**GRADE 4 ENERGY SUMMARY**

**Grade 4 Learning Standards (From BCEd Curriculum)**

Energy:

* has various forms
* energy can be described in these ways: the energy of motion (kinetic), light, sound, thermal, elastic, nuclear, chemical, magnetic, gravitational, and electrical
* is conserved
* the law of conservation of energy — energy cannot be created or destroyed but can be changed
* devices that transform energy
* devices that transform energy change input energy into a different output energy (e.g., glow stick [chemical to light], wind-up toy [elastic to mechanical], flashlight [electrical to light]).

**WHAT DO Grade 4’s need to know about Energy Transformations?**

Energy can be potential or kinetic.

 **Kinetic energy** is the energy of motion. Types of kinetic energy:

|  |  |  |
| --- | --- | --- |
| **Type** | **motion** | **Examples and subtypes** |
| **MECHANICAL**energy | motion of  objects you can see | machines, muscles, projectiles, wind, flowing water, ocean waves, …INCLUDES **SOUND**  |
| **THERMAL**energy | random motion of *microscopic* particles of matter (molecules, atoms, ions) | heat, fire, geothermal (energy from earth’s core),… |
| **ELECTRICAL**energy | flow of *charged particles* | household current, AC and DC circuits, lightning,… |
| electromagneticradiation | disturbance propagating through electric and magnetic *fields* | radio waves, microwaves, infrared, light, ultraviolet, x-rays, gamma rays |

**Potential energy** is stored; objects can have potential and kinetic at the same time. Types of potential energy:

|  |  |
| --- | --- |
| **Force field** | **Examples and subtypes** |
| gravitational | roller coaster, waterwheel, hydroelectric reservoir,… |
| electromagnetic | electric, magnetic, **CHEMICAL and ELASTIC**… |
| nuclear | nuclear reactors, nuclear weapons,… |

Law of Conservation of Energy: Energy can neither be created nor destroyed in an ordinary physical reaction, just transformed. If a system is closed (no energy can leave or enter) the total amount of energy stays the same. However, most systems are not closed—they are open to losing or gaining energy from the environment. Therefore we do not have perfect energy transformations. For example, you cannot drop (drop, not throw) a ball and have it bounce higher than where it was dropped from (except with the basketball/tennis ball drop). Some energy is lost due to friction with air, the sound of the bounce, a small amount of heat created in the bounce…etc.

**CURRICULAR COMPETENCIES**

Questioning and predicting—can students generate their own questions?

Planning and conducting—can they design and plan an experiment?

Processing and analyzing data and information—can they record data and see patterns?

Evaluating—can they draw conclusions from their data?

Applying and innovating—can they improve their design?

Communicating—can they talk, write and draw about their learning?

**WHY IS IT IMPORTANT?**

Practically every device we use and every thing we do involves energy transformations of some kind. The efficiency of those transformations determine the efficiencies of our energy sources. As we examine new energy technologies, we will need to look at different and more efficient transformations as well as ways to store energy from clean sources.

**KEY VOCABULARY**

**Kinetic-energy in motion**

**Potential-stored energy**

**Transformation-a change from one type of energy to another**

**Efficient-when more energy is converted rather than being lost**

**Closed System-where energy stays in the system, not added or lost**

**Open System-where energy can be added or lost**

**Device-a piece of equipment that uses energy**

**Input energy-energy that is put into a device**

**Output energy-energy that a device produces**

**SOME INQUIRY QUESTIONS**

* Can a dropped ball bounce higher than the height it was dropped from?
* How is energy wasted or lost in systems?
* What kind of energy transformations are most efficient?
* How is electricity generated?
* What are some ways that wasted energy is saved?
* Can you develop ways to save wasted energy?

**SUGGESTED PROVOCATIONS/ACTIVITIES/EXPERIMENTS**

Show pictures of a variety of devices and ask students to label the types of energy and the transformations involved. Or present a variety of objects to do this with. (Ex: match (chemical🡪heat and light, flashlight (chemical🡪electrical🡪light and some heat)).

