

***PA Multi-Region Mathematics and***

***Science STEM Partnership***

***UNIT #1***

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| **UNIT #1 TITLE:** | **Measurement & Conversions** |
| **FOR USE WITH GRADE(S)** | **6-9** |
| **SUBJECT AREA(S):** | **Math** |
| **KEYWORD SEARCH:** | **Ratio, proportion, measurement, notation** |

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| **DEVELOPED BY: DISTRICT/SCHOOL:** | |
| **Team Contact Person:**  **Julianne Kremer** | **Blairsville-Saltsburg SD**  **Blairsville Middle School** |
| **Team Members:**  **Barb Stile** | **Blairsville-Saltsburg SD**  **Blairsville High School** |
| **Kathy Muir** | **Blairsville-Saltsburg SD**  **Saltsburg Middle/High School** |
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**REGION:\_\_\_\_West Region \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Unit #1 At a Glance (Overview)**

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| **GRADE LEVEL(S):** |
| **6-9** |
| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** |
| [CCSS.MATH.CONTENT.6.RP.A.3.D](http://www.corestandards.org/Math/Content/6/RP/A/3/d/) Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.  [CCSS.6.RP.A.1](http://www.corestandards.org/Math/Content/6/RP/A/1/) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.  [CCSS.6.RP.A.2](http://www.corestandards.org/Math/Content/6/RP/A/2/) Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship.  [CCSS.6.RP.A.3](http://www.corestandards.org/Math/Content/6/RP/A/3/) Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.  CC.2.1.HS.F.3  Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.  CC.2.1.HS.F.4  Use units as a way to understand problems and to guide the solution of multi-step problems.  CC.2.1.HS.F.5  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  M08.B-E.1.1.3 Estimate very large or very small quantities by using numbers expressed in the form of a single digit times an integer power of 10 and express how many times larger or smaller one number is than another.  M08.B-E.1.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Express answers in scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology (e.g., interpret 4.7EE9 displayed on a calculator as 4.7 x 109). |
| **BIG IDEA(S): (RTOP #6, #7, #8)**  **(Develop at least one big idea that will enable students to make sense of seemingly isolated facts and learning experiences.)** |
| Numbers can be represented in many ways to show equivalence through ratios and conversions. |
| **ESSENTIAL QUESTION(S):**  **(Develop at least two essential questions that focus learning toward the big idea and fosters critical thinking and deeper understanding.)** |
| * How do I measure accurately? * How do I choose an appropriate tool and unit when measuring? * How are the units of measure within a standard system related? |
| **UNIT GOAL(S):** |
| The students will better understand how numbers are related within one system of measurement as well as between systems of measurement (metric versus English). |
| **MATERIALS AND/OR RESOURCES NEEDED FOR UNIT DELIVERY:**  **(Include technology, NASA resources, etc…)** |
| Smartboard, **Metric PowerPoint Presentation & related worksheets, equivalent ratios worksheets,**  **Rulers, various measurable objects (such as books or ipad), yard/meter sticks, volume measurement tools, large scale to weigh large objects such as the students, small scale to weigh smaller object (such as a pan balance scale), measurement worksheet(s)**  **post-it notes, marble, walnut, golf ball, raisin, acorn, basketball, soccerball, softball, grapefruit, kidney bean, scientific notation worksheets, calculators**  Various websites:  <http://dev.physicslab.org/img/6538fa53-3c4a-4f8f-aafe-2303fc0374db.gif>  [www.google.com](http://www.google.com)  <http://spaceplace.nasa.gov/en/kids/dsn_fact1.shtml>  <http://www.windows2universe.org/teacher_resources/galileo/6.html> |

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| **ASSESSMENT/EVALUATION: (authentic student products, assessment methods)** |
| Formative:  Homework  Quizzes  Completing worksheets |
| Summative:  Observation/Teacher Questioning  Class/Group discussions  Projects  Experiments |

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| **ACCOMMODATIONS FOR STUDENTS WITH SPECIAL LEARNNG NEEDS**  **(Choose an important anchor assessment from the unit, and tell how would you modify for a student with a learning disability.)** |
| Material read aloud above students’ level, small group if needed with LS staff to complete assignments if needed, guided worksheets and/or LS staff in the room to assist. |

**IMPLEMENTATION PLAN**

**Unit #1**

**A.** A professional development component is required for each unit. Each team member should contribute at least one activity via which he/she will share professional knowledge or resources from related to the grant with individuals who are not affiliated with the grant. Some ideas for ways you could meet this requirement include:

* Professional development training to colleagues
* Local program to share with community
* Presentation at a conference
* Video documentary to duplicate and share with others
* Online resources and video for district website
* Professional publication
* STEM Extravaganza (program for parents)
* Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**B.** You are not limited tothe examples listed above.

