

Oceans 11

Our Changing Sea

A. Global Warming

Sue Hellman
6/18/2009

A. Our Changing Sea: Global Warming Learning Targets

General Knowledge Learning Targets	Assessment Plan for “Our Changing Sea” Mini-Unit
<ul style="list-style-type: none"> Understand the following terms and concepts: <i>climatology atmospheric CO₂, average (mean) global temperature, direct correlation, longwave radiation, shortwave radiation, infrared, greenhouse gases (GHG’s), greenhouse effect, thermal energy, energy balance, global cooling, fiords, enhanced greenhouse effect, abiotic, biotic, ecosystem, glacier recession, terminal moraine, albedo, high vs. low albedo, polar ice caps, latent heat.</i> Understand the difference between <i>conventional</i> and <i>dissenting</i> points of view in science. Suggest issues about which scientists who argue for and against the power humans to cause global warming might agree and disagree. Diagram and explain the greenhouse effect. Explain the connection between energy balance, global warming and global cooling. Differentiate between the greenhouse effect and enhanced greenhouse effect. Understand the interaction between changes in albedo and changes in the energy balance. 	<ol style="list-style-type: none"> Meet with your teacher to collaborate on your Intentional Learning Plan. Together you will: <ol style="list-style-type: none"> select your targets develop the rubric set your goals; record them on a calendar with ‘check in’ dates This counts for 20% of your final grade so it must not be ignored. Complete and correct your Student Booklets and the glossary in Quizlet. When you come to them, do the 2 short projects. (5%) <ol style="list-style-type: none"> Ask for the rubrics. When you have the project assembled and think it is ready for an audience, initiate your peer consultation. Incorporate suggestions and make the final edits. Present your project. When the 3 “Changing Seas” student booklets are done, review & then complete and correct the Progress Check. Ask for the Project Booklet; review the multi -purpose rubric; select and copy what is needed; do the final project. At the end of Oceans 11 <ol style="list-style-type: none"> complete and correct the Review Guide do the final test retest if you and you teacher are not pleased with the result.
<ul style="list-style-type: none"> Give examples of changes to the polar ice caps in the Arctic and Antarctic that have occurred in the past 5 years as a result of global warming. Know when the Arctic Ocean is predicted to remain open all summer. Identify the factors that are speeding up the rate of warming of the Arctic Ocean and loss of sea ice. 	<p>Assessment of General Knowledge targets:</p> <ul style="list-style-type: none"> learning activities in the Student Booklet ‘Changing Seas’ Progress Check unit test their application in the final project
<ul style="list-style-type: none"> Summarize the threats to coastal communities such as White Rock, BC, as sea levels rise. Understand the long term outlook for these areas if current warming trends continue. 	

Skills Learning Targets	Skills Assessment
<ul style="list-style-type: none"> • Read print articles and use video or audio resources to locate information. • Develop definitions, answers, explanations, and descriptions that show some paraphrasing, rather than a copy & paste approach. • Use Quizlet to create a glossary • Cite sources and make a bibliography using Easybib • READ AND INTERPRET VARIOUS SORTS OF GRAPHS 	<ul style="list-style-type: none"> • Student Booklet • included in other project rubrics • Student Booklet, Prog. Chk., Unit Test
Products	
<ul style="list-style-type: none"> • Create a PowerPoint presentation or video slide show. • Create a tour in Google Earth. 	Multi-purpose project rubric sections <ul style="list-style-type: none"> • I-g, IV-e,g; Va,b • I-h, IV-b,e,g; V-a,c
'Purposeful Learning' Targets	'Purposeful Learning' Assessment
<ul style="list-style-type: none"> • Set a goal for completion of Section B. • Engage in planning, persistence, actively making connections, taking safe risks, and reflection. 	Progress will be assessed jointly by the teacher and student <ul style="list-style-type: none"> • teacher observation • student reflection & self-assessment • ongoing collaborative discussions • final discussion

I. GLOBAL WARMING -- what is it? who or what is causing it?

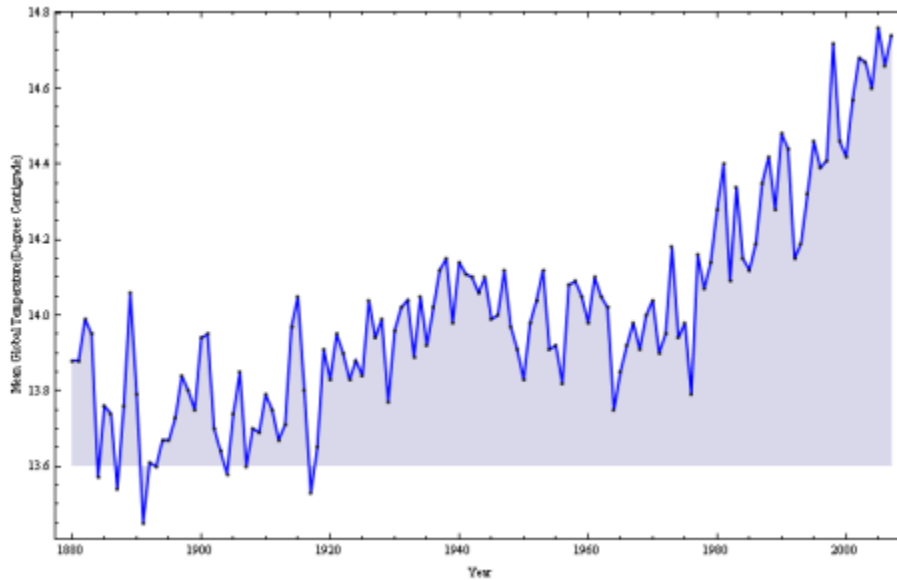
GLOSSARY: add to your **Oceans 11** glossary in [Quizlet](#). Include **BOLD TERMS** and other words you feel need clarification. The sign in and password are 'wrlc1wrlc2'.

1. CONTROVERSY



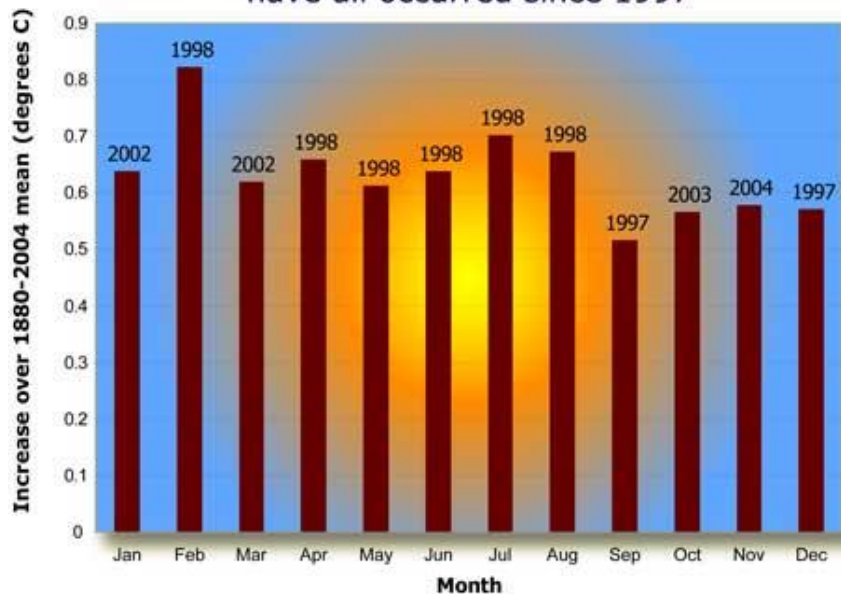
[Image Source: Walt Handelsman, [Newsday](#), Feb.1, 2007]

Scientists generally agree that the earth is heating up. Because there has been so much weather data kept all over the world since 1880, the evidence is hard to ignore. The average Earth temperature has been rising in the past decade. Although not every year has been hotter than the one before, the general trend is increasing.



[Image Source: <http://zipcodezoo.com/Trends/Trends%20in%20Global%20Temperature%20Appendix.asp>]

Record Global Monthly Temperatures, 1880 - 2004 have all occurred since 1997



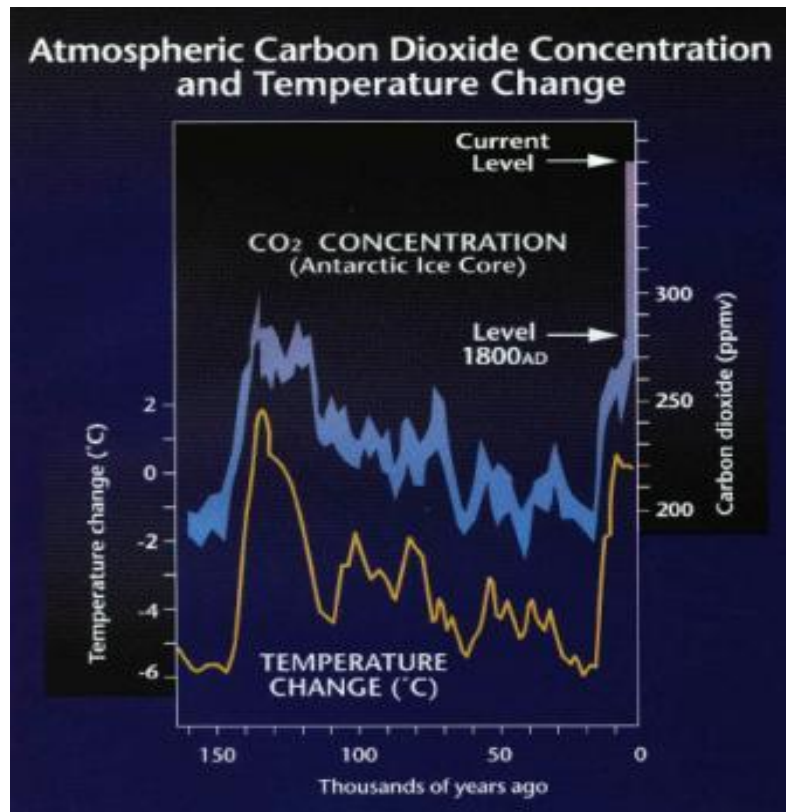
Data source: University of East Anglia, Climatic Research Unit
<http://www.cru.uea.ac.uk/ftpdata/tavegl2v.dat>
 Graphic: Michael Ernst, The Woods Hole Research Center



This graph from 2004 shows how much warmer it was during the hottest month on record compared to the average for that month.

