

Electromagnetic Radiation and You

Type of Electromagnetic Radiation	Electromagnetic Radiation and You	More information
Radio	A radio wave is the energy emitted by radio stations to your boom box. They also transmit television signals. Also emitted by stars and gases in space	Radio waves have wavelengths that range from less than a centimeter to tens or even hundreds of meters. FM radio waves are shorter than AM radio waves. Radio waves can also be used to create images. Radio waves with wavelengths of a few centimeters can be transmitted from a satellite or airplane antenna. The reflected waves can be used to form an image of the ground in complete darkness or through clouds.
Microwaves	Cook your hot dog or warm your apple cider	Microwave wavelengths range from approximately one millimeter (the thickness of a pencil lead) to thirty centimeters (about twelve inches). Microwaves are emitted from the Earth, from objects such as cars and planes, and from the atmosphere. These microwaves can be detected to give information, such as the temperature of the object that emitted the microwaves.
Infrared	Infrared radiation is felt as the heat coming off burning charcoal.	Infrared is the region of the electromagnetic spectrum that extends from the visible region to about one millimeter (in wavelength). Infrared images obtained by sensors in satellites and airplanes can yield important information on the health of crops and can help us see forest fires even when they are enveloped in an opaque curtain of smoke.
Visible Light	Your eyes see visible light Emitted by fireflies, stars, light bulbs, etc.	The rainbow of colors we know as visible light is the portion of the electromagnetic spectrum with wavelengths between 400 and 700 billionths of a meter (400 to 700 nanometers). Visible waves

		have great utility for the remote sensing of vegetation and for the identification of different objects by their visible colors.
Ultraviolet	UV rays of the sun cause our skin to burn	Ultraviolet radiation has a range of wavelengths from 400 billionths of a meter to about 10 billionths of a meter. Sunlight contains ultraviolet waves which can burn your skin. Most of these are blocked by ozone in the Earth's upper atmosphere. A small dose of ultraviolet radiation is beneficial to humans, but larger doses cause skin cancer and cataracts. Ultraviolet wavelengths are used extensively in astronomical observatories. Some remote sensing observations of the Earth are also concerned with the measurement of ozone.
X-rays	Used to look at your bones or teeth Hot gases in the universe also emit x-rays	X-rays are high energy waves which have great penetrating power and are used extensively in medical applications and in inspecting welds. X-ray images of our Sun can yield important clues to solar flares and other changes on our Sun that can affect space weather. The wavelength range is from about ten billionths of a meter to about 10 trillionths of a meter.
Gamma-rays	Radioactive materials emit gamma-rays and are not something you would want to get too close to	Gamma rays have wavelengths of less than about ten trillionths of a meter. They are more penetrating than X-rays. Gamma rays are generated by radioactive atoms and in nuclear explosions, and are used in many medical applications. Images of our universe taken in gamma rays have yielded important information on the life and death of stars, and other violent processes in the universe.

Electromagnetic Radiation and You

Type of Electromagnetic Radiation	Electromagnetic Radiation and You	More information
Radio		
Microwaves		
Infrared		

Visible Light		
Ultraviolet		
X-rays		
Gamma-rays		

Communication Technology Research Project

(Note: The focus of this assessment is on Knowledge/Understanding and Making Connections)

Instructions

1. Select one type of communication technology.
(eg. semiconductors in computers, radio, television, telephone, radar, satellites, fibre optics, converters, cell phones, GPS, CD...)
2. Research information about the technology and do the following:
 - _____ Explain the fundamental scientific principles related to the use of the selected communications technology (CS1.03), (CS2.01)
 - _____ Explain the energy transformations that take place to permit the transmission and reception of signals in the selected communications system (CS1.08)
 - _____ Assess the impact of the selected communications systems on individual lifestyles and on home and workplace environments (eg. economically, socially, morally, ethically, politically...)
(CS3.01)

_____ Assess the impact of the selected communications systems on the privacy of individuals and communities focusing on risks and benefits (eg. economically, socially, morally, ethically, politically...)
(CS.3.02)

