To Submit To Me:

- On the next slide there are 3 bullet points. You are to write a summary of those points from the information in the slides
- In the slides there are periodic questions, those should be answered and submitted to me as well.
- All submissions should be a pdf emailed to dconnor@sd73.bc.ca

Topic 3.1: How is electrical energy part of your world?

- Electrical energy has many applications.
- Many different types of energy can be transformed into electrical energy.
- Electrical energy is generated in different ways from different sources.

Concept 1: Electrical energy has many applications.

Electrical energy: the energy of charged particles

What uses electrical energy?

- The human body
- Technology (touch-sensitive screens, robots, maglev trains)

Figure 3.1

Electrical Energy Applications: The Human Body

The human body uses electrical energy

- Moving your eyes to read relies on electrical signals in your muscle and nerve cells
- Electrical signals help maintain breathing and heart beats

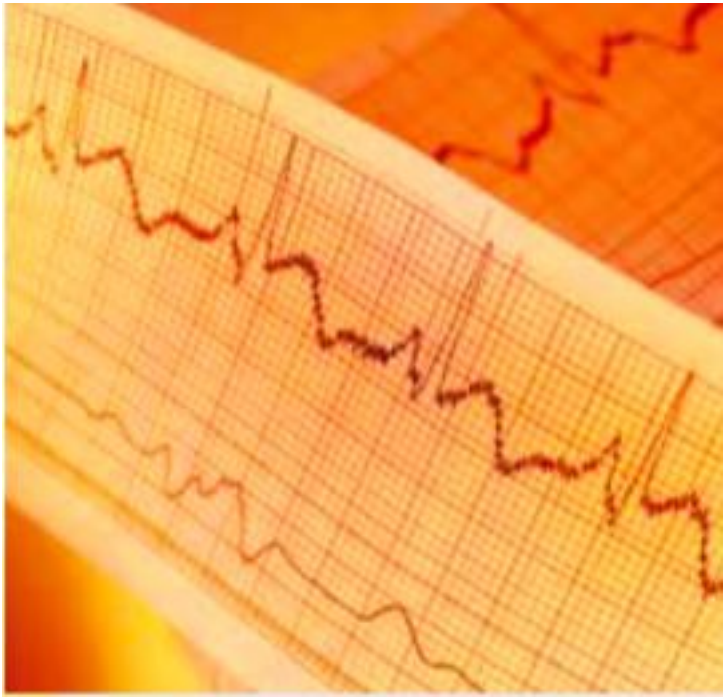


Figure 3.1

Electrical Energy Applications: Technology

Different types of technology use electrical energy

- Touch-sensitive screens
- Robots (made of flexible plastic that response to electrical signals like your own muscles)
- Maglev trains (hover above electrified coils along tracks)

Figure 3.1

Discussion Questions

1. Describe three ways that you have depended on electrical energy since you woke up this morning.

Concept 2: Many different types of energy can be transformed into electrical energy.

Energy is the ability to do work.