For example Feb. 1998, the hottest February on record, was nearly 1°C warmer than the average for that monthly dating back to 1880.

Still -- science is full of controversy, and what we believe to be true today may be totally proved wrong in years to come. Graphs that convey one story to some scientists, may be interpreted differently by others. In **CLIMATOLOGY**, not all scientists agree that people are responsible for this global warming.



This graph shows that there is a **DIRECT CORRELATION** between the amount of CO₂ in the atmosphere and the average temperature of the Earth. These 2 properties of atmosphere and Earth are closely related. Although temperature change seems to follow CO₂ levels, the problem is that it is not yet possible say for sure if CO₂ is causing temperature increase, or whether it is the other way around, or whether something else is causing them both to vary.

The most widely held view today is that increased CO₂ is causing global temperature to rise. However, dissenting scientists, many of them leaders in their own fields, point to the fact that the Earth has been hot for much longer than it has been cold. Some attribute global warming to the natural cycle of warming and cooling that is part of Earth's geologic history. They believe that man -- a mere pipsqueak compared to the scale of the entire atmosphere and solar system -- could not possibly generate enough greenhouse gases to cause large scale change in the temperature of the Earth. In their opinion: "the ongoing rise of atmospheric CO₂ has only a minor influence on climate change and . . . attempts to control CO₂ emissions are ineffective and pointless -- but very costly." (Singer, 2007)

READ: *Arctic Climate Switched from Greenhouse to Icehouse*

→ <http://www.cbc.ca/health/story/2006/05/31/arctic-climate.html>

For those who take the conventional view the steep rise in atmospheric CO₂ since 1800 is cause for alarm (shown in purple at the far right the graph). During the most of the 450,000 year time period for which [evidence](#) has been collected ([click & scroll](#) to see graph with longer time frame), CO₂ parts per million levels have never above 300. Today, however, atmospheric CO₂ concentration has [surpassed 380 ppm](#), and is climbing rapidly. Will the temperature line in the graph follow the CO₂ line's lead? If the answer is yes, then we [haven't yet experienced the full consequences](#) of this astonishing carbon dioxide concentration ([Thibodaux, 2007](#)).

READ: *Earth at Warmest Point in 12, 000 years Say Scientists*

→ <http://www.cbc.ca/technology/story/2008/08/27/arctic-seaice.html>

If people are responsible for global warming, it would be good to know

- how we're doing this,
- what some of the consequences will be, and
- whether there's still time to reverse the trend

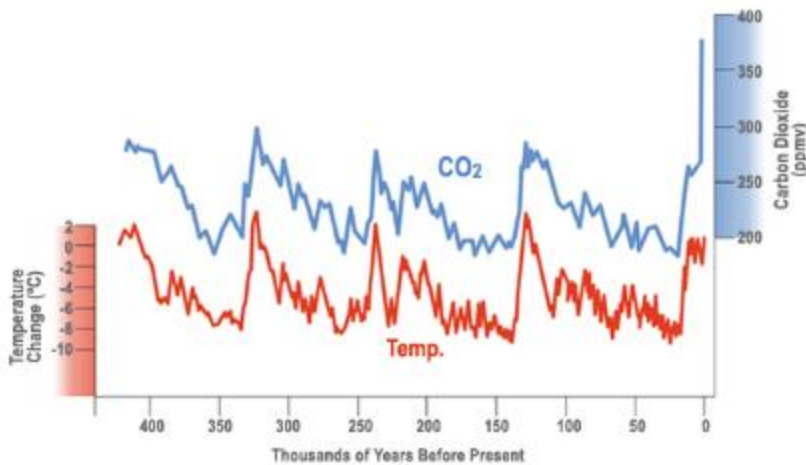


ANSWER:

1) Climatologists have some points of agreement and some of disagreement. Summarize in the table below.

Shared Views	Conventional View	Dissenting View

2) Interpreting a graph



- How far back does the data on this graph go?
- What 2 properties are being compared (be specific).
- what does 'ppm' stand for?
- When were the 3 greatest spikes in temperature in the past?
- What is the current mean global temperature?
- Why is it pretty safe to predict that global temperature will continue to rise?

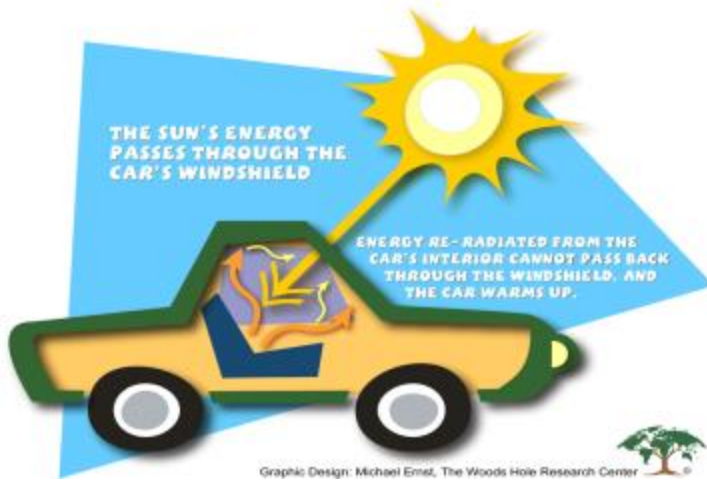
2. GREENHOUSE EFFECT

To understand global warming, you first have to know about two kinds of radiation: **LONGWAVE** and **SHORTWAVE**. Sunlight is a form of shortwave radiation. Although some of it is reflected and scattered back to space at the top of the atmosphere and by clouds in the troposphere, a good 50% of the sun's shortwave radiation reaches the surface of the Earth and warms it up. At night when the planet cools, the energy it absorbed during the day is reradiated as heat or **INFRARED** radiation back out towards space. Infrared is longwave.

Heat energy is longwave radiation. It cannot pass through the atmosphere as efficiently as shortwave, because some of it is absorbed by the **GREENHOUSE GASES** (GHG's) -- mainly water vapour, carbon dioxide, and **METHANE**.

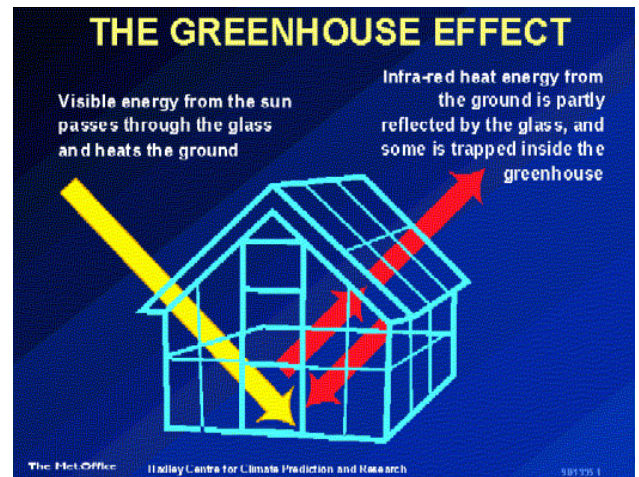
This special group of gases act like window glass. Glass permits the shortwave light rays of the sun to enter a structure like a greenhouse or your car on a sunny summer day and then keeps the longwave heat energy trapped inside.

In the same way, GHG's absorb some of the longwave infrared (heat) radiation that is trying to escape from the surface back into space and send it back earthward. This is called the **GREENHOUSE EFFECT**.