_____ Identify the scientific discovery that enabled the selected technology to be developed scientific discovery (SS1.05)

_____ Explain how this application is perceived by various interest groups in the community (SS3.01)

3. Create a timeline that illustrates the development of the selected technology and its key uses.
4. Prepare and conduct a lesson that outlines the required information.
5. Design and distribute a handout that summarizes key points.
6. (*Optional*) Design, construct and test a simplified model of the selected device that shows the transformation of energy from one form to another. (CS2.03)

[RETURN TO TABLE](#)

Communication Technology: Research Assignment Assessment Rubric

Communication...page 4

(Note: The focus of this assessment is on Knowledge/Understanding and Making Connections)

Achievement Chart Category and Criteria	Level 4	Level 3	Level 2	Level 1
Knowledge/Understanding				
Facts and Terms	Identifies and explains numerous relevant facts and terms related to communication systems	Identifies and explains a considerable number of relevant facts and terms related to communication systems	Identifies and explains some relevant facts and terms related to communication systems	Identifies and explains a limited number of relevant facts and terms related to communication systems
Concepts, Principles, Laws & Theories	Thoroughly explains all scientific principles related to the use and function of communication technology	Explains many scientific principles related to the use and function of communication technology	Explains some scientific principles related to the use and function of communication technology	Explains few scientific principles related to the use and function of communication technology
Transfer of Concepts	Precisely transfers complex scientific concepts to explain the function of communication technology	Transfers many scientific concepts to explain the function of communication technology	Transfers some scientific concepts to explain the function of communication technology	Transfers simplistic scientific concepts to explain the function of communication technology
Understanding Relationships	Describes all relevant energy relationships discussed in class Extends to include more complex relationships	Describes many energy relationships discussed in class	Describes some energy relationships discussed in class	Describes few energy relationships discussed in class
Making Connections				
Understanding Connections	Thoroughly describes and discusses the numerous connections between aspects of communication technology and facets of society	Describes and discusses many connections between aspects of communication technology and facets of society	Describes and discusses some connections between aspects of communication technology and facets of society	Describes and discusses few connections between aspects of communication technology and facets of society
Assessment of Impacts	Thoroughly identifies and discusses the social impact of communication technology	Identifies and discusses the social impact of communication technology	Identifies and casually discusses the social impact of communication technology	Identifies the social impact of communication technology
Proposing Action	Proposes many workable,	Proposes some workable and	Proposes some workable	Proposes few workable courses of

	meaningful and original courses of action as related to the social impact of communication technology	original courses of action as related to the social impact of communication technology	courses of action as related to the social impact of communication technology	action as related to the social impact of communication technology
--	---	--	---	--

[RETURN TO TABLE](#)

Communication...page 5

ELECTRICAL SAFETY DEVICES AT HOME

ASSIGNMENT

Electricity has the potential to pose great harm if it is not used properly. It will be your job over the next few days to do an electrical home inspection. Where possible you can interview knowledgeable people about electrical safety.

Electrical devices include toasters, ovens, hair dryers, computers, can openers , digital clocks and even electric lawn mowers. All of these devices pose danger that can be avoided by following electrical guidelines.

Answer the following questions:

1. What is a fuse and what are some improper uses of fuses?
2. What is grounding and why is it important?
3. What are electrical panels?
4. What is a surge protector?
5. List at least 10 important electricity safety guidelines that should be followed by everyone in your home.
6. List as many electrical safety devices as you can and explain how they work

[RETURN TO TABLE](#)

Place Mat

The Place Mat tactic requires groups of students to work both alone and together around a single piece of paper.

1. Place students in small groups. (3-6)
2. Place a central square or circle in the center of the paper then divide the paper up into pieces based on the number of members in the group.
3. Present the students with the task (eg. response to a question, brainstorming, etc.).
4. Place the question in the center of the square and the responses (brainstorming) will go outside the middle square.
5. Each student will individually complete the task in his/her own section, respectful of silence and privacy.
6. When time has elapsed, each student will take a turn to share their ideas with the other members of the group.
7. In the center of the paper, students can record key points.

