Mrs. Grace Martin's Science 10 UNIT B Lesson Plan #6

Subject: Science 10 **Date**: Friday September 24

Unit B: Energy Flow in Technological Systems **Time**: 120 minutes

Outcomes:

STSK GLO 1. Analyze and illustrate how technologies based on thermodynamic principles were developed before the laws of thermodynamics were formulated.

• 1.2 describe, qualitatively, current and past technologies used to transform energy from one form to another, and that energy transfer technologies produce measurable changes in motion, shape or temperature *(e.g., describe examples of Aboriginal applications of thermodynamics in tool making, design of structures and heating)*

• 1.4 analyze and illustrate how the concept of energy developed from observation of heat and mechanical devices *(e.g., the development of pre-contact First Nations and Inuit technologies based on an understanding of thermal energy and transfer)*

STSK GLO 3. Apply the principles of energy conservation and thermodynamics to investigate, describe and predict efficiency of energy transformation in technological systems

• 3.1 describe, qualitatively and in terms of thermodynamic laws, the energy transformations occurring in devices and systems (*e.g., automobile, bicycle coming to a stop, thermal power plant, food chain, refrigerator, heat pump, permafrost storage pits for food*)

• 3.2 describe how the first and second laws of thermodynamics have changed our understanding of energy conversions (*e.g., why heat engines are not 100% efficient*)

• 3.6 apply concepts related to efficiency of thermal energy conversion to analyze the design of a thermal device (*e.g., heat pump, high efficiency furnace, automobile engine*)

Skills:

• PR2 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data

• PR3 use library and electronic research tools to collect information on a given topic

• AI4 compare theoretical and empirical values and account for discrepancies *(e.g., determine the efficiency of thermal energy conversion systems)*

• AI6 construct and test a prototype of a device or system, and troubleshoot problems as they arise *(e.g., design and build an energy conversion device)*

• AI8 evaluate a personally designed and constructed device on the basis of self-developed criteria *(e.g., evaluate an energy conversion device based on a modern or traditional design)*

Attitude Outcomes:

- Interest in Science
- Scientific Inquiry
- Collaboration

Lesson Objective: By the end of the lesson, students will:

- Understand systems and energy transfer within systems
- Know the first and second laws of thermodynamics
- Be able to complete a per cent efficiency calculation

Resources/Materials
PowerPoint titled: 6_unitB_lesson6.pptx
Addison Wesley Science 10 Textbook by Pearson Education Section B3.3-3.5

Preparation:
•Ensure the Rube Goldberg machine materials are ready in the classroom
•Get Laptop Cart #2 from the library
•Print out copy of handouts for Greg Ogilvie, who is observing

Lesson Procedure:
10:30 am - 12:30 pm
•Turn on PowerPoint to Today's agenda
•Prayer
•Review Chapter 3 material using PowerPoint Slides
•Students should have their green Ch 3 note sheet filled out
•Students may have more time to continue their project from yesterday
•If done, students may work on their practice problems for their handouts, and study for their Chapter 3 test Monday and their Physics Unit B: Energy Transfer Technologies unit exam which is next Tuesday.
•Remind students today or Monday that the majority of their unit exam focuses on Chapter 1, so make sure that this chapter is well understood
•Give students one test hint: to memorize the first and second laws of thermodynamics (do NOT mix the numbers up)
• At 11:45 the Volleyball girls need to be excused for their tournament

Assessment:
If students have not handed in their Chapter 2 video assignment and energy problems, remind them
Projects will be handed in today (Friday) if they are complete, or Monday if students need time over the weekend to polish it
Formative assessment at the beginning of every class with warm-up question, as per PowerPoint slides
Formative assessment during circulation and helping students with their projects.

Design an Energy Conversion Machine Project Report
(Each student must submit their own report)

Considering that a Rube Goldberg machine transfers different forms of kinetic and gravitational potential energy, design your own device that performs at least three energy transformations. You will write a report with the following content. You must be able to describe how your working model functions and identify all places where energy is wasted.

Content (worth 10 marks):
/4 definitions for: "system, open system, closed system, isolated system"

/2 define the first law of thermodynamics

/2 define the second law of thermodynamics

/2 answer: "can any machine be perfect? why or why not?"

Design (worth 4 marks):

/2 describe your construction, and modification process

/2 draw your design (or explain in full sentences if you cannot draw)

Analysis (worth 9 marks):

/3 describe the THREE energy conversions in your device

/2 identify at least two places in which energy could be lost as waste energy

/2 obtain two reasonable input and output energy measurements for your design type and calculate the per cent efficiency of your design

/2 how could you modify your project to be more efficient? (if you had unlimited resources)

Design (worth 2 marks):

/2 Teacher will assign marks for creativity, observation of group work, and overall project quality

/25 marks total

To avoid plagiarism, reference the textbook. Failure to do so will result in a loss of marks. Copying another student's work word for word will have the same penalty.