[Image sources: ___ &

<http://io.uwinnipeg.ca/~simmons/16cm05/1116/16ecosys.htm>]



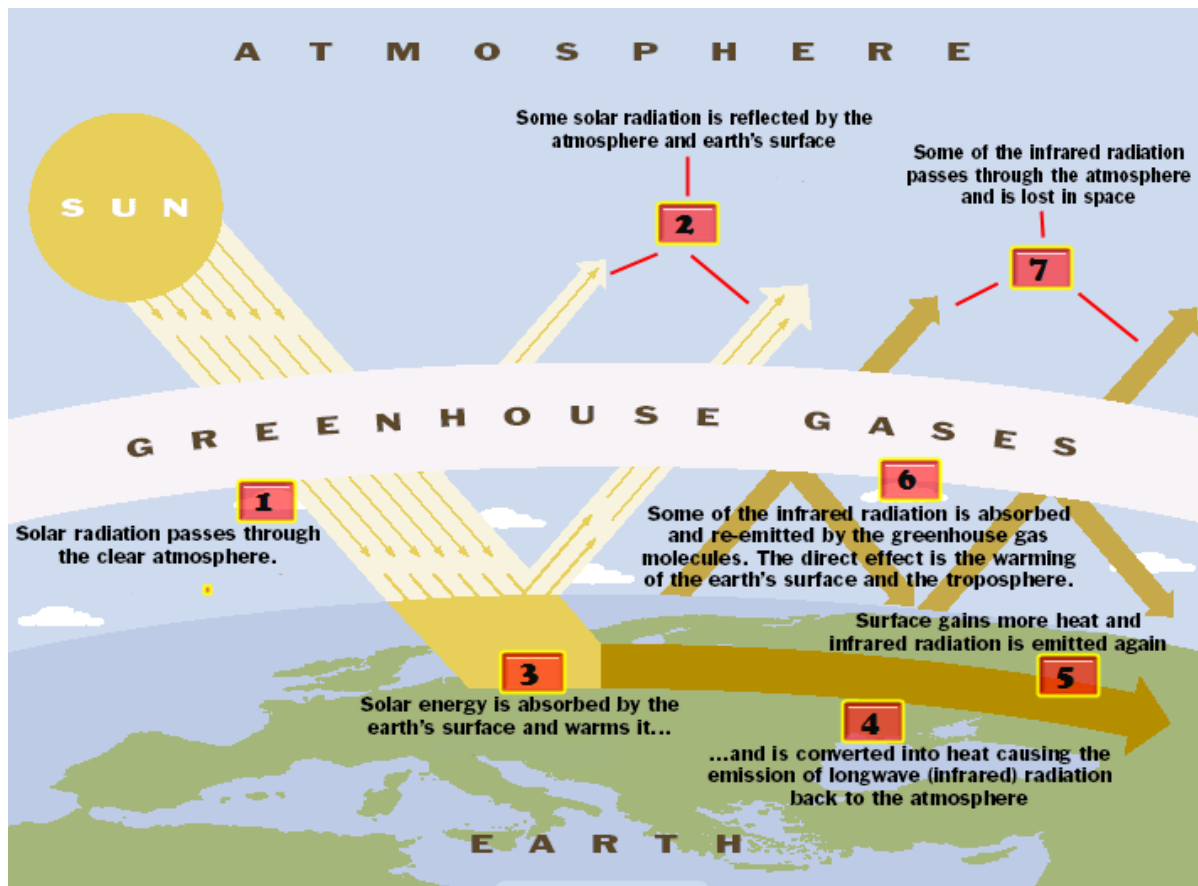
VIEW ANIMATIONS: (greenhouse effect)

→ http://www.planetguide.net/book/chapter_3/greenhouse1.html

→ <http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/>

READ & VIEW: Earth's Greenhouse Gases

→ http://www.windows.ucar.edu/tour/link=/earth/climate/cli_greenegas.html

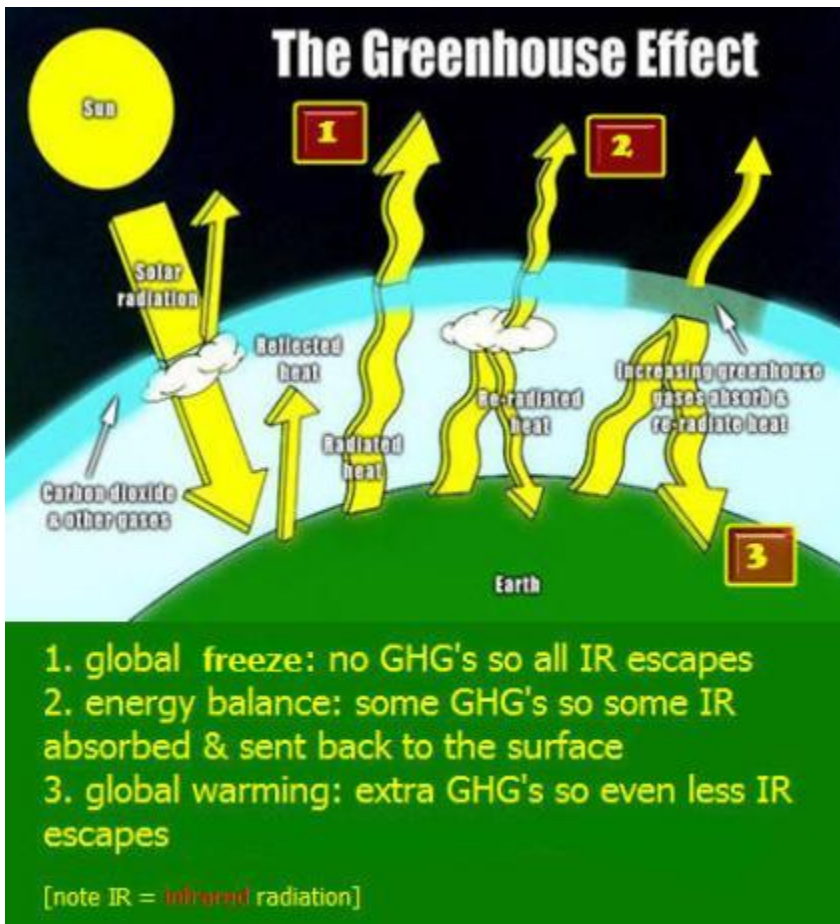


[Image source: <http://io.uwinnipeg.ca/~simmons/16cm05/1116/16ecosys.htm>]

Without greenhouse gases, all the heat absorbed by the surface during the day would escape back out to space at night. The result would be a frozen planet like Mars which has no atmosphere to keep it warm.

There are 3 scenarios to understand:

- When enough **THERMAL ENERGY** is trapped by the GHG's to keep the Earth's average temperature in what we consider to be the normal range, we call this an **ENERGY BALANCE**.
- If the energy that escapes back to space becomes greater than the energy absorbed, that leads to **GLOBAL COOLING**. There have been many Ice Ages during the Earth's history with the most recent ending about 10 000 years ago. During that period, deep glaciers sculpted our North Shore mountains, created the Fraser River, and carved deep **FIORDS** like Indian arm into our coast.
- When the total incoming energy exceeds the outgoing, the energy balance is disrupted and **GLOBAL WARMING** is the result.



Most scientists believe humans are now adding enough extra CO₂ to the atmosphere to cause the planet to overheat. The extra GHG's in the atmosphere are believed to trap longwave radiation that would otherwise have escaped into space. This is sometimes called the **ENHANCED GREENHOUSE EFFECT**.

ANSWER:

3) Complete the table

Both	Longwave radiation	Shortwave radiation

3) Create and label a diagram to show the normal and enhanced greenhouse effects.

(Please use colour effectively and provide title and a legend.)

3) If the enhanced greenhouse effect is described as too much of a good thing, what might that mean?

4) List 6 most important GHG's.

5) What is meant by *the energy balance*? What happens to it when global cooling occurs?

II. GLOBAL WARMING -- impacts on glaciers & sea ice

The Earth is a fragile place. Global warming affects both **ABIOTIC** and **BIOTIC** components of any **ECOSYSTEM**. Because you are studying oceans in this unit, you'll look at how coastal areas of BC and the Arctic Ocean will be affected if this warming trend continues.

STARTER PROJECT: Sir Ranulph Fiennes, one of a team of 2 men who were the first to go to both the North and South Poles by land, wrote in his Introduction to the book *Fragile Earth*:

“On the day we reached the North Pole, it seemed like another world which would be untouched by man forever. As we are all becoming increasingly aware, this is not the case. . . . The world is now approximately 0.60C (1.10F) warmer than 100 years ago and there is clear evidence that many glaciers are now retreating and that the polar ice caps are shrinking.” The icy world . . . may feel a long way from our civilized world, but changes there will have a huge impact globally.

VIEW: *Fragile Earth* video

→ http://www.bartholomewmaps.com/fragile_earth_movie/index.html

There are 4 quotations in that video. Pick the one that means the most to you. Use it as a starting place for a PowerPoint or video slide show to portray the story of shrinking sea ice and glaciers. Include 4 pairs of before and after images. Consider the impact of people on these locations. Do you think people have to be living in an area to have an effect on its future? What factors make the impact of man so far-reaching? Write a concluding statement of your own. Include a bibliography slide. Use *Easybib* to help you with the format.

1. GLACIERS



VIEW:

a. **Metro Vancouver: The Sustainable Region TV Program.** Scroll down to **2008: Episode 37** and view the last clip entitled **Last Glacier in Metro**

→ http://www.metrovancouver.org/region/tsr_tv/Pages/default.asp

b. **Surrey Leader's Gallery>Last Glacier**

→ <http://picasaweb.google.ca/thesurreyleader/LastGlacier#>

c. Read the cached **Surrey Leader** article about this glacier your **Oceans 11** resource folder

d. **National Geographic>Global Warming Videos** (right)>**Glacier Melt** (in the Austrian mountains)

→ <http://video.nationalgeographic.com/video/player/environment/global-warming-environment/antarctica-ice.html>

ANSWER: Use the above sources to answer the following questions.