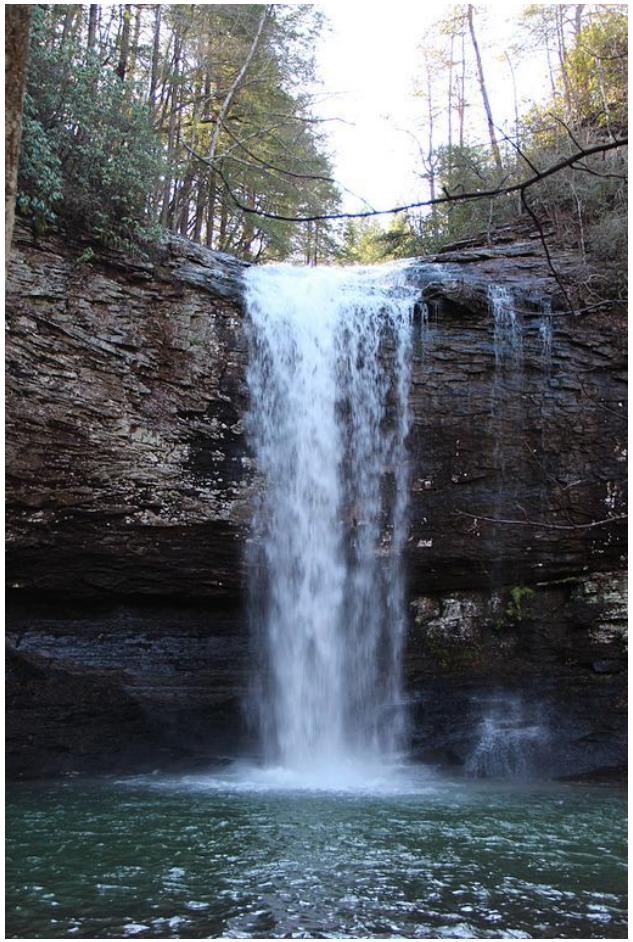
Energy is neither created or destroyed

- It is transformed from one kind of energy to another kind of energy
- Many types of energy can be transformed into electrical energy

Energy That Can Be Transformed Into Electrical Energy: Mechanical Energy

Mechanical energy: The sum of kinetic energy and potential energy

- **Kinetic energy**: Energy of motion
- **Potential energy**: Stored energy that a system has due to its position or condition
- **Example**: Water at the top of a waterfall, just before it falls, has *potential energy* because of its position, and *kinetic energy* because it is moving



Energy That Can Be Transformed Into Electrical Energy: Chemical Energy

Chemical energy: Energy stored in chemical bonds, and released when a chemical reaction occurs

- Batteries store chemical energy
- Chemical energy stored in animals and plants is called *biomass*
- Fossil fuels (coal, oil, natural gas) store chemical energy

Figure 3.2

Energy That Can Be Transformed Into Electrical Energy: Solar Energy

Solar energy: Energy carried by electromagnetic radiation given off by the Sun

- Fossil fuels and biomass result form energy from the Sun being captured by plants and plant-like organisms

Figure 3.2

Energy That Can Be Transformed Into Electrical Energy: Nuclear Energy

Nuclear energy: Energy generated by forming new atoms

- **Nuclear fusion**: New atoms are made as smaller atoms collide and fuse (occur in the Sun and stars)
- **Nuclear fission**: New atoms are made by splitting larger atoms (carried out in reactors on Earth)

Figure 3.2

Figure 3.2

Energy That Can Be Transformed Into Electrical Energy: Thermal Energy

Thermal energy: Energy due to the rapid motion of particles that make up an object; detected as heat

- Sources include nuclear reactions or from Earth's interior (geothermal energy), where steam and hot water form naturally
  - **Example**: Geysers, volcanoes, hot springs

Figure 3.2

Discussion Questions

1. Explain the difference between kinetic energy and potential energy.

2. Describe the relationship among solar energy, biomass, and fossil fuels.

Concept 3: Electrical energy is generated in different ways from different sources.

Different types of energy can be transformed into electrical energy

- Most of the electrical energy in Canada is generated by transforming kinetic energy into electric energy
- Source of kinetic energy may be moving water, wind, or moving steam produced by nuclear reactions or burning fossil fuels

Kinetic Energy to Electrical Energy: Generator System

Generator system: A system that transforms kinetic energy to electrical energy

- **Turbine**: Steam, water, or wind cause the turbine to spin
- **Shaft**: As the turbine spins, the shaft spins
- **Generator**: Kinetic energy of the spinning shaft is transformed into electrical energy inside the generator by a **dynamo** (spinning coils of wire and magnets, like a motor working in reverse)