Sandner, L., Schaeffer, H., Lacy, D., & Sosnowski, C. (2004). ***Science 10.*** **Ontario: Addison Wesley, Pearson Education Canada Inc.**

Aboriginal Heat Transfer Technologies Research Project
(Each student must submit their own report)

You must pick three technologies to report on. Research at least three ways in which any aboriginal group(s) use heat transfer to meet their needs. An energy transfer technology could be using heat from a fire to mold a weapon, or the design of a teepee to contain heat in a circular area, using heat to dry/smoke/cook foods, the science of sweat lodges, or even potential energy conversions using Earth's gravity, such as at Head-Smashed-In-Buffalo Jump (this is not heat but it's okay). The energy conversions must be described for each.

Content (worth 10 marks):
/4 definitions for: "system, open system, closed system, isolated system"

/2 define the first law of thermodynamics

/2 define the second law of thermodynamics

/2 answer: "can any machine be perfect? why or why not?"

First Research Topic (4 marks)
/2 describe the technology

/2 what are the energy conversions that occur within this technology?

Second Research Topic (4 marks)
/2 describe the technology

/2 what are the energy conversions that occur within this technology?

Third Research Topic (4 marks)
/2 describe the technology

/2 what are the energy conversions that occur within this technology?

Analysis (3 marks)
/2 calculate the per cent efficiency of a fire to heat a small teepee if there is 9.3x10^6 J of potential energy stored in the wood, and 3.1x10^6 J of heat energy is kept in the teepee?

/1 what makes teepees more efficient structures at heat distribution than a square shelter?

/25 marks total

To avoid plagiarism, provide the website link for each technology researched. Failure to do so will result in a loss of marks. Copying another student's work word for word will have the same penalty.

Historical Engine Technologies Project
(Each student must submit their own report)

You must pick three technologies to report on. Use your Science 10 Textbook for Chapter Three (Unit B). The energy conversions must be described for each technology selected.

Content (worth 10 marks):
/4 definitions for: "system, open system, closed system, isolated system"
/2 define the first law of thermodynamics
/2 define the second law of thermodynamics
/2 answer: "can any machine be perfect? why or why not?"

The Gunpowder Engine, page 207 (2 marks)
/2 describe the technology and the drawbacks

The Heat Engine, page 207 (2 marks)
/2 describe the technology and the drawbacks

The Watt Engine, page 209 (3 marks)
/1 what scientist was responsible for the development of this engine?
/2 describe the technology including the benefits and drawbacks

The Internal Combustion Engine, page 210-211 (4 marks)
/1 what scientists were responsible for the development of this engine?
/2 describe the technology
/1 describe the benefits and drawbacks

Analysis (4 marks)
/2 calculate the per cent efficiency of a combustion engine in a car if gasoline has a stored energy content of 3.2x10^6 J and the kinetic energy of the wheels turning is 2.84x10^5 J?

/2 how have older heat technologies been improved or added upon to create the current technologies that we have today?

/25 marks total

To avoid plagiarism, reference the textbook. Failure to do so will result in a loss of marks. Copying another student's work word for word will have the same penalty.

Sandner, L., Schaeffer, H., Lacy, D., & Sosnowski, C. (2004). *Science 10.* Ontario: Addison Wesley, Pearson Education Canada Inc.

RESOURCES FOR: Aboriginal Heat Transfer Technologies Research Project

Textbook Reference for the "content" section:

Sandner, L., Schaeffer, H., Lacy, D., & Sosnowski, C. (2004). *Science 10.* Ontario: Addison Wesley, Pearson Education Canada Inc.

YouTube Resources:

Planet Doc (2015). Aboriginal Hunting Culture: Planet Doc Full Documentaries. Obtained from: https://www.youtube.com/watch?v=6RTiGmnMvvU

BBC (2014). Australian Aboriginal use of Spinifex resin technology. Obtained from: https://www.youtube.com/watch?v=CoMKQww5pq8

Website Resource:

Colorado Yurt Company (2014). History and How a Tipi Works. Obtained from: http://www.coloradoyurt.com/tipis/how-a-tipi-works/

Teepee

The tipi is tilted into prevailing winds so it is nearly vertical in the back making the tipi stand strong against the weather and increasing the useable living space. The smoke hole is positioned towards the more gently sloping front and has adjustable flaps that enhance the draw for an open fire.

Heating Your Tipi

When a tipi is properly pitched, the cover is staked several inches above the ground. The liner hangs against the inside of the poles and seals the bottom of the tipi. The liner makes a double wall and creates a chimney effect–air flows under the cover, is channelled up between the cover and the liner and finally, rises up through the smoke flaps taking the smoke with it. The addition of an ozan can increase the heat retention in your sleeping area and redirect any moisture that may enter through the smoke flaps.

A tipi may also be heated with a wood stove. A few lacing pins are removed from the front of the tipi to accomodate the exit of the stove pipe. A detailed pitching guide is included with every tipi order and includes information on heating with a wood burning stove.

Cooling Your Tipi

In hot weather, the smoke flaps are left open and the bottom of the tipi cover is rolled up (either all the way around or just on one side). Even the most gentle breeze creates a nice cooling effect.