- 1) Where is the Coquitlam glacier located?
- 2) What is its importance to the Lower Mainland?
- 3) What has protected it when the other 9 glaciers have melted away?
- 4) What is “**GLACIER RECESSION**”?
- 5) How far has the Coquitlam glacier receded from its **TERMINAL MORAINES**?
- 6) How is a glacier eroded by water?
- 7) How much ice is being lost every year?
- 8) How much water is contained in this glacier's ice?
- 9) How long is the glacier expected to last?
- 10) Long term weather forecasts predict that our West Coast climate will change significantly in as little as 45 years. Winter and spring will be warmer and wetter with more storms and less snow accumulation. Drought will be more common as summers will be dry and there will be less snowmelt to replenish streams and rivers. The Coquitlam glacier will be gone or just a remnant of what is there now.
 - a) How old will you be then?
 - b) Give 3 examples of adaptations that will be required to ensure people in the Lower Mainland have enough water.

2. SEA ICE

READ & VIEW:

- a. **Arctic Sea ice Drops to 2nd Lowest Level on Record**
→ <http://www.cbc.ca/technology/story/2008/08/27/arctic-seaice.html>
- b. scroll to **Video Feature: The National > Sea Ice Melt**
→ <http://www.cbc.ca/news/background/climatechange/index.html>
- c. **Polar Ice Caps**
→ <http://www.truveo.com/Arctic-Warning-Polar-Ice-Caps-121206/id/4116951843>
- d. scroll to **Ayles Ice Shelf Collapse** (Ellesmere Island) > **Multimedia > Arctic Ice Melt** (slide show, video, and interactive map)
→ <http://www.cbc.ca/news/background/climatechange/index.html>
- e. about Antarctica
→ <http://video.nationalgeographic.com/video/player/environment/global-warming-environment/antarctica-ice.html>

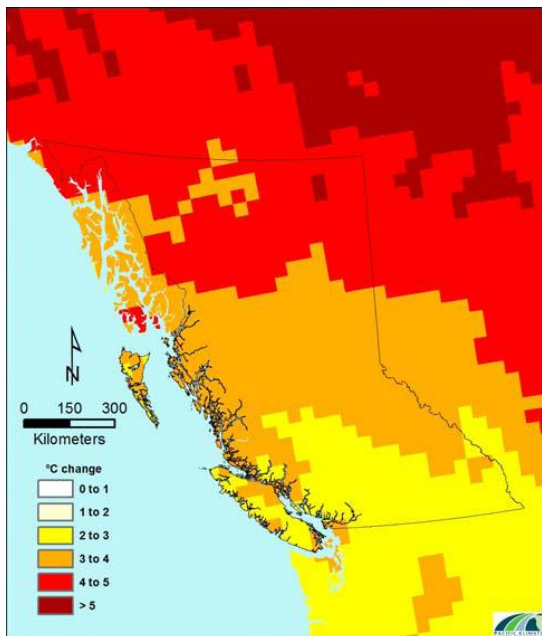


Image Source:

http://www.env.gov.bc.ca/soe/eto7/04_climate_change/technical_paper/climate_change.pdf p. 11

“The Earth is not warming evenly, and some areas, particularly in northern latitudes, have been warming more rapidly than equatorial regions. As remote as they are, the polar regions have been most obviously affected so far by climate change. The average temperature in the Arctic is increasing twice as quickly as the global average.

The extent of sea ice, which was relatively stable until the 1960s, has been shrinking at the rate of 7.8% per decade since then. Arctic sea ice coverage in April 2007 was the lowest for that month since satellite imagery of the northern ocean began in 1979.”

This map shows the predicted average temperature change for the Pacific Northwest by 2050 (over 1961-1990 average). The Far North could be more than 5°C warmer by the middle of this century.

Global warming is taking its toll on the **POLAR ICE CAPS** in both hemispheres. Satellite photography and direct observation both have provided plenty of direct evidence that the rate of melting is increasing. The Northwest Passage (pictured below) –the route so many European explorers believed would be a shortcut from their continent to China – could be **open this summer** (2009).



[Image Source: <http://seekingalpha.com/article/40675-canadian-energy-renewing-arctic-territorial-claims>]

ANSWER: Use the above sources to answer the following questions.

- 10) Looking at the map of BC and the North compare the predicted temperature increase that is expected to occur in Surrey (Lower Mainland) vs. the Far North by 2050.
- 11) About how long ago did the Arctic sea ice begin shrinking?
- 12) Using any of the CBC links list 3 biotic and 3 abiotic components of the north affected by global warming.
- 13) How long do scientists expect the polar ice caps to last?
- 14) Give 2 changes occurring in Antarctica.
- 15) What is the greatest danger if the rate of melting in Antarctica continues?

3. ALBEDO

What happens to the insolation that reaches the Earth? Dark ground cover and oceans cover 70% of the Earth's surface so it normally absorbs and re-emits a lot more energy than it reflects. Some of this re-radiated shortwave radiation is absorbed by and heats the lower atmosphere. However, not all insolation that reaches the surface is absorbed. A small but significant portion -- about 4% -- is immediately returned to space by reflective surfaces like ice, snow, and deserts. A significant problem associated with melting glaciers and sea ice is the change in the Earth's reflectivity -- i.e. its **ALBEDO**.

HIGH ALBEDO	LOW ALBEDO
light colours or white	dark colours
smooth surfaces	rough surfaces
ice, snow, & desert	forest, soils, rough ground, water

Even small changes in the Earth's albedo can disrupt the energy balance enough to cause global warming or global cooling. Scientists fear Earth's albedo is now so low that the energy balance -- equilibrium of incoming and outgoing energy-- no longer exists.

In recent decades, glaciers and the polar ice caps have been melting a rapid rate. Previously highly reflective areas now absorb heat because more rough ground or water beneath the ice is exposed. Atmospheric processes such as conduction and convection transfer increased amounts of thermal energy away from the surface, so the atmosphere also warms up.

In some area this results in more severe storms. In others **DESERTIFICATION** follows. Other impacts of lowering the albedo include: stronger winds, changes in ocean currents, and -- sadly yes -- faster melting of more ice. It's a downward cycle that's hard to stop once it gets started. Habitats change. Plants, animals, and people suffer as a result.

VIEW: NASA animations about albedo

→ <http://svs.gsfc.nasa.gov/vis/ao10000/ao10000/ao10021/index.html>

→ <http://svs.gsfc.nasa.gov/vis/ao10000/ao10000/ao10023/index.html>

ANSWER:

16) In each case say how the albedo of a surface (**H to L or L to H**) would change and why.

- _____ a) frozen lake thaws in the spring
- _____ b) cutting and burning of a rainforest to make way for farming
- _____ c) sea ice around Greenland is melted and remains open in the summer
- _____ d) areas that previously had vegetation turn into desert drought of many years
- _____ e) putting a subdivision where there was one a field where crops were grown

17) Over the Earth's long history, there have been many times when much of the northern hemisphere was covered by vast sheets of ice and snow. During the last Ice Age which ended only about 9 000 years ago, glacial ice over a kilometre thick covered up to 97% of Canada. In BC only one mountain peak was high enough to peak out of the top of the ice. It is found on Vancouver Island.

How might a global Ice Age have developed? Give a detailed answer using the terms: **energy balance, global cooling, glaciers, polar ice caps** and **effect on albedo**. Paste in a map to show much of North America was covered by ice during the last Ice Age. Be sure to cite your source and include a link.

4. CONSEQUENCES

VIEW:

- a. the Northwest Passage
→ <http://geology.com/articles/northwest-passage.shtml>
- b. scroll down about 2/3 to **Effects of Sea Level Rise & Island Nations**
→ http://en.wikipedia.org/wiki/Sea_level_rise

Factors that are contributing to the rapid melt of polar ice caps include:

- lower albedo -- Once the ice starts to melt, the region's albedo decreases. A surface that once reflected insolation even in the summer, becomes dark and absorbs energy instead. The temperature of the water rises. Areas once covered by ice all year round have open water in the summer.
- thinner ice -- Once fall comes and the seasonal temperature falls, thin 'first year' ice replaces the thicker year-round ice which originally formed when the earth was cooler but now is gone. The newer ice is will melt again the following summer.
- warmer air -- Shifts in atmospheric circulation have brought much warmer air (5°C) to the Arctic from neighbouring locations.
- warmer surface currents -- the Gulf Stream is transporting warmer water to the North

Eventually it seems, when the polar ice caps have melted, the polar bears of the north and penguins of the south will lose their familiar habitats. Because there will be no colder areas to which they can migrate, these species will either have to adapt genetically or they will not survive. But what about us? What about the residents of places like White Rock? Why should we care about changes to the sea ice way up in the Arctic?

Global warming will cause the Earth's sea level to rise first because of the increased amount of water added to the ocean basins as the melting accelerates and also because of the thermal expansion of ocean water. Remember the Kinetic Molecular Theory? The warmer sea water becomes, the farther apart its molecules move and causing its volume to increase.

“The global links between atmospheric temperatures, ocean circulation, sea level, and weather and storm patterns mean that changes to the climate from global warming will affect everyone. Because climate is the major factor controlling the global pattern of ecosystems, this is expected to result in changes to the ecosystems that people depend on for food, water, clean air, and economic activities. Also, existing infrastructure (e.g., cities, ports, dams), agricultural systems, and other human activities will be affected because they have been based on past sea level and climate patterns.”