* Describe the ways in which your team members will meet the professional development requirement for Unit #1 (meetings, events, publications, etc.):

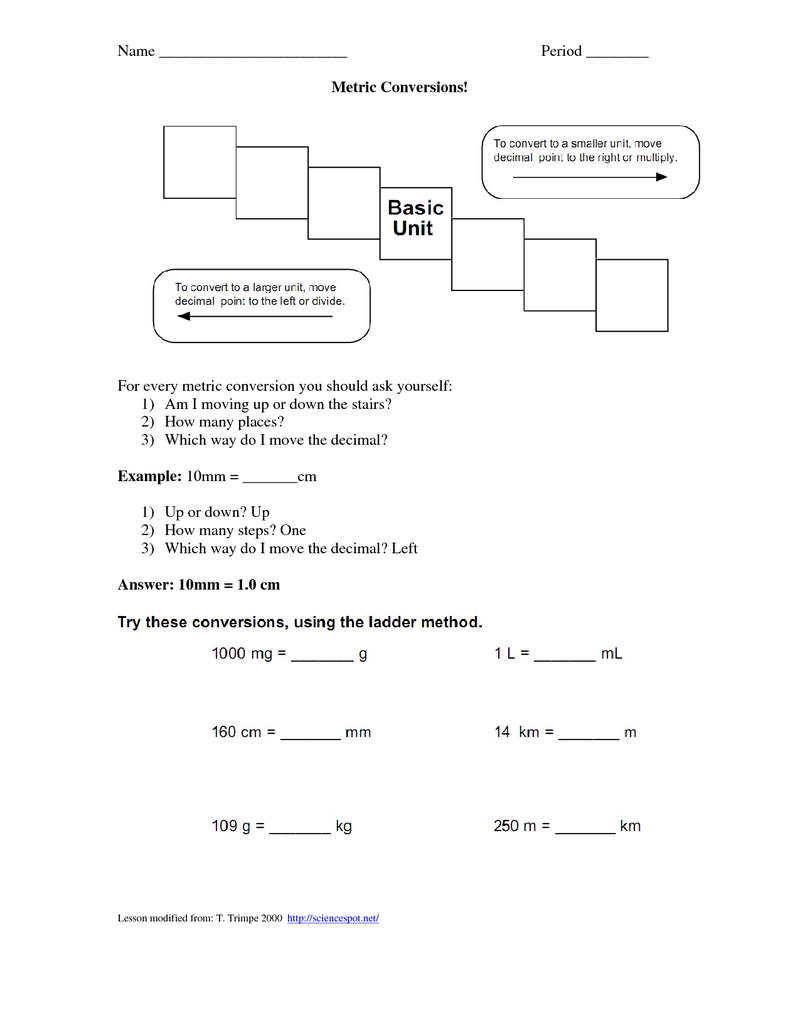
Professional development training to colleagues-our district has Friday Professional Development time every week. We will share with our colleagues in departments at this time.