[RETURN TO TABLE](#)

Impact of New Communication Technology: Place Mat

Ask students to consider the following questions and respond on their group place mat:

How much are you willing to sacrifice in pursuit of convenience?

**To what degree should we be required to
sacrifice our individual freedoms for the security of the community?**

To what extent are you comfortable with the degree of privacy you lose each day?

**Should certain members of society be required to
relinquish more privacy than others?**

[RETURN TO TABLE](#)

Impact of New Communication Technology

Read the statements below and answer the following questions:

"A double-edged sword of good and evil has hung over human technology from the beginning."

-- Issac Asimov, *Science Writer*

"Scientific and technological advances are the only possible solutions to world

problems"

-- Issac Asimov, *Science Writer*

"It is possible to give a new direction to technological development, a direction that shall lead it back to the real needs of man [people], and that also means to the actual size of man. Man is small, and therefore, small is beautiful. To go for giantism is to go for self-destruction."

-- E.F.Schumacher, *Economist*

"The cost of a thing is the amount of life that is required to be exchanged for it – immediately or in the long run".

--A.D. Thoreau

1a. Select one of these statements. What does it mean?

b. Do you agree or disagree with the statement? Provide examples to substantiate your opinion.

2. What is the possible connection between this statement and the advent of new types of communication technologies such as GPS, cell phones, surveillance technology, the Internet?

3. Select one new communication technology and complete a P.M.I. chart regarding its present and future impact on society.

P (<i>plus</i>)	M (<i>minus</i>)	I (<i>interesting</i>)

--	--	--

4. Evaluate the extent to which new technologies are worth the risks they pose?
5. Which groups are at odds with each other over the use of communication technologies? Why is this so?

[RETURN TO TABLE](#)

FACTS ABOUT NUCLEAR ENERGY

- There are very few people who know very much about nuclear energy
- A vast majority of the public do not support nuclear technology because they are afraid of it
- Negative information is being disseminated on the subject of nuclear technology
- Nuclear fission is already an important source of energy in the world and its use will continue to grow
- Nuclear plants are a clean, safe and inexpensive way to make electricity
- Radiation is common in nature and is also produced by humans for many important applications
- Canadians use large amounts of energy, especially electricity, for homes and industry
- More than 60% of the electricity produced in Ontario is generated by nuclear power plants
- Most countries rely mainly on fossil fuels for electricity production
- There are several concerns about the burning of fossil fuels, including global warming
- Developing countries want higher living standards and will use more energy
- World population growth, from 6 to 10 billion in 50 years will put pressure on already existing energy resources

- World production of oil is expected to peak in the year 2003 – the end of cheap oil
- Nuclear energy will be an important part of the solution of supplying the energy need
- Nuclear technology is a high-tech industry that employs 50 000 in Canada

(Facts obtained at The Canadian Nuclear FAQ page @ http://www.ncf.ca/~cz725/cnf_sectionA.htm ,
October, 2002)

[RETURN TO TABLE](#)

NUCLEAR CHAIN REACTIONS

Definition: A nuclear reaction in which a heavy nucleus (such as uranium) splits into two parts (fission products) which subsequently emit either two or three [neutrons](#), releasing a quantity of energy equivalent to the difference between the rest mass of the neutrons and the fission products and that of the original nucleus. Nuclear fission is the process used in nuclear reactors and atom bombs.” (Taken from the [About Physics Dictionary @ http://physics.about.com/library/dict/bldefnuclearfission.htm](#))

When a neutron from a fission reaction strikes another nucleus, it may cause it to fission. For example, when a neutron from a U-235 fission hits another nucleus, it will also fission and the chain reaction will continue. If left uncontrolled, the chain reaction will continue and accelerate exponentially. An uncontrolled chain reaction can lead to an extremely large energy release and is the concept behind nuclear weapons. On the other hand, if the chain reaction was adequately controlled it could be used as an energy source for a nuclear reactor.