Some of the projected and observed changes include:

a) Physical impacts, such as increasing frequency and severity of extreme weather (heat waves, drought, and high-intensity rainfall), changes in river flow, increased flood risk, increased wildfire risk, shrinking glaciers and

snowpacks at most locations, rising sea level, and alteration of ocean temperature, salinity, and density.

b) **Biological impacts** on ecosystems, such as changes to vegetation, species composition and distribution, ecosystem function (productivity, nutrient and water cycling), and distribution of ecosystems in the landscape. Timing of biological events, such as flowering, migration, growth, and reproduction, and interactions between species, will be affected. Patterns of natural disturbance (fires, pest infestations) and the impacts of alien species will also change.

c) **Socio-economic effects**, including the economic cost of dealing with the impacts listed above. In particular, there will be costs due to extreme weather, flooding, and sea level rise, as well as costs of investing in conservation measures, developing alternative water supplies, building or replacing infrastructure, and possibly moving people to other locations. Ecosystem-based economic activities, such as agriculture, forestry, salmon fisheries, and tourism, will also be affected.

d) **Health effects** will include increasing range of certain diseases (such as malaria) and increased risk of heat-related illnesses such as heat stroke." (pp. 4-5)

Global temperature is predicted to continue to increase for hundreds of years even if we manage to stabilize GHG concentrations in the near future. If the current increase of 5°C lasts for 1000 years, enough if Greenland's ice will melt to raise sea level by 3 meters. "Several centuries after CO₂ emissions occur, about a quarter of the increase in CO₂ concentration caused by these emissions is still present in the atmosphere." Under these conditions, global temperature would remain higher than it is today for a very long time. A sustained temperature increase of about 3°C would eventually melt all of Greenland's ice and increase sea level by about 7 meters.

Rising sea water will certainly cause local areas which are currently snug and dry to be flooded. Climatologists estimate sea level has risen by about 3cm in the last 10 years, and with the acceleration in sea ice melt, it could go up as much as 20 to 40 cm by 2050. Interestingly, because much of White Rock is perched on a cliff, although the beach and Marine Drive areas will be underwater, most White Rock residents will not have to swim to school or work. Low lying areas in the Lower Fraser Valley and at Crescent Beach, however, are at high risk. The Serpentine and Nicomickel Rivers empty into the Pacific and at high tide their water levels rise. As the rising sea swells the lower reaches of these two local rivers, many properties will be submerged.

ANSWER:

18) Give 2 reasons the Northwest Passage is now considered economically so important?

19) 4 factors that contribute to the rapid melt of polar ice caps include -- give a synonym phrase

- _____ changes in atmospheric circulation
- _____ decrease in the reflectivity of the surface as more and more ice melts
- _____ ice that has reformed after melting is not a thick
- _____ Gulf Stream circulates warmer water northward

20) Use Inspiration to create a mind map to illustrate the changes that have and will continue to occur if global warming continues. Make it memorable by using icons to represent the problems.

21) If we stopped adding CO₂ and GHG's to the atmosphere today, would global warming cease? Explain.

SHORT PROJECT TO FINISH THE BOOKLET:

VIEW: Sierra Club layer in Google Earth to see the predictions for sea level changes in the Lower Mainland

→ http://www.google.com/gadgets/directory?synd=earth&url=http%3A%2F%2Fwww.google.com%2Fmapfiles%2Fmapplets%2Fearthgallery%2FVancouver_Sea_Level_Rising.xml


By 2050 most of the northern polar ice cap will have melted and sea levels in Surrey will have risen enough for areas we now commonly visit to be under water. Project yourself forward into 2050. Imagine you are telling your grandchild what it was like to live in Surrey in the 'good old days'. Think of the places you liked to go -- where you met up with friends or you skateboarded, good places to go for walks, a favourite restaurant or café, or a place you worked -- places that are now underwater or only accessible by boat as the city has held off building new bridges until the rising water stabilizes.

Your task is to create a tour in Google Earth of between 5 and 8 such locations. Put the first placemark at the school and the last one at your current home. Use the GE path tool to connect the placemarks in order and help your grandchild visualize the journey. At each placemark, include an original image of yourself in front of a description of each location as it is now. The description may be written or in the form of a video or audio clip. It is intended to be very brief -- 3 or 4 sentences at most. The story should make for an interesting 'historical' tour, so spice it up with personal anecdotes or links to newspaper articles or other memorabilia that will give your grandkid the feeling of what it was like to live in Surrey before the sea level rose. It should also contain some cautionary information about what (a) caused the sea levels to rise back in 2009, (b) what people could have done to prevent this natural disaster from occurring. Cite all sources. Include a link on the first or last page to your bibliography in Easybib.

This is a learning activity. It is not intended to be a long project. My intention is for you to have an interesting way to learn about the long term outlook for our community if the

current warming trend continues. In fact part of the evaluation will be that you completed the project in an efficient and timely fashion, so you will have to develop a timeline on a calendar. You will use your ESC 11 First Class calendar, your Google Calendar, or the planning calendar in your school agenda book for this purpose. If you want to include special effects such as video, music, or other storytelling devices, they must not prevent you from keeping to your timeline. Consult other students who have done the project for help with planning and production, and also check in with me daily

- for planning approval,
- to show me you are meeting your goals,
- to book out equipment, and
- to arrange for class time to take the photos if needed .



Oceans 11

Our Changing Sea

B. Resources (fossil fuels)

Sue Hellman
6/18/2009

General Knowledge Learning Targets	General Knowledge Assessment
<p>Natural Resources</p> <ul style="list-style-type: none"> • Understand the following terms and concepts: <i>natural resources (renewable & non-renewable), fossil fuels, subterranean, reservoir, refinery, fractionation.</i> • Give examples of resources used to make common articles or products found in a student’s bedroom, book bag, or car. • Differentiate between <i>renewable</i> and <i>non-renewable</i> resources. • Be able to give examples of each. • Explain how/when fossil fuels reserves in Canada were formed (with reference to the geological time line), how long this took, and where the greatest known reserves are located in Western and Northern Canada. • Explain the processes involved in taking crude oil from extraction to production of commonly used fuels. • Identify common products in addition to oil, gasoline, and natural gas that are made from petroleum resources. <ul style="list-style-type: none"> • Explain the importance of locating new reserves of fossil fuels in Canada • Identify the level of government to which revenues accrue and the types of programs funded by this revenue (economic, social, and political benefits) • Identify the level of government which is responsible for environmental protection <ul style="list-style-type: none"> • Identify uses that could be made of the Arctic Ocean when it becomes common for it to remain open in summer as a result of global warming. Include shipping, and harvesting of natural resources (sea and ocean bottom). • List benefits to Canada of staking a large claim to the Arctic Ocean floor. 	<p>To be completed & corrected in Part B</p> <ul style="list-style-type: none"> • Part B Learning Activities • Part B Progress Check <p>To be completed & corrected at the end of the unit</p> <ul style="list-style-type: none"> • Oceans 11 Review Guide <p>Final General Knowledge Assessment</p> <ul style="list-style-type: none"> • Oceans 11 Unit Test
<p>Skills Learning Targets</p>	<p>Skills Assessment</p>
<ul style="list-style-type: none"> • Read print articles and use video or audio resources to locate information. • Read and interpret maps. • Label on a map of Canada: the 4 western provinces and 2 northern territories, Greenland, Baffin Is., Ellesmere Is., and Alaska; the Beaufort Sea and Hudson Bay; Inuvik and Surrey. • Develop definitions, answers, explanations, and descriptions that show some paraphrasing, rather than a copy & paste approach. • Add to your Quizlet glossary. • Organize information into a mind map or table. 	<ul style="list-style-type: none"> • learning activities, progress check, unit test <ul style="list-style-type: none"> • from Multi-use Rubric (I-d; IV-b,e; VC)
<p>‘Purposeful Learning’ Targets</p>	<p>‘Purposeful Learning’ Assessment</p>

I. NATURAL RESOURCES -- do I need these?

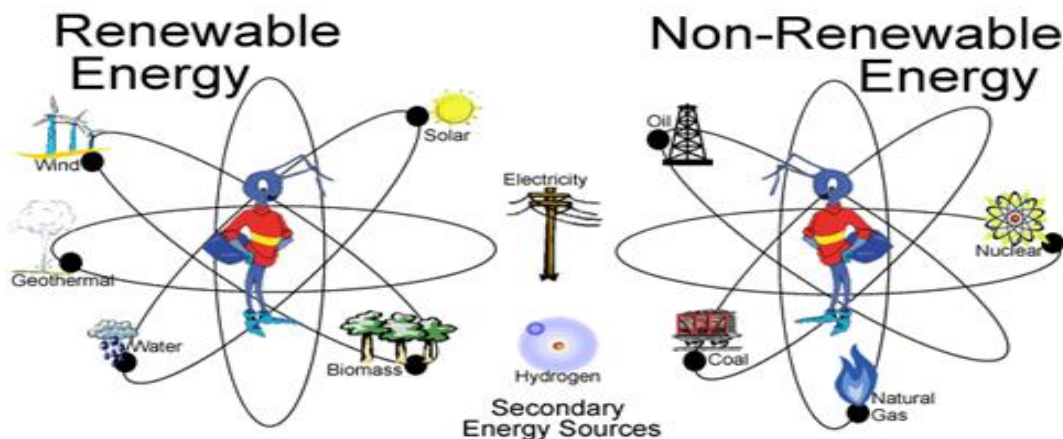
You may recall from Science 10 that **ENERGY** is the ability to do work or make things move. Energy can be transformed from one form to another. Your body turns the chemical energy stored in food into mechanical energy of your moving muscles and beating heart. In a similar way your car turns the chemical energy stored in fossil fuels into mechanical energy of the moving parts and into heat and light energy as well.

