND: Fluids

CRITICAL LEARNING: BIG IDEAS

1. analyse how the properties of fluids are used in various technologies, and assess the impact of these technologies on society and the environment;
2. investigate the properties of fluids;
3. demonstrate an understanding of the properties and uses of fluids.

FOCUS QUESTIONS

How do distance, temperature, resistance, or fluid type (density) affect the flow of a fluid through a pipeline?

CURRICULUM EXPECTATIONS

2. Developing Investigation and Communication Skills By the end of Grade 8, students will:

2.1 follow established safety practices for using apparatus, tools, and materials (e.g., use syringes and tubing for the purposes for which they were designed)

2.5 use scientific inquiry/experimentation skills (see page 12) to identify factors that affect the flow rates of various fluids Sample problem: Devise an experiment to find out how the flow rate of a fluid is affected by changing its temperature; by changing the angle or tilt at which it is poured; by changing the

LEARNING GOALS:

This activity is designed to explore the affect of distance, temperature of fluid, resistance, and type (density) of fluid on fluid flow through a pipeline.

2.6 use technological problem-solving skills (see page 16) to design, build, and test devices that use pneumatic or hydraulic systems Sample problem: Use your knowledge of Pascal's law to design, construct, and test a working model of a device (e.g., a dentist's chair, an automobile hoist, a hydraulic brake, a backhoe 2.7 use appropriate science and technology vocabulary, including viscosity, density, particle theory of matter, hydraulic, and pneumatic, in oral and written communication 2.8 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g., using appropriate scientific and/or technological 3. Understanding Basic Concepts By the end of Grade 8, students will: 3.1 demonstrate an understanding of viscosity and compare the viscosity of various liquids (e.g., water, syrup, oil, shampoo, ketchup) 3.6 explain in qualitative terms the relationship between pressure, volume, and temperature when a liquid (e.g., water) or a gas (e.g., air) is compressed or heated 3.7 explain how forces are transferred in all directions in fluids (Pascal's law)	
MINDS ON...(*ELICIT & ENGAGE*)	**ASSESSMENT & EVALUATION**
Using a thematic map of Canada showing energy resources, have students determine the location of Canada's oil resources such as the Alberta Oil sands, Hibernia Oil field, and Grand Banks oil field. Discuss the proximity of large urban centers to these oil fields (they are thousands of kilometers apart). Discuss the options for delivering natural gas and oil over thousands of kilometers (Train, truck, airship, barge, and pipeline) and the possible environmental risk and relative cost of each option. (A pipeline offers the lowest environmental risk and most cost effective method for transporting natural gas and oil). Briefly review Pascal's law relating to fluid pressure. The factors that the students will be investigating relate not just to hydraulics but also to particle theory, density, and viscosity. Have them review their notes and activity guides.	Each group's inquiry plan will be used as a formative assessment.

Students will work in small groups to conduct their inquiry. Each group of students must: Decide which variable they will test: distance, temperature of fluid, resistance (number of bends in pipeline), or type (density) of fluid. It is important that only one variable be changed during each inquiry in order to determine the effect of that one variable. Make a hypothesis predicting how their variable will affect the flow of a fluid through their pipeline system. Brainstorm possible pipeline designs. They must build a closed hydraulic system made of plastic tubing and a syringe or syringes. Gather all necessary materials. Plan and record their procedure. The following questions should be considered when developing a plan: What type of observations/data should be collected to test the hypothesis? What steps should be taken to collect this data? How will you record your results? (table, graph) How many trials will you make to ensure that your results are consistent and reliable? What safety precautions need to be followed? How will you make sure that there are no leaks in your system? Submit a plan for approval prior to starting their inquiry.	

ACTION! (EXPLORE & EXPLAIN)	ASSESSMENT & EVALUATION
EXPLORE: Students will conduct their experiment. Results will be recorded in an observation table.	Students will create a table to record observations including: the time it takes for each liquid to travel through the tubing for each trial (there should be a minimum of 3 trials) Calculate the average flow rate. Create a graph to show the results. Determine the conditions under which the liquid travelled the fastest. Compare the results with the original hypothesis Did your results support your hypothesis? If not, what reasons might explain the difference? Students will present their findings to the class.
CONSOLIDATION (*ELABORATE, EVALUATE, & EXTEND*)	**ASSESSMENT & EVALUATION**
Present the students with the following scenario: In order to facilitate the transportation of oil from the Alberta tar sands to the Greater Toronto Area a proposal has be submitted to build a pipeline between these two areas. Which of the pipeline design considerations studied in your investigations (distance, temperature, resistance, and fluid density) do you think would affect the cost of building of the pipeline? Explain your reasoning. What environmental factors/costs would be associated with the building of the pipeline? How could some of these be minimized or even deleted?	Students could assist in the development of a rubric to evaluate this activity.

Working in groups of 3 or 4 students will create a proposal outlining: The pipeline design considerations (distance, temperature, resistance, and fluid density) which would affect the cost of the pipeline; What environmental factors/costs would be associated with the building of the pipeline? Considering the design considerations, how could the pipeline be built most efficiently?	

BACKGROUND INFORMATION FOR THE TEACHER

"Pipeline 101" found on the Canadian Energy Pipeline Associations (SEPA) website is an excellent resource for background information on pipelines. It can be found at:

http://www.cepa.com/Pipeline101.aspx?page_guid=6F35823F-A318-499B-BAC0-CB5DDE396C42

REFERENCES:

Sandner, L. et.al. Investigating Science and Technology 8. Canada: Pearson Education Canada, 2008.