The following lessons will introduce you to CANDU, fission and fusion and where your understanding and appreciation of nuclear chain reactions will grow.

[RETURN TO TABLE](#)

CANDU WORKSHEET

What does CANDU stand for?

What is CANDU?

What is the moderator used at CANDU?

What is the coolant used at CANDU?

What is another name for heavy water?

How many protons does deuterium contain?

How many neutrons does deuterium contain?

How is heavy water different than regular water (H₂O)?

What makes heavy water “heavy”?

How is fission energy converted to electrical energy in CANDU?

How much of Canada's electricity comes from nuclear energy?

How many CANDU reactors can be found in Canada?

How many CANDUreactors can be found around the world?

Why is the CANDU design considered one of safest in the world?

How much Uranium does Canada produce?

Answers can be obtained by browsing the following websites:

<http://www.ncf.ca/~cz725/>

http://www.ncf.carleton.ca/~cz725/cnf_sectionA.htm

http://www.ncf.carleton.ca/~cz725/cnf_sectionB.htm

[RETURN TO TABLE](#)

FISSION AND FUSION

Fission and fusion are both types of nuclear reactions that produce large amounts of nuclear energy. In order to better remember and understand fission and fusion, it helps to remember that fission means "to split" and fusion means "to join".

Nuclear fission is the splitting of an atom into two or more parts. For example, nuclear fission occurs when a uranium-235 nucleus is hit by a stray neutron. The uranium absorbs the stray neutron, becoming very unstable and it fissions, in one or both of the following ways, as you can see below:

- $^{235}\text{U} + 1 \text{ neutron} \rightarrow 2 \text{ neutrons} + ^{92}\text{Kr} + ^{142}\text{Ba} + \text{ENERGY}$
- $^{235}\text{U} + 1 \text{ neutron} \rightarrow 2 \text{ neutrons} + ^{92}\text{Sr} + ^{140}\text{Xe} + \text{ENERGY}$

The 2 neutrons that result from a fission reaction are now likely to break apart other nearby fissionable nuclei, starting a chain reaction. The result is a great amount of energy in the form of radiation and heat. The reactants are now different chemical elements and highly radioactive.

Nuclear fusion is another form of nuclear energy but it involves the joining of smaller nuclei to make a larger nucleus. One example is the combining of two light hydrogen atoms to form a heavier helium atom. At temperatures of 100 million degrees, the hydrogen atoms may fuse if they are held together long enough for fusion to occur.

[RETURN TO TABLE](#)

COMPARE AND CONTRAST FISSION AND FUSION

ASSIGNMENT

1. Make a table to compare and contrast fission and fusion. Use the note provided by your teacher as well as internet or library research. Be sure to include scientific principles.
2. Using at least one paragraph, define with examples of feasibility, costs and energy efficiencies, three of the following:
 - Net energy production
 - Initiation process
 - Control technologies
 - Military uses
 - Sun
 - Waste production
3. Compare the use of nuclear reactors to other methods of producing electrical power. Take a stand. Choose a side. Explain your choice in a three paragraph report.

[RETURN TO TABLE](#)

Renewable & Non-renewable Resources: Cost/Benefit Analysis

1. Conduct a cost/benefit analysis on the following forms of energy.
Consider cost, pollution, efficiency, sustainability, geographical feasibility in Canada, global impact (economically, politically) etc...

Energy Source	Costs	Benefits
Coal		
Biomass		
Gas		
Oil		
Nuclear		
Tidal		

Geothermal		
Solar		

2. Once you have finished your cost/benefit analysis make a table listing energy sources that are considered alternatives and give at least one specific example for each. State why these are good or poor choices in terms of availability, renewability and cost.

[RETURN TO TABLE](#)

Renewable vs. Non-Renewable Resources

In 1973, economist E.F. Schumacher asked us to look at the whole world through the eyes of corporate economics. In his opinion, the firm Spaceship Earth, was not living off its *income*, but instead was consuming its *capital* at an alarming rate.