Where does that original chemical energy come from? It comes from the sun. Green plants store it when they convert solar energy into carbohydrates during photosynthesis. Fossil fuels are made of decayed biological matter. Because matter cannot be created or destroyed, when fossil fuels are burned, the original stored carbon is released into the atmosphere as carbon dioxide.

1. ENERGY RESOURCES

The energy that is stored in matter is called potential energy. Energy resources provide us with a supply of potential energy. We burn or harness them to convert their stored energy into a form we can use to make electricity, heat our homes, and power our vehicles. Energy resources can be classified as either: **NON-RENEWABLE** or **RENEWABLE**. Non-renewable resources such as fossil fuels are generally found in the earth's crust and exist in a fixed supply. Renewable resources are often referred to as 'alternative' sources. They are considered 'clean' because their use does not create polluting by-products.

READ: *What is Energy?* → <http://www.eia.doe.gov/kids/energyfacts/sources/whatsenergy.html>



ANSWER:

- 1) Define 'energy resources'.
- 2) Compare & contrast renewable and non-renewable energy resources.

	Both	Renewable	Non- Renewable
Describe			
Sources			
Impact on the environment			

2. FOSSIL FUELS

Fossil fuels, also known as **HYDROCARBONS**, are a very important energy resource because they can be burned to produce significant amounts of energy. Over 85% of our energy needs are currently met this way. There are 2 main problems associated with fossil fuels:

- As they burn large amounts of CO₂ and other GHG's are added to the atmosphere.
- The easily-reached supplies in countries friendly to North America will not always be able to meet the increasing demand for oil.

If we are to continue to use large amounts of fossil fuels, we will have to find new, more remote, North American sources of oil and will also have to invest in new technologies to make them more 'clean' burning. Unfortunately the people who will pay for all of this are the consumers. Gas will cost more at the pumps. Heating fuel prices will go up. Any product in your local grocery store will be more expensive because of cost of the fuel to process, package, and deliver it.

READ:

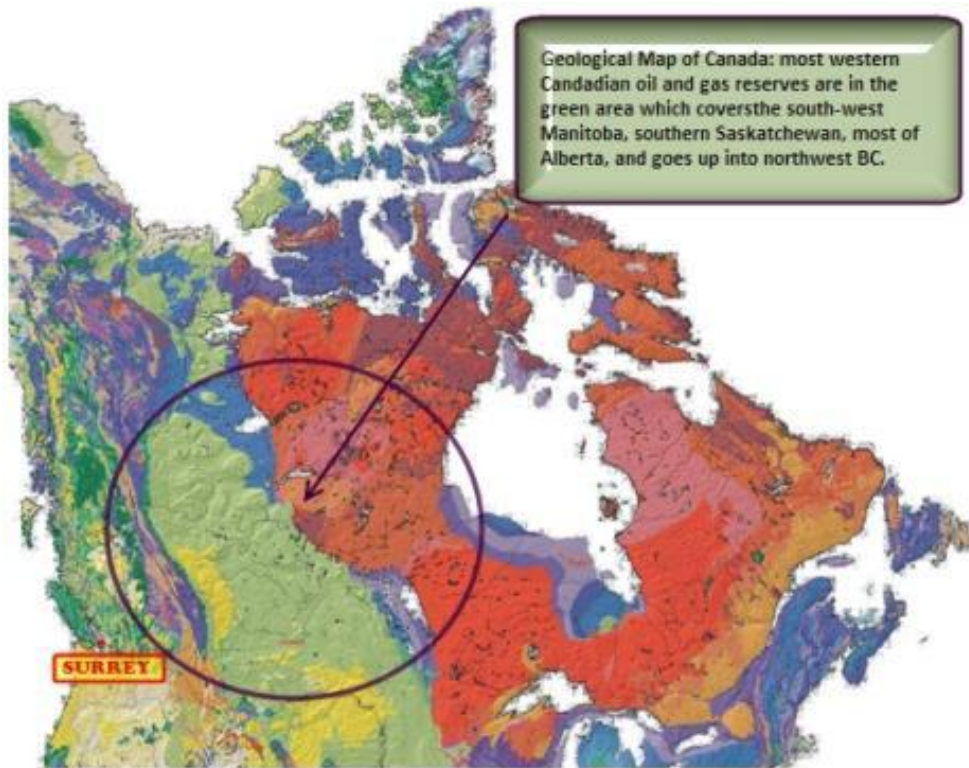
a) **What is Energy?** → <http://www.eia.doe.gov/kids/energyfacts/sources/whatsenergy.html>

b) **5 Most Coveted Offshore Petroleum Reserves > Introduction** → <http://science.howstuffworks.com/5-offshore-petroleum-reserves.htm/printable>

MAPS:

Where are the richest Canadian reserves of fossil fuel resources found?

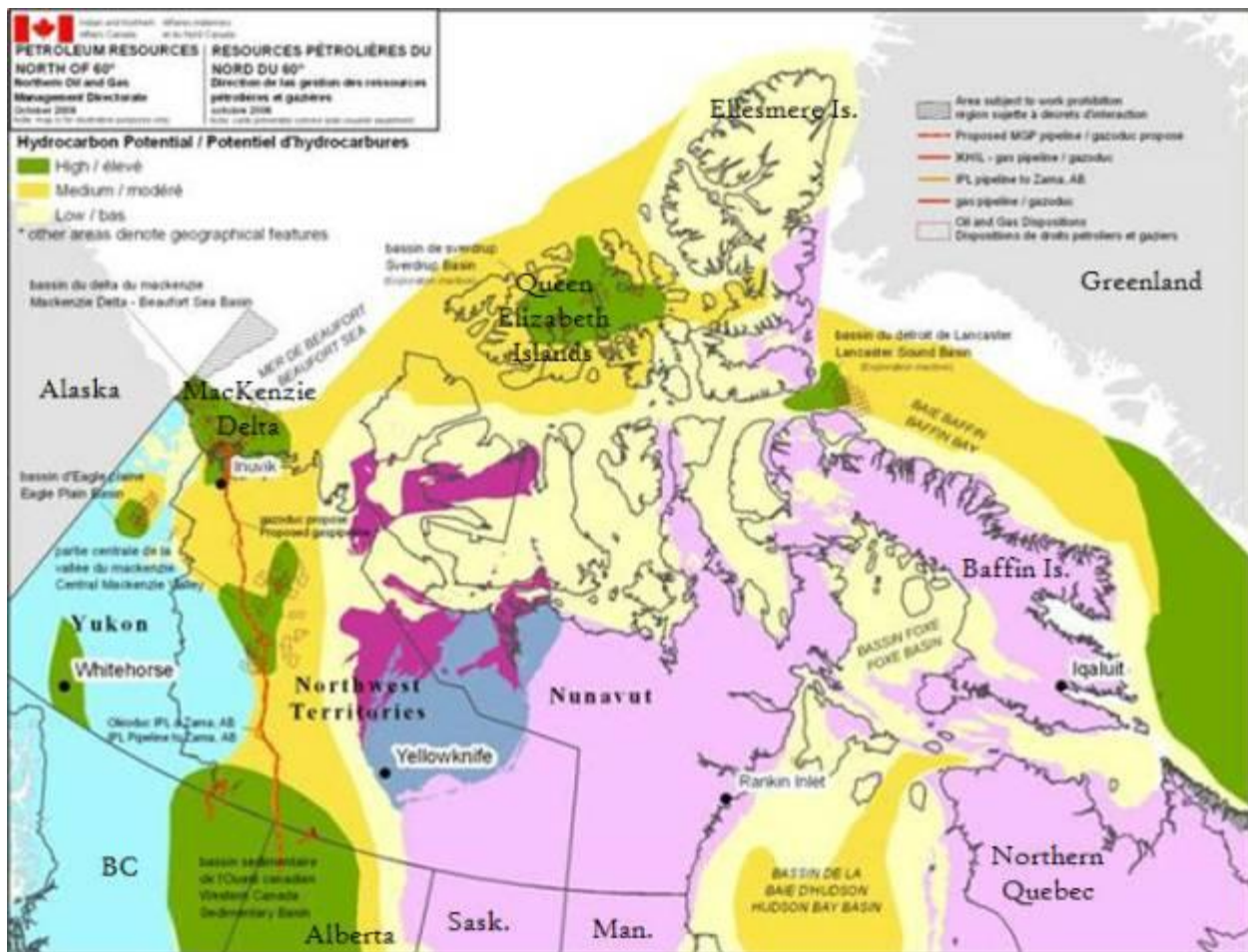
a) western Canadian continental region (mostly Alberta; some of BC, Sask., Man.)



[Image Source: Wikipedia, 2009 → http://en.wikipedia.org/wiki/History_of_the_petroleum_industry_in_Canada]

[See map at top of next page]

b) This 2008 map shows Canada's Arctic region -- green shading shows areas with the highest probability of finding oil; yellow is the next best. 3 areas with high potential are the Mackenzie River Delta at the edge of the Beaufort Sea, Queen Elizabeth Island, and the ocean floor between NE Canada (Quebec and Baffin Is.) and Greenland.



[Image Source: Beaugregard-Tellier, 2008) → <http://www.parl.gc.ca/information/library/PRBpubs/prb0807-e.htm>]

When **PETROLEUM**, naturally occurring **CRUDE OIL**, comes out of the ground, it has many impurities. It goes, often by pipeline, to a **REFINERY** where the hydrocarbon molecules are separated from the impurities and then further divided up to make different petroleum products such as gasoline and diesel in a process called **FRACTIONATION**. 65% of all petroleum extracted is made into fuels. The rest is used in a great variety of products as you will see in the list in the second article.