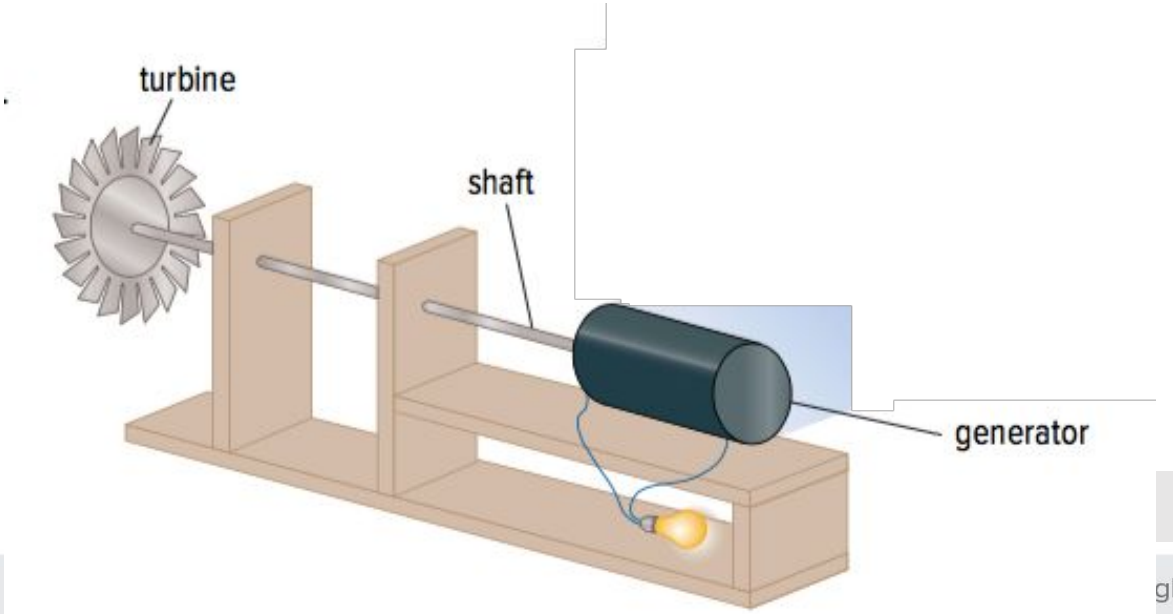


Figure 3.3

Kinetic Energy to Electrical Energy: Generator System (continued)

Turbine: Steam, water, or wind cause the turbine to spin.

Shaft: The shaft connects the turbine to the generator. As the turbine spins, it makes the shaft spin.

Generator: The kinetic energy of the spinning shaft is transformed into electrical energy inside the generator. This happens when energy from the shaft turns a wire loop or coil. A magnet surrounds the rotating wire, as shown in the inset. As the wire turns, electrons flow in the wire. This flow of electrons powers electrical devices.