Not only were we consuming that which was produced on a regular basis and could be produced again (eg. crops and solar, wind and water, but we were also using up resources that could not be replaced when needed (eg. fossil fuels).

The problems he warned about then have only gotten worse.

(E.F. Schumacher. *Small is Beautiful*. New York: Perennial Books, 1973)

Answer the following questions: (CBC News in Review will help you answer the questions)

1. What role, if any, does capitalism play in the usage of resources for energy generation?

- 2a. Should economic sanctions be imposed on countries who continue to utilize non-renewable resources as their primary source of energy generation?
Justify.

- b. What impact might this opinion have on a global scale?
-
- 3. If the risks of utilizing non-renewable resources can be minimized through scientific and technological advances, should their use continue?

 - 4. Which, if any, groups stand to gain from a global shift from non-renewable to renewable resources? Who stands to lose? Justify.

[RETURN TO TABLE](#)

EMERGING ENERGY ALTERNATIVES

Today there are many emerging energy alternatives. Technology has allowed us to harness several of the following energy alternatives for use in many areas:

- Nuclear
- Wind
- Solar
- Biomass
- Hydrogen fuel cells
- Geothermal

Although it is unlikely that we will eliminate the use of fossil fuels in the near future, limiting fossil fuel use is attainable. Not only should we consider the effect on our environment, we must also consider the monetary cost of the fuel, the sustainability and the actual amount of energy that can be harnessed.

Assignment:

1. For each of the energy alternatives above, research and find several examples of responsible energy use. For example, list some technologies related to wind power use.
2. Choose one of the energy alternatives from the list above and create a poster that communicates how it is used, why it is used and reasons for choosing this alternative.

[RETURN TO TABLE](#)

SUSTAINABILITY OF ENERGY

There is a growing need and interest in the sustainability of energy. This includes both traditional and alternative energy sources.

Everyone in the class is to do an internet search to find the distribution of natural resources in Canada. For example: Where is the water and how much is left? Where can heat sinks be located? Can meteorology allow us to calculate a distribution for wind or tides? Include both traditional and alternative energy sources.

After the class discussion and sharing of information, you will be responsible for writing a three-page essay, a correlation map or a concept map called, "Sustainability of Energy".

Go over the rubric carefully, so that you know what is expected of you.

To get you started:

Do an internet search for "sustainability of energy" or check out the following sites:

<http://www.sll.fi/energia/ecolabelling.html>

<http://www.nea.fr/html/pub/newsletter/2001/measuring19-1.pdf>

<http://www.utoronto.ca/env/papers/askewd/sec2.htm>

<http://www.energy.ru/eng/articles/ised.htm>

<http://www.worldenergy.org/wec->

geis/publications/reports/etwan/policy_actions/chap_5_action5.asp

<http://www.helio-international.org/anglais/observatory/annexesD.html>

[RETURN TO TABLE](#)

SUSTAINABILITY OF ENERGY RUBRIC

	Level 4	Level 3	Level 2	Level 1
<u>Knowledge</u>				
Use of current knowledge	Essay and references demonstrates application of current knowledge	Essay and references demonstrate some application of current knowledge	Essay and reference show some application of current knowledge	Very few references to current knowledge
Opening statement	Opening is creative and catches readers interest	Opening catches the readers interest	The opening is informative and catches the readers interest	The opening may not catch the readers interest
Thesis Statement	Thesis statement is very clear and states topic and main ideas	Thesis statement is clear and states topics and main ideas	Thesis statement states topics and most main ideas	Thesis statement is somewhat clear and states only a few ideas
<u>Making Connections</u>				
<u>Point of View</u>	Sustains a strong point of view	Strong point of view throughout the majority of the essay	Point of view was strong some of the time	Point of view was not always obvious
Organization	Very organized with strong evidence of editing	Good organization and editing	Organized with some evidence of editing	Some organization and some editing
Conclusion	Excellent conclusion with a powerful sense of closure	Good conclusion with strong closure	Fair conclusion and closure	Weak conclusion and closure

CONSUMPTION OF ENERGY PER CAPITA

Move over GDP, energy needs to take the stand. Although many take our use of energy for granted, it is becoming more and more certain that we all need to be concerned. Even the leaders of Canada, the U.S. and Mexico are starting to look at energy issues as being worthwhile and working toward sustainable development for the benefit of all.

