

"A Case Study on Water Pollution in Canada" Grade 6-12

Subject: Social Studies

Topic: The relationship between industry and the natural environment, socio-technology of use, and the mining industry in Ontario.

Time Frame: 180 minutes (60 minutes each to complete the research, the debate, and the completion of the final report).

Objectives: The students will be able to analyze the relationships between large industries in Canada and the natural environment, paying specific attention to water quality. The students will grasp the concept of socio-technology of use and they will evaluate the sustainability of the mining industry in Ontario.

Methodology: Brainstorm, Independent Research, Role Play, Debate, Discussion

Materials:

- Overhead (or individual handouts) of Handout 1
- Copies of Handout 2
- Copies of the Information Sheet and ABC Stats (Note: INCO. is a real company. However, to keep them anonymous, we've chosen to use the name INCO.. (but the handouts later are about INCO))

Space Requirements: Classroom and other areas where students can break into small groups, the library or computer lab for research purposes, a large area for the final debate and discussion.

Background Information: This activity should have made students more familiar with the ways that industry can affect society and the environment.

Results: They should also learn that everyone in society has the responsibility to give feedback to the government/industry on the way that

things are run, and that every part of society is connected to each other; a change in one place will have implications for others.

Directions/ Procedure:

1. Ask students to quickly brainstorm a list of economic sectors that contribute in some way to our standard of living. A list may look like the following:
 - agriculture
 - crop farming
 - dairy
 - transportation
 - energy
 - oil and gas
 - electrical
 - retail
 - financial
 - research and development

2. Put up an overhead of Handout 1, or make copies for the students. Pick an industry, and ask students to discuss how changing the socio-technology of use of that industry would affect the various parts of the chart.
ie. A lack of pulp and paper resources would affect advertising, which may affect consumer consumption of product, which would

Encourage students to think about the implications of forcing change in our major industries. Could good intentions have less than good consequences?

3. Divide the class into groups to represent the following points of view:
 - The investors and shareholders of a company
 - The top administrators of a company
 - Workers for the company
 - The general public (consumers, citizens)
 - Representatives of various organizations
 - Environmental organizations
 - Consumer s' rights organizations

The company will be the mining company INCO., and the class will be analyzing the socio-technological effects of INCO. in Ontario.
(Another company or industry may just as easily be used.)

4. The members of each group will use Handout 2 and the information provided to guide their research on INCO.'s impact on society and the environment. Some time at the library or on-line would be helpful.

Some things that the students should consider while doing their research:

- What does the industry contribute to the standard of living of our society?
- Does the product make our lives better?
- Does the production/use of the product cause pollution?
- Does the industry create jobs?
- Overall, are we better off with or without this industry as is?

(again, most of these questions require yes/no answers - it would be better to have questions that require more detailed answers - e.g. How does the product affect our lives? How many and what kind of jobs does the industry create?)

Each of the special interest groups should also consider:

- what their assumptions are
- the definition of the problem
- the goals that they want to achieve
- criteria that they would use to know that they have achieved their goals

5. After the research has been completed, the groups will participate in a round table discussion on the problem at hand: INCO. creates products useful to society and creates jobs, yet pollutes the water and air. During the discussion:
 - Every interest group will have the chance to present their point of view
 - Each presenter may be questioned in order to get a clearer picture
 - Debate between various points of view will be allowed as needed to find where points of conflict may arise