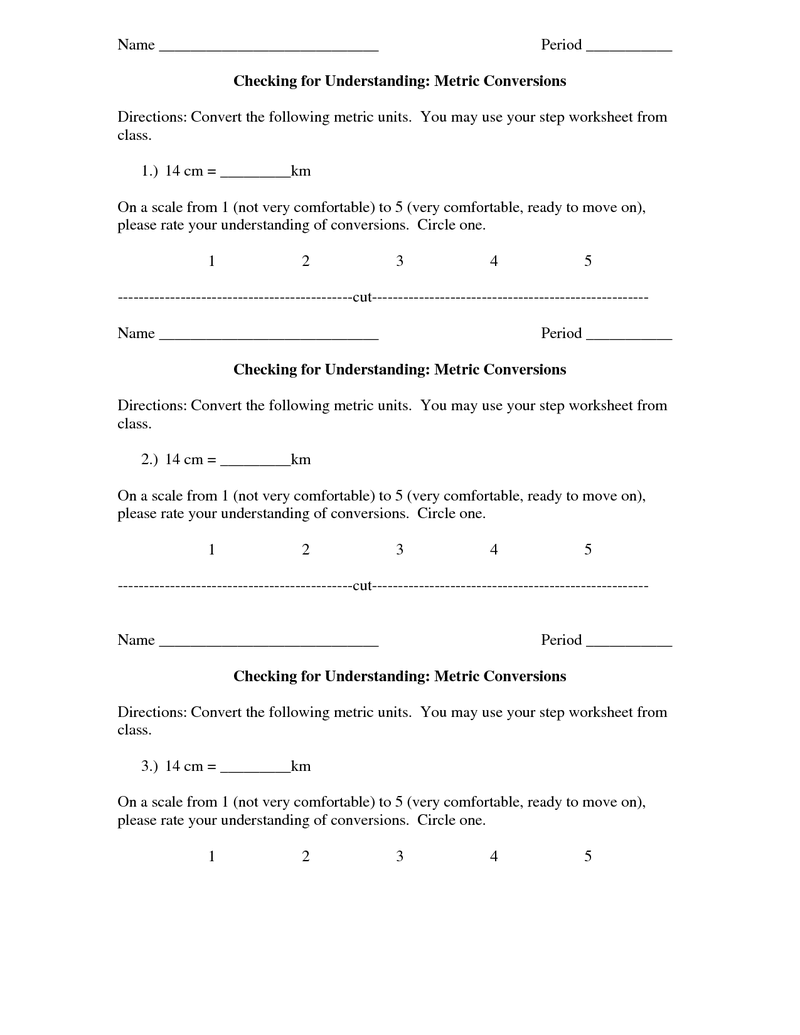
**Lesson Plan #1 – Unit #1**

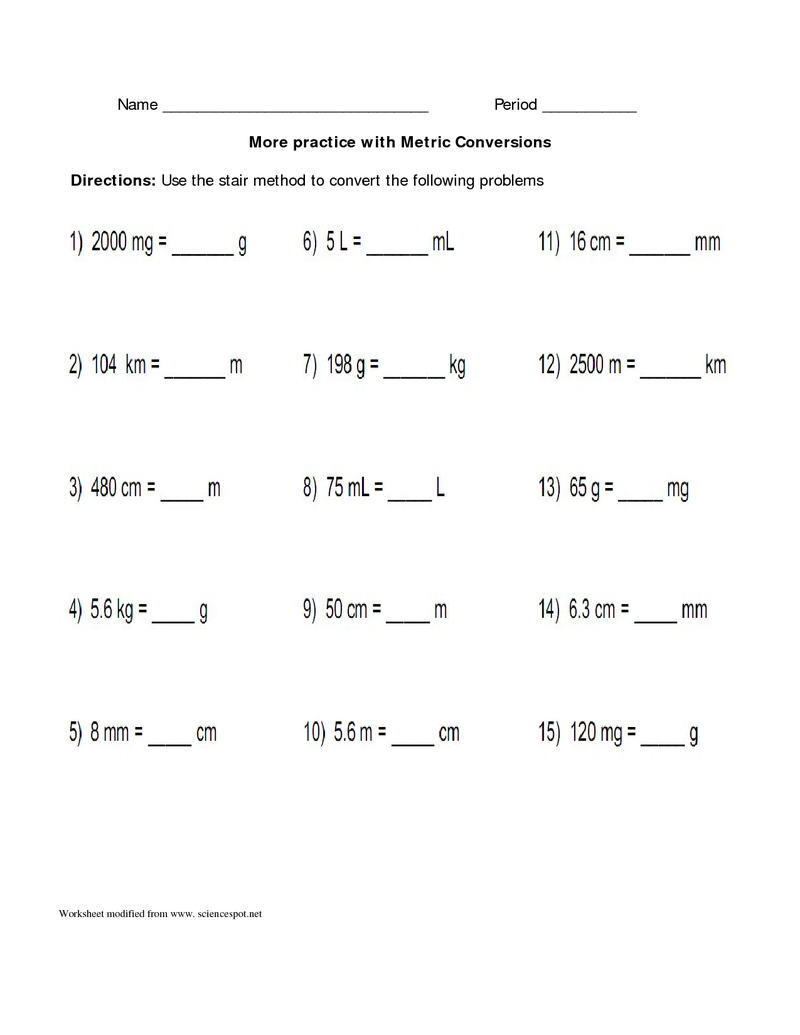
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| **TOPIC/TITLE OF LESSON** | **Converting Metrics** | |
| **AUTHOR(S)** | **Barbara Stile** | |
| **GRADE LEVEL(S)** | **6th grade** | |
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| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| [CCSS.MATH.CONTENT.6.RP.A.3.D](http://www.corestandards.org/Math/Content/6/RP/A/3/d/) Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| **Students will be able to –**  **-** convert metrics  **-**compare different units | | **\*Summative assessment**  **-** quiz on converting metrics  **\*Formative assessment**   * student answers through questioning during class discussion * Completing the worksheet |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| Ask: Which number is larger?    1.1 or .1?  Explain.    Rational: Many students struggle with decimals, so start off class reviewing them.  Also, this unit occurs early in the year, so they probably need a refresher.  Remind them that if the decimal is in front of the numbers then that number is less than one.  Doing this will alleviate confusion and frustration in the future.  Show this picture on Smart Board for visual comparisons.  <http://dev.physicslab.org/img/6538fa53-3c4a-4f8f-aafe-2303fc0374db.gif>  Go over some more examples of numbers with decimals. | | |