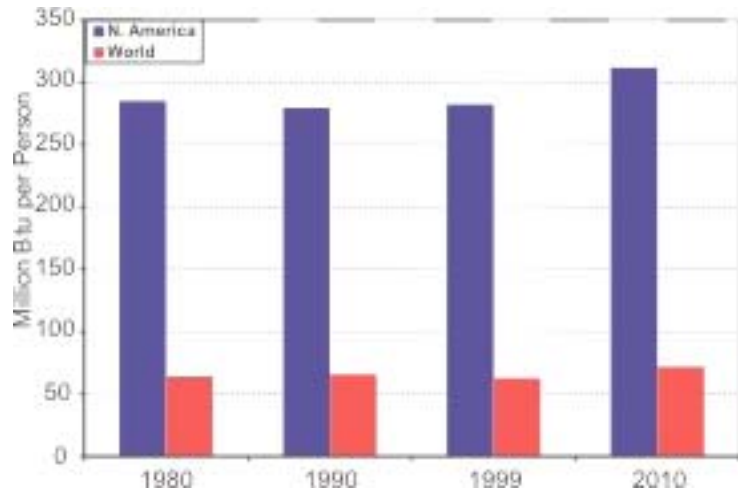
North America produces about one fourth of the world's energy supply and uses about 30% of the world's commercial energy – not bad, but what if you consider that only 7% of the world's population lives in North America?

In 2000, Canada's population was 31 million; Mexico's was 97 million; and the United States' population was about 281 million.

In 1999, North America's per capita energy consumption was about 4 ½ times greater than the world average. North America's per capita energy consumption is forecast to increase nearly 10 percent by 2010.

If this alarms you – take a look at the following graphical analysis:

Can you see how much energy North America consumes compared to the rest of the world?



Comments/Response?

(Statistics and Figure reference: <http://www.eia.doe.gov/emeu/northamerica/engecon.htm>)

[RETURN TO TABLE](#)

PROMOTION OF ENERGY REDUCTION

ACTIVITY

Instructions:

1. The class is to get into groups of two or three.
2. In your group come up with at least ten different ways the use of energy can be reduced.
3. Share your ideas with the rest of the class.
4. The teacher will record your ideas.
5. In your group, from the class list of ideas, choose one topic for your group (eg. Mass transit).
6. In your group, record your ideas on how to reduce the energy consumption specified by your topic.
7. Finally, your group is to create a poster or pamphlet to promote energy reduction for your topic.

8. Share your poster or pamphlet with the class.

(NOTE to teacher: Ideally this activity would be best if it followed a lesson on; "which human activities consume the most energy".)

[RETURN TO TABLE](#)

Atmospheric Pollution Versus Nuclear Waste

Set up the following two tables, each on their own sheet of paper:

NUCLEAR WASTE

PROS	CONS

ATMOSPHERIC POLLUTION

PROS	CONS

Using the internet or library as your resource, complete the tables.

[RETURN TO TABLE](#)

Environmental Impact of Energy Alternatives

Four Corners

Read the statement below.

The federal government should force every region in Canada to utilize energy alternatives in order to generate electricity.

Do you agree or disagree? Explain using knowledge from previous lessons and independent research.

Mind Map & Carousel

1. Consider all of the factors that need to be taken into account when making plans to use alternative forms of energy to generate electricity.
2. Start creating a mind map that illustrates these considerations.

3. Pass your mind map to another group/person.
4. Continue to brainstorm and add ideas to the map that you receive.
5. Repeat this pattern until you have received your original.
6. Use this mind map as basis upon which to complete your culminating activity

[RETURN TO TABLE](#)