LESSON: Energy Mathematics GRADE: 5

OBJECTIVES:

Measurement & Data-
Convert like measurement units within a given system.

- **5.MD.A.1** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

MATERIALS & RESOURCES:

- Access to Internet or library
- Poster board or other material for project base
- Markers, paint, recycled magazines, construction paper; any materials that students can use to illustrate their research

PRESENTATION:

Tell students the class will study the mathematics of energy with self-guided Internet or library research.

DIRECTIONS:

1. Tell students the goal is to learn about energy by using math.
2. Allow students time to research energy on the Internet or in the library. Tell them they will create illustrations of their research. Examples of illustration could be pie charts, bar graphs, and pictograms. It may be efficient to mark the websites so they can return to the site when needed.
3. If desired refer to the page of ideas included in this lesson.
4. Illustrations can be shared in class or displayed around the room.
5. After students have had a chance to study each other's work, have individuals or small groups create their own test based on the body of research done by the class. Have them exchange tests with each other, complete testing, and discuss as a class or in small groups.

TIME: 45-60 min

ENERGY QUESTIONS RELATED TO MEASUREMENT

Work is the amount of energy required to move an object from one point to another (W=F x d or Work=Force x distance)

Lift a 5 kg box from the floor to the top of a table 2 meters tall.

5kg x 2 meters = 10 Newton meters of work (A Newton-meter is a measurement unit of work. 1 N-m = 1kg of mass x 1 meter of distance)

Power is the rate at which the energy is spent (P= W/t or Power=Work/time)

Say it took you 3 seconds to lift the 5 kg box on to the 2-meter tall table.

We already know the **work** = 10 N-m

10 N-m / 3 seconds = 3 1/3 Power

Joule = **Power** exerted over time (J=P x t)

3 1/3 **Power** x 3 seconds = 10 **Joules**

You can see that 1 Newton meter (N-m) is equal to 1 Joule

If you want to convert kg to lbs: 1 kg = 2.20462262185 lbs.

To convert meters to yards: 1 meter = .914 yds

Horsepower- Horsepower is defined as work done over time(HP=W/t) The exact definition of one horsepower is 33,000 lb.ft./minute. Put another way, if you were to lift 33,000 pounds one foot over a period of one minute, you would have been working at the rate of one horsepower. In this case, you'd have expended one horsepower-minute of energy.

1 **Horsepower** unit is = to 735.5 watts of energy

Watt is a unit of electrical energy

1 **watt** = 1 **Joule** (remember that a Joule = Power x time or P x t)

If your box fan requires 100 watts in an hour, you run it 8 hours per day, how many watts does your box fan use?

8 hrs x 100 watts =800 watts/day

if you run the fan 30 days per month

30 days x 800 watts per day = 2400 watts per month

How many kilowatts is this? 1 kilowatt = 1000 watts

2400/1000 = 24

If 1 kilowatt of electricity costs 8 cents how much does it cost to run the fan for a month?

24kw x .08/kw = $1.92/month

Calorie- A unit of energy equal to the amount of heat needed to raise the temperature of one gram of water by one degree Celsius. One calorie is equivalent to 4.1868 joules. Also called *small calorie*.
If 1 calorie= 4.1868 Joules, how many calories equal a watt? Kilowatt? 1 horsepower?

If an apple has about 100 calories, how many apples would be required to run a box fan for 8 hours? Is this possible?

ENERGY QUESTIONS RELATED TO USE

How much oil does the world use per year? What fraction of that is US consumption?

Contrast the time required to make fossil fuels compared to how quickly we use fossil fuels.

Oil is a fossil fuel. Fossil fuels are finite. How long do you predict the US will produce crude oil? What about other forms of oil? What is the difference in these oils? What kinds of math problems can you think of related to these questions?

What do you imagine it would be like if our country conserved energy by 25%. What about 35 or 50%?

What is oil used for in the US? What fraction of total use is for transportation in the US?

Which country uses the most electricity? Per person, which population uses the most electricity?

What are the possible sources of electricity? Which of these is used most in the US? What about other countries?

What is the average use globally? What is US average use? What fraction of our current electricity use would the US need to cut out in order to use an average amount of energy?

What fraction of electricity in the US is generated through nuclear power?

Make a graph of electricity used by various appliances.

Find a website that helps you calculate how much energy you or your family use? In what areas do you have the choice to conserve energy? How would you go about cutting down on energy use? What fraction or percentage of your current energy use could you live without?

What kind of math is used when using solar energy? What about geothermal, wind, hydropower, and biomass. Any other sources?