The vertical red line on the map is a proposed pipeline route from the Mackenzie Delta southward. It would deliver crude oil from a deep water port to be built in Inuvik to refineries in Alberta and the US.

READ:

Refining of Petroleum

→ <http://www.world-petroleum.org/education/petref/index.html>

What Products are made from Oil?

→ http://www.energy4me.org/questions/products_from_oil.htm

The images below are of a refinery in Burnaby on Indian Arm not far from Simon Fraser University. It's pretty at night, but during the day when it's burning waste gas, you can see how much of a polluter it really is. People live very near by.



[Image Source: Howard, CP, 2008 → http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/20080521/oil_prices_080521/20080521?hub=TopStories & Lo, 2006 → <http://outdoors.webshots.com/photo/2759376580040083688qPpjcB>

ANSWER:

- 1) When were fossil fuels formed?
- 2) Fossil fuels are formed from decayed _____ that build up on the ocean floor and eventually are _____. With the _____ from the Earth's core and _____ from the build-up of deep overlying layers, this dead matter eventually decayed into _____.
- 3) Why is extraction of fossil fuel reserves so difficult?
- 4) Fossil fuels have to form under water. Why then can they be extracted from continental locations such as Alberta and northern BC? (Apply your knowledge.)
- 5) Although the geological processes by which they were formed continue today, would you consider fossil fuels renewable or non-renewable. Defend your choice
- 6) Summarize the steps of petroleum extraction, transport and fractionation of petroleum in a refinery.

EXTRACTION	TRANSPORT	FRACTIONATION

7) Go through your handbag, backpack, locker, or the classroom and make a list of all items that contain petroleum products.

8) Locate each of the following on the map: BC, Surrey (blue dot), Manitoba, Alberta, Saskatchewan, Yukon, Nunavut, Northwest Territory, Inuvik (red dot), Baffin Island, Ellesmere Island, Beaufort Sea, Hudson Bay. Sketch in Greenland and Alaska. Shade in green the areas with rich oil reserves in the west and the north.



II. ECONOMIC BENEFITS & THE ENVIRONMENT

Now that the sea ice is melting, nations with coastlines on the Arctic Ocean are rushing to stake their claims to the sea floor so they will be able to control mineral and fossil fuel resources beneath it.

VIEW: → http://archives.cbc.ca/economy_business/transport/topics/2349/ >> (7-1985) **The Polar Sea Controversy;** (12-2006) (#19-1985) **The ‘Humiliation’ of the Polar Sea; US& Canada ‘must develop a plan now’;** (11-2002) **Global Meltdown May Clear the Passage** (2002)

The Big Melt

→ http://www.cbc.ca/national/blog/special_feature/the_big_melt/index.html

READ & EXAMINE:

Defending Our Sovereignty in the Arctic (2007)

→ <http://newsinreview.cbclearning.ca/wp-content/uploads/2007/11/arctic.pdf>

Human Actions Leading to Coastal Degradation (poster)

→ http://maps.grida.no/go/graphic/human_activities_leading_to_coastal_degradation

Human Impact on the Arctic Environment 2002 (poster)

→ <http://maps.grida.no/go/graphic/human-impact-on-the-arctic-environment-2002>

Industrial areas and Seasonal Zones of Oxygen-depleted water (poster)

→ http://maps.grida.no/go/graphic/industrial_areas_and_seasonal_zones_of_oxygen_depleted_waters

Industrial Development in the Arctic (poster)

→ <http://maps.grida.no/go/graphic/industrial-development-in-the-arctic>

Time to “use it or lose it,” Harper declares

→ <http://www2.canada.com/montrealgazette/news/story.html?id=f1cbc914-e437-4378-b1be-91c47540631c&k=214>

Ice Free Arctic Waters Open UP New Opportunities and Dangers

→ http://www.martechpolar.com/Press%20Clippings/Professional_Mariner_Feb2009.pdf

In Canada, natural resources including minerals and fossil fuels belong to the provinces. Fossil fuel development decisions are made by provincial governments, and oil and gas revenues belong to the province where they are found not to the country as a whole. However, the 3 northern territories (Yukon, North West Territory, and Nunavut) are not provinces. Resources there remain under the control of the [federal government](#).

All levels of government share the responsibility for environmental protection, but the provinces and territories have control over the protection of air and water quality, conservation of land resources, and energy management. The Canadian government acts mainly a coordinator trying to ensure environmental assessments are done according to national environmental standards. It also carries out some inspection activities.

Yet the current government(2009/10) is pushing a policy of “use it or lose it” in order to establish a greater Canadian presence in the parts of the sea we have always considered belonged to us. There a number of initiatives now underway:

SOME MEASURES THAT HAVE BEEN PROPOSED TO PRESERVE SOVEREIGNTY

- Improved surveillance
- Increased military presence
- More icebreakers
- Construction of deep-water ports
- “Geo-mapping”
- Promotion and regulation of regional development

[Image Source: <http://www.arcticnet.ulaval.ca/pdf/talks2008/macnabRonald.pdf>]

Canada’s continent-based reserves of natural gas are declining as the same time that demand is increasing. In the US, since ‘9/11’, the need to develop American sources of fossil fuels to meet the needs of their people has intensified. Other countries which border the Arctic Ocean view the exploitation of oil reserves beneath its sea floor as a way to ‘get rich quick’ by selling the fossil fuels at rising prices. If the Northwest Passage opens for shipping it will shave big \$ off the cost of shipping goods around the world. New summer fisheries are likely to develop. Our Prime Minister is proposing a deep water port (like Robert’s Bank) on Baffin island. Where people move, facilities, roads, and housing must be built.

How would Canadians benefit from staking a claim to as much of the ocean floor as we can?

- a) we would then own the minerals and resources beneath and ensure our own supply for a long time.
- b) the Northwest passage would lie inside our territorial waters giving us control over the kind of activity that goes on there.
- c) we could enforce protection of this environmentally sensitive area.
- d) we would enjoy the jobs that go with the massive construction projects which will occur if development does go forward.

But as you can see in the posters above, where development goes, the environment will surely suffer. More fossil fuels will be taken out of the Earth to create still more greenhouse gases. Instead of investing billions in development projects, if that money were put into the alternative technologies and energy sources, we might help slow the rate of global warming and give the north a chance to recover.


VIEW: Ocean Ranger (resources to come)
Exxon Valdez
Oil spill footage



[Image Source → <http://www.treehugger.com/2009/05/03-week/>]

TO DO:

This image tells a quite a story. Write the [cautionary tale](#) that this artist is trying to portray. Focus on 3 key parts of the image and illustrate what actions Canada should take if we are successful in defending our claim to a large portion of the Arctic Ocean floor. This is a creative piece. It will be included in the completion mark for this booklet when your proofreading and editing are adequate and you have can add links to 3 articles that support your conclusions.



Oceans 11

Our Changing Sea

D. Project Booklet

Sue Hellman
6/18/2009

Our Changing Sea

~Project Instructions and Guidelines~

THEMES	Deep Understanding and Reasoning Learning Targets
A. Global Warming	<ul style="list-style-type: none"> Using recent changes to Greenland as a case study and considering specifically new information about its physical features that is coming to light as a result of melting of the northern polar ice cap, summarize changes that have already occurred and predict changes that may occur to the Arctic Ocean and Canada’s northern islands in future as a result of global warming. Give examples of changes to the polar ice caps in the Arctic and Antarctic that have occurred in the past 5 years as a result of global warming. Summarize the threats to coastal communities such as White Rock, BC, as sea levels rise. Understand the long term outlook for these areas if current warming trends continue.
B. Resources (fossil fuels)	<ul style="list-style-type: none"> Define <i>sustainability</i>. Explain the statement: “Local decisions have regional and global consequences.” (Washington State Department of Ecology) Using evidence from case studies past northern oil spills (Exxon Valdez), oil platform failures (Ocean Ranger) and other sources, identify potential environmental hazards associated with exploitation of these natural resources. Describe the benefits and drawbacks associated with fossil fuel extraction from the Arctic Ocean floor. Conduct a risk analysis that considers different points of view related to resource management; include environmental, social/cultural, economic, and political consequences and considerations of reliability of data given changing conditions in the north, interpretation, safety, ability for government to oversee, and ethics concerns.
C. Oceanography (the continental margin)	<ul style="list-style-type: none"> Describe the Arctic Ocean Conference of May, 2008: who the participants were and how participating nations propose to negotiate their claims to the Arctic Sea floor. Discuss how their overlapping claims will make negotiations at the conference much more complex. (Consider specifically the US claim that the Northwest Passage is an international waterway and not part of Canada’s territorial waters.) Explain the importance of accurate scientific data in helping a nation sustain its claim. Give reasons why it has become so important for nations to stake their claims to the Arctic Ocean floor.
Related Skills	
<ul style="list-style-type: none"> Access Creative Commons sources for music and images from the Wikispaces list for project work Cite sources and make a bibliography using Easybib. Know how to use the various software and Web 2.0 programs you will need to complete your project. 	
Final Project	
<ul style="list-style-type: none"> Communicate effectively in writing or using other media such as video or podcasts <ol style="list-style-type: none"> create a multimedia project using online tools or school software including: Discovery Box, Adobe Premier Elements, or PowerPoint write a comprehensive Wikipedia- style article: analyze how Wikipedia entries are structured; use a writing template provided by the teacher; use Inspiration for prewriting – specifically to create a mind map and outline for the article 	
Intentional Learning	
<ul style="list-style-type: none"> Set a goal for completion of you final project. Engage in planning, persistence, actively making connections, and taking safe risks Reflect on the value of the peer consultation and peer review processes for your multimedia tasks. 	