Website Resource:

Wikipedia (2015). Tipi. Obtained from: https://en.wikipedia.org/wiki/Tipi

Website Resource:

Mukwa Teepees (2015). Teepee Facts. Obtained from: https://mukwateepees.wordpress.com/teepee-facts/

A teepee can quickly and easily be adjusted to maintain solar heating for warmth or to ventilate excess heat, depending on the situation. Unlike a tent, a teepee can have an open fire inside to warm up the living space with radiant heat. An inner liner can also be added to keep the inside warm and cozy, even in the winter and in the snow.

A teepee has natural air conditioning! Thanks to teepee technology, the temperature inside the teepee can be easily adjusted to produce an air draft that quickly cools down the temperature of the space to a pleasant level, up to 15 degrees cooler than the outside ambient temperature.

A properly set-up teepee is remarkably wind-resistant. Thanks to its aerodynamic shape it stays firmly planted on Mother Earth during storms.

Teepees are flexible and move with the earth. They don't collapse in earthquakes.

Website Resource

Anthropolis. (2005). Facts: Cold, Icy, and Arctic. Obtained from: http://www.athropolis.ca/arctic-facts/fact-clothing-caribou.htm

Inuit Clothing for Insulation

When the Inuit lived exclusively from the land, caribou and seals were the main sources of clothing material. Both provided protection from the harsh Arctic winters.

No part of an animal was wasted. Caribou provided meat and the skin was the best material for making winter clothing because it is very warm. The hair growth is about twice as dense as that on seal skin, and the hollow guard hairs enclose air, providing a high level of insulation against the cold.

Traditional Inuit clothing for the coldest weather consisted of two layers of garments. The inner one had the fur against the skin, the outer one had the fur outside. Not only does the hollow fur itself provide an insulating layer, but the two layers of clothing trap an insulating layer of air between them.

Of course, caribou skin was usually one of the few materials available. The textiles that became available from the European's were not considered by the Inuit to be at all suitable for winter wear - you'd have to put on layers and layers and layers of clothing and you'd STILL be cold!

Website Resource

Pitt Rivers Museum. (2010). Inuit Clothing. Text, photos and recordings by John Tyman. Obtained from: http://www.johntyman.com/arctic/inuit201.html

Website Resource

Platinum Heritage. (2013). 7 WAYS BEDOUINS CAN TEACH US TO STAY COOL IN SUMMER AND 1 FROM US. Obtained from: http://www.platinum-heritage.com/blog/7-ways-bedouins-can-teach-us-to-stay-cool-in-summer-and-1-from-us

Camp Location *Ancient Technique:* The Bedouin would build their camps on the TOP of dunes for many reasons; to catch any cool winds, to avoid low area's susceptible to flash floods, to keep watch on approaching tribes, and to avoid snakes and scorpions which prefer low lying brush. **Head Cover** *Ancient Technique:* The Bedouin would cover their heads to protect from sunburn and use to cover their faces in case of sand storms. **Clothing** *Ancient Technique:* Scientists were surprised to learn that Bedouins would wear black during the day. After conducting numerous experiments including; wearing loose white clothing, loose dark clothing, an army uniform and shorts with no shirt; the scientists concluded that both black and white loose clothing was the most effective way to stay cool under the sun. While the white colors' reflected the sun, the black were best at absorbing body heat. **Henna** *Ancient Technique:* Bedouins would use henna under their eyes to protect against the glare of the sun. **Water** *Ancient Technique:* Water was the lifeblood of the desert. Even within living memory, many Bedouins tell us that water wells were like modern petrol stations of today. Used to refill and navigate across the desert. Terracotta posts elevated off the ground took advantage of wind flow to keep the posts cold. **Hot Drinks/Soup** *Ancient Technique:* Bedouins knew that drinking a hot drink or soup would help to keep them cool down. Scientists from the University of Ottawa's Thermal Ergonomics Laboratory only recently were able to prove this theory. In environments where there is low humidity, hot drinks trigger a sweat response which naturally cools the body. Cold drinks have the opposite effect, cancelling out the cooling benefits of the drink.

Website Resource

Wikipedia. (2015). Fire Hardening. Obtained from: https://en.wikipedia.org/wiki/Fire_hardening

Fire hardening, also known as "fire-polishing", is the process of removing moisture from wood, changing its structure and material properties, by slowly and lightly charring it over a fire. This makes a point, like that of a spear, or an edge, like that of a knife, more durable

Pre-historic weaponmakers would rub the end of a selected wood pole against a smooth rock surface until a point was achieved. Then the point was heated in a fire, making sure to thrust the point into the coals. This put a light coating of carbon on the surface, which was then polished with a special stone, which ground fine particles of stone into the pitch which had been brought to the surface of the wood by the fire. Subsequent firings and polishings of the wooden tip of the spear would eventually form a hardened glaze consisting of pitch, wood particles and carbon on the tip which could eventually be even harder than a copper tip. This kind of technology was developed by primitive humans at least 400,000 years ago—long before flint or stone points.

Website Resource

Ancient Craft. (2009). Fire-hardened spear. Obtained from: http://www.ancientcraft.co.uk/Projects/spear/spear.html