Challenge students to bounce different types of balls and measure how high the bounces are. For greater detail, video this with a camera or iPad and play back in slow motion. Why do different types of balls bounce differently?

This stacked ball experiment seems to violate the above rule of conservation: <https://www.youtube.com/watch?v=dOJFjKSHQD0> . Have students watch and do a Predict Explain Observe Explain with a demonstration of this (careful—outside or gym is good). <https://sites.google.com/site/studentcentredinquiry/home/1-peoe>

Here is a follow up to the above video—why does the single person end up flying higher than the jumpers in this Guiness Record Setting feat? <https://www.youtube.com/watch?v=n8BX6v9k9CU&feature=youtu.be>

Experiments to show the collection and storage of solar energy: <http://www.theteacherscafe.com/Science/Hands_On_Activity/Solar_Energy_Activity.php>

 This video of Wile E Coyote and the Roadrunner shows some energy transformations. <https://www.youtube.com/watch?v=i6e-KrNCe_E> Show students and have them discuss.

Have students pick a particular toy or household object and have them trace the energy transformations involved. Or they could consider the energy transformations involved in getting to school (walking, cars and biking would all have different energy transformations).

Here are a number of experiments involving energy transformations of one kind or another: <https://www.stevespanglerscience.com/lab/categories/experiments/energy/>

**CROSS-CURRICULAR CONNECTIONS**

ADST: students could make a mousetrap or elastic band car or a matchstick boat to demonstrate energy transformations. <http://pbskids.org/designsquad/build/rubber-band-car/> or a putt putt boat <https://sciencetoymaker.org/putt-putt-boat/> (you can find many diverse patterns for this on line)

Art: Kinetic art is interesting-- <https://www.youtube.com/watch?v=PIbk4AKFMTc>

Kids version here: <https://www.youtube.com/watch?v=qs88aC0k0yI>

Here is a simple version requiring common materials: <http://pbskids.org/designsquad/build/kinetic-sculpture/>

Of course lego and many other building projects have kinetic components—talk about the energy transformations involved.

Social studies—this is an excellent place to discuss the pros and cons of various forms of energy. An exploration of all the stakeholders in things like the Kinder Morgan. fracking or Site C debates would be useful, and could incorporate inquiries about all the energy transformations involved. Geographic concerns could also be explored by looking at possibilities for solar, hydro, wind and wave energy as clean technologies.

Literature: Here’s an interesting resource that links Greek Mythology to Energy: <http://www.need.org/files/curriculum/guides/GreekMythology.pdf>

**INDIGENOUS PERSPECTIVES**

Unit 3 and Unit 5 of the FNESC Science First Peoples explore energy and its effects:

<http://www.fnesc.ca/wp/wp-content/uploads/2015/08/PUBLICATION-61496-Science-First-Peoples-2016-Full-F-WEB.pdf>

Explore energy transformations in a number of traditional activities—such as hunting bows, fire, bentwood box cooking…etc.

Explore how renewable energies are being used to power First Nations communities.

<http://www.cbc.ca/news/indigenous/indigenous-owned-company-renewable-energy-first-nations-1.4066524>

Also explore how major energy megaprojects are affecting First Nations.

<https://globalnews.ca/news/1728749/everything-you-need-to-know-about-the-site-c-dam/>

**RESOURCES**

Interesting demo of conservation or transfer of energy: <https://www.youtube.com/watch?v=vegdgaI30rA>

Good outline of most energy sources and of transformations: <http://www.thunderboltkids.co.za/Grade4/03-energy-and-change/chapter2.html>

**References:**

The Physics Hypertextbook: <https://physics.info>

SD71 Science Info (this is a great source of info for all science areas):

https://portal.sd71.bc.ca/group/wyhzgr4/physics/grade4/Documents/sd71\_web\_Physics\_g4.pdf

(you can find many good video links in the above document)