I. Criteria by which your project will be judged

To conclude the work of this unit, you will select 1 from 3 possible project options

- a) a multimedia project using Adobe Premiere Elements, Audition, and Discovery Box;
- b) an impact assessment using PowerPoint, or
- c) a Wikipedia-style write up using Inspiration and a template that can be obtained from your teacher.

Each of these 3 projects requires that you use the information learned about climate change (global warming), resources (fossil fuels) and oceanography (continental margins) to respond in some way to the question: ‘Why should we care?’ You will be assessed on:

Final product will be scored /20	{	<ul style="list-style-type: none">• your understanding of the concepts and information learned in the learning packages• your ability to incorporate this information and other evidence into your presentation• the ethical, documented use of source material• the overall impact of your presentation• growth in the specific multimedia and/or writing skills required to create your presentation• your thorough and thoughtful/ persuasive/ creative/ original (any or all of these 4) response to the issue or problem
/10		<ul style="list-style-type: none">• your planning and progress towards becoming an intentional learner

There is a difference between just ‘doing a project’ and using it as an opportunity for learning about a topic, about your world, and about yourself. These projects are designed with those 3 goals in mind. You can expect to experience some frustration along the way as that is part of the growth process. Your teacher will not rescue you with our ideas, but will guide you to find and develop your own perspective by asking you challenging questions to help you think more deeply about your work habits, your topic, and your responses. Students who always work in their comfort zone may produce strong projects but will not achieve as much growth in ‘habits of mind’ as others who struggle to improve.

Select from the **Deep Understanding and Reasoning Learning Targets** table above to help guide your inquiry. You are not expected to cover them all. You may focus on a few and look at them in depth or answer several in your presentation.

Rubrics with a maximum score of 40 will be provided to show you how each project option will be assessed. A rubric with a maximum score of 20 will be used to assess your level of progress towards becoming an intentional learner. These scores reflect BC provincial standards for letter grades.

II. Project Descriptions

“Canadian governments have often failed to make Arctic sovereignty a priority, but recent steps have been taken to reinforce - and extend - Canada’s claims.” Perhaps none is of greater importance than Canada’s 2004 signing of the United Nations Law of the Sea Convention. The Convention gives Canada the right to lay claim to any undersea extensions of its continental shelf that it can prove exist. Under the Convention, if Canada can complete undersea mapping of the land that it believes it owns by the 2013 deadline for proof, thousands of square kilometres of the Arctic Ocean will be added to our territory. . . . Some of the measures that have been proposed to preserve Canada’s sovereignty over the Arctic include: increased military presence, construction of deep-water ports, and the promotion and regulation of regional development” (“Defending Our Sovereignty in the Arctic”).

OPTION 1: Multimedia Presentation

You would like to be accepted to the Students on Ice Arctic Study program next summer. You have decided to use Discovery Box (1 cube) to develop a multimedia portfolio to accompany your application and help you fundraise in the community to pay for the trip if you are accepted. You have decided to include:

1. a video introduction of yourself and this portfolio. It should provide an overview of this presentation for the people at Students on Ice and for potential donors.
2. a 2 minute slide show with music to illustrate why Canadians should care about the fate of the Arctic. This should have high emotional appeal but not misrepresent the facts.
3. a descriptive or narrative written piece predicting a worst case scenario for the future of the Arctic 50 years from now if resource extraction from the Arctic Ocean floor goes ahead. The predictions are to be supported by information learned as you did your booklets and by evidence from sources bookmarked for you in Diigo.
4. a mind map outlining all the key information you have learned about the continental margin, its importance in establishing Canada’s Arctic sovereignty, and the role and responsibilities our nation should take on to protect this fragile region. There should be at least 6 embedded links to videos, images, and other sources of information.
5. scripted podcast explaining the impact of global warming on the Arctic Ocean. Make reference to recent changes to the sea ice around Greenland as an example. Suggest possible changes that might occur to Canada’s continental margin with further melting of the sea ice surrounding some of our northern islands.
6. an annotated bibliography created using Easybib (either linked or uploaded).

OPTION 2. Impact Assessment

(adapted from the Geography 12 Assessment Suggestions)

You work for a company that conducts impact studies for the federal government. In light of changing climate conditions that are expected to soon result in the opening the Northwest Passage, there is an increased urgency for Canada to establish sovereignty over the Arctic Ocean. One consideration is whether to permit drilling for fossil fuels on the ocean floor. You have been asked to investigate the possible ramifications of that action, to assess whether the benefits or risks are greater, and to conclude whether such a project should proceed.

You will organize your information, evidence, conclusions and recommendations into a compelling cost/benefit analysis presented in PowerPoint. The final presentation should include:

1. information about how Canada's claim to sovereignty in the Arctic Ocean floor is being established through research about our northern continental margin and the role of global warming in making this issue an urgent one
2. a description of how fossil fuels would be extracted from the Arctic Ocean floor and what installations would be required. Based on current conditions, predict when a drilling program might get underway.
3. arguments in favour of (pro) and against (con) drilling for oil on the Arctic Sea floor supported by evidence and considered from seven perspectives
 - a. earth scientists/geographers (feasibility)
 - b. environmentalists (hazards)
 - c. oil company executives (benefits)
 - d. community development planners (other secondary costs and benefits to the region)
 - e. member of First Nation residents (impacts on the local aboriginal community)
 - f. members of our local community (perspective of non-northerners)
 - g. government officials (national sovereignty; environmental protection through regulation and surveillance; tax revenue; employment opportunities; costs)
4. conclusions & recommendations
5. an annotated bibliography created using Easybib

OPTION 3: Wikipedia-style Article

You attended the most recent Arctic Ocean Conference in Illulissat, Greenland, in May of 2008 as a student delegate and now passionately believe that the controversy over claims to the Arctic Ocean floor should be more widely publicized and better understood. You know that more and more people are relying on Wikipedia as a key source of information. You have read the Wikipedia *Arctic Ocean Conference* page ("Arctic Ocean Conference") and have concluded that it does little more than provide a brief synopsis about the issues and numerous links. Reading this would not clarify for most people what is at stake for the various nations and for the Arctic Ocean itself.

Analyse several Wikipedia articles on Earth Science topics and come up with properties they have in common. Create a rubric with your teacher to help you write this article. Do not choose articles on this specific topic. Using Inspiration as your pre-writing tool and outlining tool, write a new, illustrated Wikipedia article from a Canadian perspective including:

1. an illustration of the nations with claims to the ocean floor together and a list with an explanation of the basis for their claims. Provide examples of specific nations' claims. This can be in outline form.
2. a description and an illustration of Canada's territorial waters - their extent and how they are established. Describe our continental margin and its main physical features.
3. an explanation of why nations with shores on the Arctic Ocean feel an urgent need to secure their claims to its resources now. Reference should be made to
 - a. the role of global warming and rising ocean temperatures,
 - b. how fossil fuels are created and the non-renewable nature of this resource,
 - c. economic concerns (e.g. keeping fuel prices down), and
 - d. political concerns (e.g. independence from foreign sources).
4. an explanation of why this is a contentious issue (i.e. overlapping boundaries) and a description of the role earth scientists/geographers will have in establishing Canada's claim. Describe the technologies used to map the ocean floor and recently discovered evidence that should extend our claim.
5. suggestions regarding several fears Canadians could have regarding exploitation of Arctic Ocean resources. Ask yourself questions such as
 - a. how will we maintain our Arctic sovereignty if other countries intrude on our territorial waters?
 - b. what other resources might countries find valuable?
 - c. what might happen if countries with lower environmental standards than our own start a drilling and extraction program?
 - d. how might a greater human presence adversely affect the Arctic as a whole?
6. an annotated bibliography created using Easybib

III. Rubrics

Provincial Letter Grade	Final Project Criteria	Assessment Guidelines -- these are provided to help you understand what the provincial letter grades mean
A	7	Excellent or outstanding project that exceeds expectations
B	6	Very good project which fully meets all expectations and shows excellence in at least one area
C+	5	Good project which fulfills all requirements and shows very good work in at least one area
C	4	Satisfactory project which fulfills all requirements; the project can be submitted as a final product
I	incomplete	The project does yet not fulfill requirements in one or more areas; the project or a part of it will be returned to you for further work. No grade below 60% will be given. This will be treated as a work in progress.

[Note: in mainstream schools a grade of C- is considered “minimally acceptable”. Because students at the Learning Centre do not have to meet the normal classroom deadlines and have the opportunity for plenty of feedback and time to improve their work, projects will not be accepted until minimum project requirements have been met.

These unusual numbers have been chosen as they make percentages that correspond quite well to our provincial letter grades.]

A comprehensive **Multi-Use Project Rubric** is found in the Teacher’s Booklet (File 3) . Ask to see it to help you understand the scope of each project and guide your selection. Once you have done that, your teacher will help you delete the sections that do not pertain to your work and will copy the file into this project booklet file or print it for you so you can refer to it regularly.