Figure 3.3 A generator system

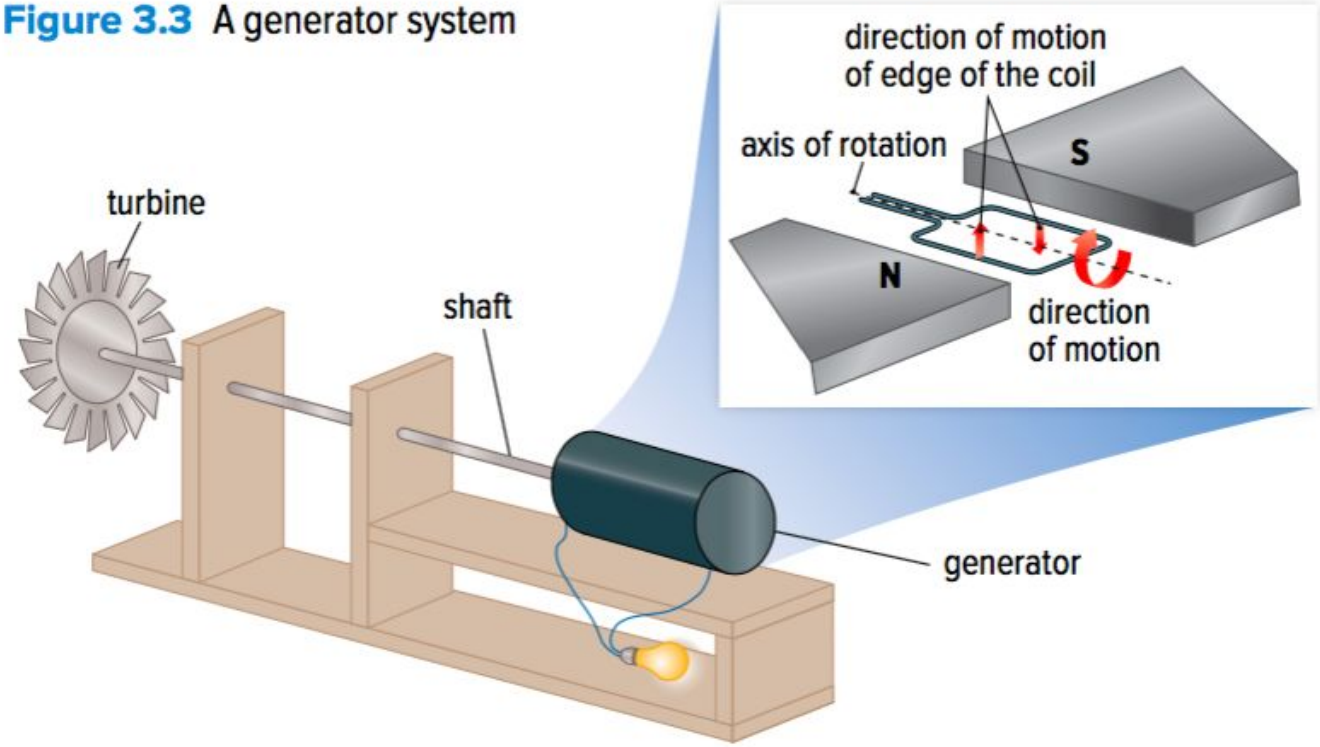


Figure 3.3

Generating Electrical Energy in Canada

Most of the electrical energy in Canada comes from river flow, fossil fuels, and nuclear reactions

British Columbia:

- River flow is the main source (hydroelectric energy)
- Also uses fossil fuels
- No nuclear reactors

Hydroelectric Energy from River Flow

Two systems generate hydroelectric energy:

- Dam station (shown below)
  - Water stored behind dam has potential energy
  - As water flows downhill, it gains kinetic energy, which turns a turbine connected to a generator
- Run-of-river station
  - Water flowing freely in a river turns a turbine

Figure 3.4

Water flowing through a dam spins giant turbines, which spin a generator to produce electrical energy.

Electrical Energy from Fossil Fuels

Generating station:

- Thermal energy from burning coal is used to boil water into steam
- Pressure associated with moving steam turns the blades of turbines connected to generators

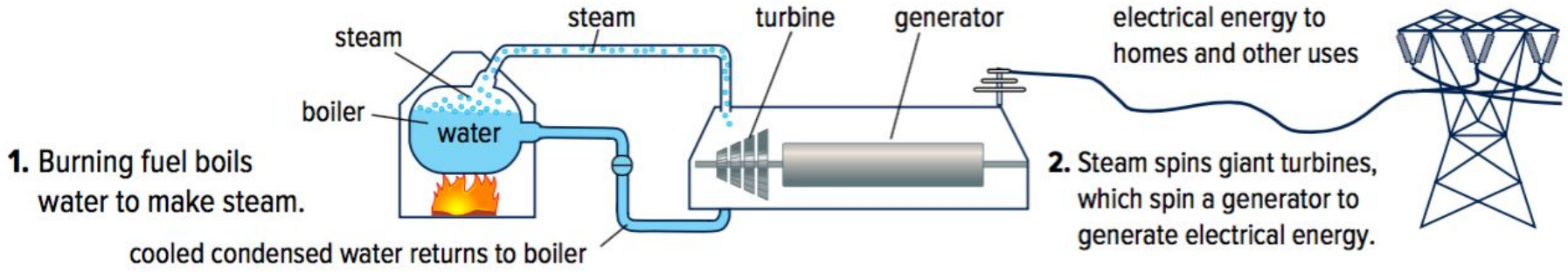


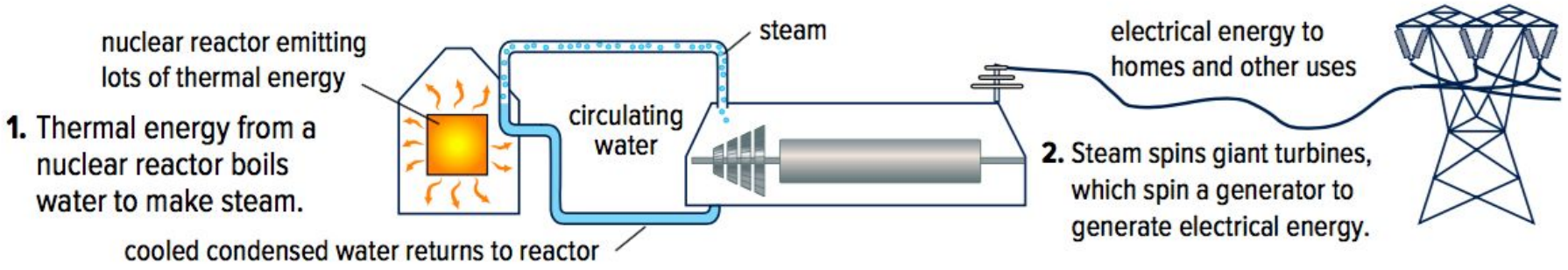
Figure 3.4

Electrical Energy from Nuclear Reactions

Nuclear reactor:

- Uranium or plutonium atoms undergo fission reactions
- Splitting one atom sets off a chain reaction that causes more atoms to split, which releases energy
- Most of the energy is thermal energy, which is used to boil water into steam
- Pressure from the moving steam turns turbines connected to generators

Figure 3.4



Generating Electrical Energy from Other Energy Sources

Other energy sources include:

- Wind
- Sunlight
- Geothermal sources
- Waves and Tides

Electrical Energy from Wind

- Kinetic energy of wind is transformed into electrical energy as the moving air turns the turbine of a generator system
- Wind turbines have an anemometer is used to measure wind speed

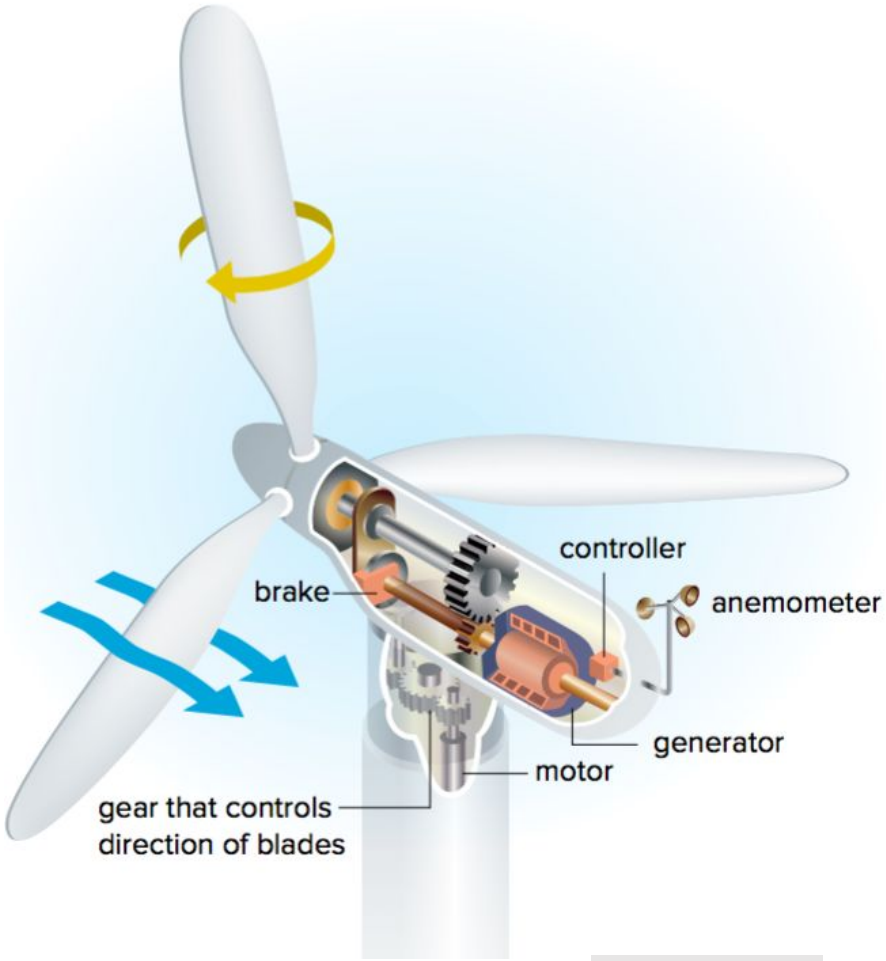


Figure 3.5

Electrical Energy from Sunlight

- Photovoltaic cells transform the energy of visible light to electrical energy
- When light strikes silicon atoms in the photovoltaic cells, the electrons absorb enough energy to flow in a specific direction and generate electrical energy

Figure 3.6

Electrical Energy from Geothermal Sources

- Where Earth's crust is thin and molten rock comes close to the surface
- hot steam from boiling groundwater can be used to turn turbines to generate electrical energy

Figure 3.7

Electrical Energy from Waves and Tides

- Tides and the rise and fall of waves can turn turbines to generate electrical energy

Figure 3.8

Discussion Questions

1. List three key parts of a generator system. Briefly describe their functions.

2. Use a flowchart to explain how moving water can generate electricity.

Topic 3.1 Summary: How is electrical energy part of your world?

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- Many different types of energy can be transformed into electrical energy.
- Electrical energy is generated in different ways from different sources.