PLTW GTT EE MATH Frameworks

PLTW Course GTT Energy and the Environment

Math Strand being addressed Number & Operation

Math Standard being addressed 6.1.2.4

Overview:

Math Standard and Benchmarks 6.1.2; Understand the concept of ratio and its relationship to fractions and to the multiplication and division of whole numbers. Use ratios to solve real-world and mathematical problems.

- 6.1.2.4; Use reasoning about multiplication and division to solve ratio and rate problems. *For example*: If 5 items cost $3.75, and all items are the same price, then 1 item costs 75 cents, so 12 items cost $9.00.

Correlation to Common Core Math Standards: MN 6.1.2.4 ≈ CCSS 6.RP.3.C

Essential Understandings/Big Ideas:

The concept of ratio is a critical foundation in the learning progression of algebra concepts, connecting rational numbers to proportion to function in future years. Students at this level use simple reasoning about multiplication and division to solve ratio and rate problems. For example; Work is measured in Joules (J) and is defined as force acting over a distance, or: Work = Force x Distance (W = F x D). Joules = Newton-meter, in this activity work will be done lifting a weight. The force term equals the weight in Newtons, and the distance term equals the height lifted in meters. Power is measured in Watts (W) and is defined by how fast work is done, or: *P*ower = Work ÷ time (*P* = W/t); Watts = Joules/seconds.

What should students know and be able to do [at a mastery level] related to these benchmarks? –

- Use reasoning about multiplication and division to solve ratio and rate problems**;**
- Use reasoning about multiplication and division to determine equivalent ratios;
- Determine unit rates;

Misconceptions:

Student Misconceptions:

- Students may believe that 8:4 and 2:1 represent different ratios;
- Students may not understand that order matters in a ratio. For example, students may believe that 3:1 and 1:3 are the same ratios;
- Given the ratio 3 boys to every 7 girls, students may think there are exactly only 3 boys and 7 girls;
- When scaling up by non-integer values, students revert to additive structures (e.g., When asked, "If it takes 6 pizzas to feed 24 people, how many pizzas will it take to feed 36 people," students add 6 + 12 rather than multiply 6 x 1.5);
- Students do not understand unit rates as fractions (e.g., 25 students per bus means 1bus25students)

Teacher Resources:

Teacher Notes

- When introducing these concepts into the “Measuring Energy” activity, make the problem relevant to them. Set up the problem by properly going through the introduction.
- When students are calculating their results make sure to have students properly label their work this will allow them to plug the data into its correct location.
- Make sure to guide them to self discover of how to figure out the desired answer.

Student struggle most is when they are taking the data that they have compiled and try to apply that data to their formulas.

New Vocabulary

Power	The rate at which work is performed or energy is expended.
Watt	A measure of power equal to one joule of work per second.
Work	A result of a force moving an object a certain distance.
Newton-Meter	A unit measure of work.
Efficiency	The ratio of the useful energy delivered by a dynamic system to the energy supplied to it.

Energy	The ability to do work; types include heat, light, sound, chemical, nuclear, mechanical, electrical.
Joule	The unit of energy or work in the MKS system of units, equal to the work done by a force of one Newton-meter.

rate: a ratio that compares two quantities measured in different units; may be expressed using the word *per*. *Examples:* 4buses100students; 100 students per 4 buses.
ratio: a comparison of two quantities by division. *Examples:* 12 to 25, 12:25, 2512
unit rate: a rate with a denominator of 1 unit. *Example:* $3

Vignette:

In this project students will experiment with blade materials, shapes, sizes, number of blades, angle of blades, etc. to determine the most efficient design for wind power generation. Students will design and create a blade system, then test the system to see how much power they have created. To expedite the completion of this activity the teacher may want to divide groups so that each team is solving and testing for a different problem.

Test your design and record in your engineering notebook:

- Mass of the weight you are using in kilograms
- Distance the weight is travelling in meters
- Time it takes for the weight to travel that distance

To calculate the how much power each set of blades are generating we are going to take the formula, work = Force x Distance then apply that answer to our next formula to solve for power, ***P*ower = Work ÷ time.**

Additional Instructional Resources

http://www.thefutureschannel.com/dockets/science_technology/wind_farming/
http://videos.howstuffworks.com/medialink/1212-new-wind-energy-technologies-video.htm
4-h.org/curriculum/wind.
http://videos.howstuffworks.com/planet-green/29378-g-word-wind-farms-video.htm
http://www.youtube.com/watch?v=rypl4aueD3Q&NR=1
http://www.khanacademy.org/v/finding-unit-rates?p=Developmental%20Math

Assessment:

Assessment:

A wind turbine produces 200 kW of electricity. How many 100 watt light bulbs can this wind turbine light?
A bodybuilder loads a bar with 550 Newtons (~125 pounds) of weight and pushes the bar over her head 10 times. Each time she lifts the weight 0.5
meters. How much work did she do?
If she lifts the bar 10 times in 20 seconds, how much power did she use?
How did math help you determine the amount of watts your turbine produces?
Why do engineers use math?

Differentiation:

Gifted and Talented:
This activity could be expanded by creating more restriction to the student. Such as: they can only have one blade instead of multiple blades, assign them one type of material to that is heavier than the rest.

Special Education:
For students on an IEP – or even just those that really struggle with this concept, how can they be supported in their learning?

English Language Learners:
Create a visual glossary that includes examples of ratios represented in different forms, rates, unit rates, and proportions;

Parents and Administration:

Administrative/Peer Classroom Observation

Students Are: (descriptive list)	**Teachers Are:** (descriptive list)
Investigating	Facilitating
Testing	Guiding
Problem solving	Advising
Collaborative groups	Questioning
Using problem solving skill	Monitoring
	Listening
	Redirecting

Professional Learning Communities: *(may not work for PLTW teachers); how many are in a PLC for PLTW?)*
Reflection – Critical Questions regarding the teaching and learning of these benchmarks

Materials – suggest articles and books for book study with PLC

Parent Resources:
Online videos to describe wind energy include:
http://www.thefutureschannel.com/dockets/science_technology/wind_farming/
http://videos.howstuffworks.com/medialink/1212-new-wind-energy-technologies-

video.htm
4-h.org/curriculum/wind.
http://videos.howstuffworks.com/planet-green/29378-g-word-wind-farms-video.htm
http://www.youtube.com/watch?v=rypl4aueD3Q&NR=1

References:

Project Lead the Way curriculum
Minnesota State Math Standards
SciMath Minnesota