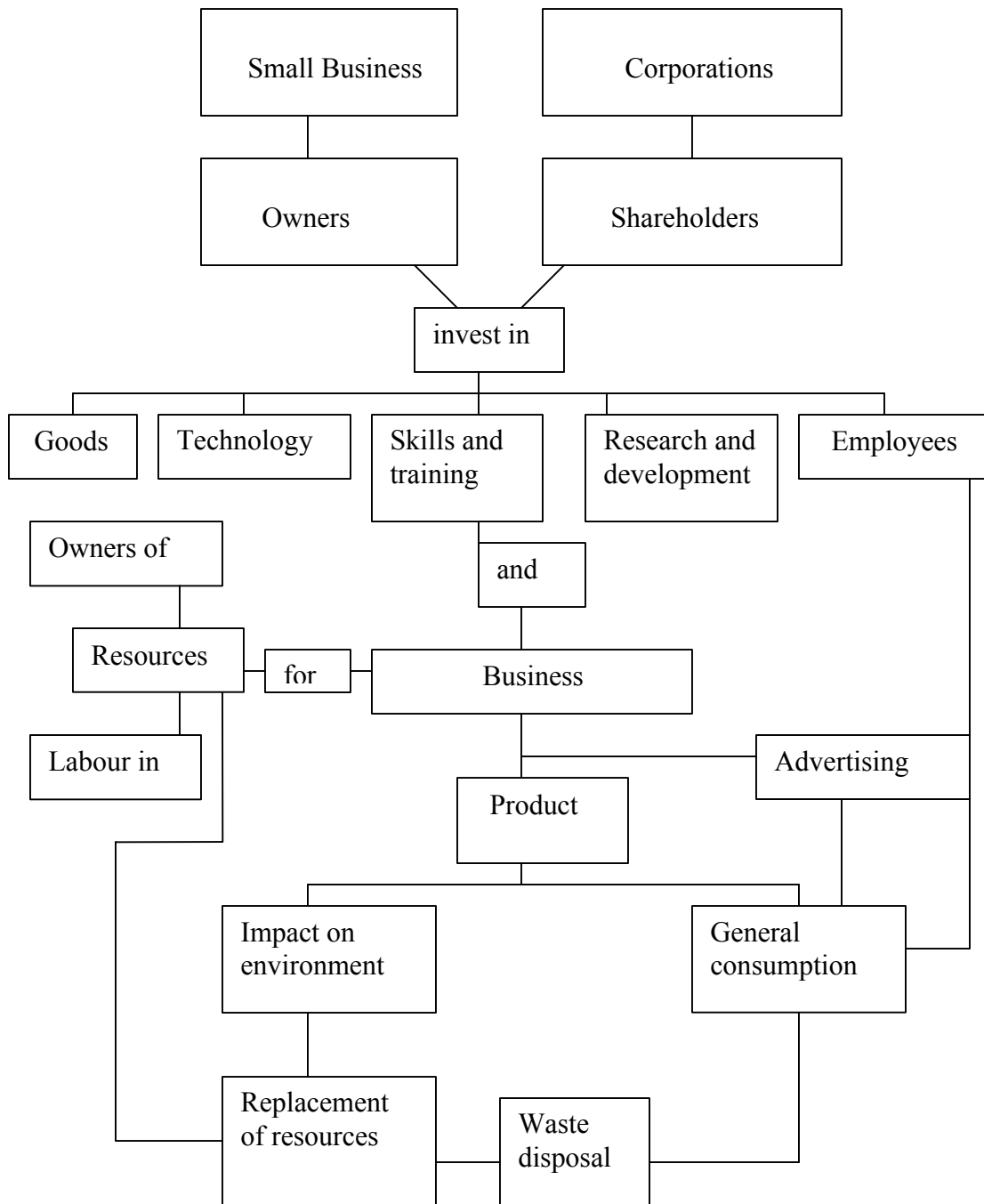
- Finally, the entire class will prepare a report together with a series of recommendations for the government to consider when making future policy for the mining industry
- Encourage the students to write a letter to the government in an attempt to take action.

Evaluation: Use the attached check chart during the discussion. Ask students to hand in some form of evidence of the research that they have done before the discussion so the teacher has an idea of the effort that went into the research. Another option is to have the students hand in a more in depth report (approximately 2-3 pages), either individually or by role playing the opinion of the special interest groups. This latter will encourage the students to see that each group of people has a special interest in the outcome for different reasons.

References and Related Links:

<http://www.sasked.gov.sk.ca/docs/actss20/u3a03.html>
www.pollutionwatch.org

Handout 1 Generalized Example of a Socio-technological System



- adapted from Evergreen curriculum, Social Studies 20, Unit 3

Handout 2

A Balance Sheet on the Impact of an Industry

Individual Industry Statistics		National & International Statistics	
<ul style="list-style-type: none"> • Investment costs in the business: <ul style="list-style-type: none"> ○ capital investment ○ research and development costs 	\$ _____ \$ _____	<ul style="list-style-type: none"> • Investment levels by the society in: <ul style="list-style-type: none"> ○ capital formation ○ research and development. 	\$ _____ \$ _____
<ul style="list-style-type: none"> • Amount and cost of resources used by the business or industry: <ul style="list-style-type: none"> ○ capital investment in resource development ○ amount of raw materials used ○ labour resources <ul style="list-style-type: none"> ▪ number of jobs generated ▪ size of payroll 	\$ _____ _____ _____ _____	<ul style="list-style-type: none"> • Resource supplies in the society: <ul style="list-style-type: none"> ○ availability of raw materials ○ projected deficits in resources ○ labour force <ul style="list-style-type: none"> ▪ size ▪ rate of growth ▪ education ▪ health 	_____ _____ _____ _____ _____

Individual Industry Statistics		National & International Statistics	
<ul style="list-style-type: none"> • Productive output of the business or industry: <ul style="list-style-type: none"> ○ number of units produced ○ taxes paid ○ profits paid to investors • Other businesses generated by this business or industry: <ul style="list-style-type: none"> ○ advertising ○ retail ○ repair ○ other 	 \$ _____ \$ _____ \$ _____ \$ _____ \$ _____	<ul style="list-style-type: none"> • Gross Domestic Product (GDP) of the society <ul style="list-style-type: none"> ○ GDP ○ population size ○ per capita income ○ annual growth of GDP ○ annual growth of population 	 \$ _____ _____ \$ _____ _____ _____
<ul style="list-style-type: none"> • Wastes generated: <ul style="list-style-type: none"> ○ in production ○ & during & after consumption of the good 	 	<ul style="list-style-type: none"> • Amount of waste generated by the economy: <ul style="list-style-type: none"> ○ in the production of goods ○ in the consumption of goods • The impact of wastes on the environment 	

Inco Information Sheet

“Inco Limited is a Canadian-based global company and the world's second largest producer of nickel. Inco also produces copper, cobalt and precious and platinum-group metals. Based on the latest data filed by the company with the Government of Canada, Inco has also been identified as the worst mining polluter in Canada, emitting toxins at more than twice the rate of any other mining company in the country. While it produces three times as much nickel as its nearest competitor, Falconbridge, it emits more than 13 times as much environmental pollution.”

“The **Sudbury Mining and Processing Operations** is located in Sudbury, Ontario. This facility opened in 1902. It is the largest fully integrated mining, milling, smelting and refining complex in Canada and one of the largest in the world, employing 3,300 workers. Sudbury residents have raised many environmental concerns around toxic pollution in soil, water and air. Levels far in excess of environmental guidelines now have leaked into the soil in many areas. The pollution from Inco's operations covers hundreds of square kilometers. Major studies are currently underway to determine the extent and danger posed by this contamination to the ecosystem and human health, and Inco may be liable for huge monetary damages and/or remediation. In September 2003, Inco's unionized work force announced strong opposition to the current plan to address the pollution issues.

“The **Port Colborne Refinery**, located in Port Colborne, Ontario, has been in operation since 1918. Currently, the facility refines cobalt and precious metals, and packages and distributes finished nickel products. Between 1918 and 1984, the facility refined nickel, releasing approximately 16 million kilograms of nickel oxide; a substance identified as a known human carcinogen by the Canadian Government and the U.S. Environmental Protection Agency. The soil on properties has been found to contain nickel levels up to 55 times higher than government guidelines for human health. Recent testing by Inco has revealed that air inside homes had nickel concentrations of more than 290 times above current government standards. Inco is now the subject of government orders to clean up these properties, and a proposed \$750 million class action lawsuit is currently before the courts.

“Inco alone accounts for 20% of all the arsenic emitted in North America, 13% of the lead and 30% of the nickel.”

Sudbury Lakes Polluted by Mining

Approximately 19,000 lakes have been damaged by smelter emissions in the Sudbury area. Inco has several of its largest mining operations in and near Sudbury. "Zooplankton, phytoplankton, benthic invertebrates and sport fish such as lake trout, brook trout, walleye and smallmouth bass have been adversely affected by the increased acidity and metal concentrations. Fortunately, a number of factors have recently contributed to the health of these lakes. First, emission controls are decreasing the amount of sulfur dioxide that is raining down into the lakes. As a result, the lakes are becoming less acidic. Reclamation of upland areas is also having a positive effect on lake systems. By controlling the erosion of topsoil, concentrations of calcium and magnesium have been decreasing in lakes (Keller et al. 1995). The active application of lime into lakes is also improving water quality by reducing acidity. The amount of powdered limestone applied depends on the acidity levels. Lime applications are apparently essential for the reintroduction of aurora trout, a rare color variant of brook trout (Carbone et al. 1998). This can be attributed either to the trout's need for certain insects that were absent before liming or their intolerance to acidic conditions. Carbone et al. (1998), conducted a study in which lime was applied to lakes in the Sudbury region to observe the effects of changing acidity. Changes were observed in insect populations within five years. While some dragonflies increased due to decreased acidity, populations of other insects decreased from restoration efforts. This was attributed to increases in predatory fish species or changes away from acidic conditions which some organisms such as Diptera may prefer."

The Sudbury region of Canada has been an example of how industry can have catastrophic effects on the environment. Fortunately, through the efforts of the multidisciplinary technical advisory committee, summer work crews, volunteer efforts, and industry itself, the region is now becoming an example of how degraded lands can be reclaimed.

(Dan Shaw, *Reclamation Technologies at Sudbury, Canada*)

Pollution Stats for Inco

Inco Central Mills site 2002 results from www.pollutionwatch.org :

- 343,999 kg of pollutants released into the water in total
- national ranking for water releases in 2002 - 53

All Inco sites in Ontario 2002 results:

- 369,070 kg of pollutants in total
- national ranking for water releases by Inco in Ontario in 2002 - 41
- these included at least 15 different water pollutants

Information on Riparian Rights, which have been used by some citizens in Ontario and other places to take action against water polluters, can be found at:

http://esask.uregina.ca/entry/riparian_rights.html

Group Discussion Evaluation Sheet

This sheet can be used by the teacher to evaluate the students during the class discussion or may be used by the students to evaluate other members of the group.

Does the student display evidence of having conducted research and developed good background knowledge of the topic?				
Does the student display evidence of the use of critical and creative thinking?				
Is the student respectful of others and listens in turn?				
Does the student make use of information given by others in the discussion or simply speak on his/her own opinion and knowledge?				
Does the student show an ability to reach a compromise?				

(evaluation sheet questions are geared to yes/no responses – it would be more effective if there was a grading scale)

e.g.

Student is respectful of others and listens in turn.	5	4	3	2	1	0
Student demonstrates thorough knowledge of the topic	5	4	3	2	1	0
Critical thinking is evident	5	4	3	2	1	0