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| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| Present the PowerPoint **(Metric PowerPoint Presentation)**.  Preview presentation prior to presenting.    Next: Have students fill in the stairs on **(Student worksheet 1)**before modeling how to convert metric units.  Show them how you can tell what the largest and smallest metric unit is, based on the presence and position of a decimal point.    Next: Model how to convert metric units by doing the first 2 examples on the **(Metric PowerPoint Presentation)**with the entire class.    I like to use the following approach with every conversion:    Example: Covert 10mm to cm.    1.) Have students look at their staircase.  Ask: Are we going up or down?  2.) Ask: How many places do we move the decimal?  3.) Ask: Which direction do we move the decimal?  Up the stairs = move decimal to the left, down the stairs = move the decimal to the right.    This is confusing because students think that if you're moving to a larger unit that the number should get larger.  However, since the unit is larger the number will be smaller.  For example: Let's use US measurement for a moment.  Let's say that we have 10 inches, but we want to find out how many miles those 10 inches makeup.  Miles are a lot bigger than a few inches, therefore, the answer will be a very small decimal.  This explains why when you go from kilo to milli the number gets really big.  It's just for the opposite reason: now the amount of smaller units that make up a larger unit is high, so this conversion will make the number larger.    Answer to example:  1) Up or down? Response: Up!  2) How many places? Response: 1!  3) Which direction do we move the decimal? Response: To the left!  Answer: 1.0 centimeters    After modeling the method used to convert have students complete the remaining questions on **(Student worksheet 1)**and then review.  While reviewing have students state how they derived their answer.  Have them state: "I went up, 3 places and I moved the decimal to the left.  My answer is..."  This will help ingrain in their memory the steps to convert metric units.    **Checking for student understanding:** Give students **(Checking for understanding worksheet 1)** and have them turn it in at the bell.  Use this formative assessment to gauge the success of the lesson. | Students will complete the chart on 5 different object’s weights for all of the planets.  Once they complete the chart they will write equivalent ratios for the different planets.  Then students will apply equivalent ratios to other objects.  Finally students will solve word problems using equivalent ratios in tables. |
| **WRAP UP RTOP (#14) EXTEND** | |
| Complete an exit slip.  Students will finish worksheet for a homework assignment on converting metrics.  Quiz on converting metric. | |

Refer to the RED text in the headings to see how the 5 E’s correspond to the lesson plan components. It is the teacher’s prerogative where extension activities are addressed.







**Lesson Plan #2 – Unit #1**

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| **TOPIC/TITLE OF LESSON** | Ratios | |
| **AUTHOR(S)** | Barbara Stile | |
| **GRADE LEVEL(S)** | 6th grade | |
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| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| [CCSS.6.RP.A.1](http://www.corestandards.org/Math/Content/6/RP/A/1/) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.  [CCSS.6.RP.A.2](http://www.corestandards.org/Math/Content/6/RP/A/2/) Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship.  [CCSS.6.RP.A.3](http://www.corestandards.org/Math/Content/6/RP/A/3/) Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| Students will be able to compare ratios to decide if equivalent or not.  Students will be able to reduce ratios.  Students will be able to use real word problems to compare ratios. | | **\*Summative assessment**   * Topic test that has ratios on it   **\*Formative assessment**   * student answers through questioning during class discussion * Completing the examples and homework. |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| The teacher will read:  In the real world, ratios and proportions are used on a daily basis. Cooks use them when following recipes. I have a recipe for hummingbird food that calls for one part water to four parts sugar. In ratio form, the amount of water to sugar is 1:4. I can use one cup of water to four cups of sugar to make food for the hummingbirds. To make a bigger batch of hummingbird food, I use proportions to increase my batch. I can double it by doubling the ratio to 2:8. My two ratios, 1:4 and 2:8, are still the same since they both divide into the same number: 1 / 4 = 0.25 and 2 / 8 = 0.25.  Ratios and proportions are also used in business when dealing with money. For example, a business might have a ratio for the amount of profit earned per sale of a certain product such as $2.50:1, which says that the business gains $2.50 for each sale. The business can use proportions to figure out how much money they will earn if they sell more products. If the company sells ten products for example, the proportional ratio is $25.00:10, which shows that for every ten products, the business will earn $25. These are proportional since both ratios divide into the same number: 2.50/1 = 2.5 and 25/10 = 2.5, also.  Teacher will ask for other examples of ratios used in the real world:  Examples: drawings, model cars or airplanes, art exhibits, etc.  Look up together some examples on Google using the SmartBoard. | | |

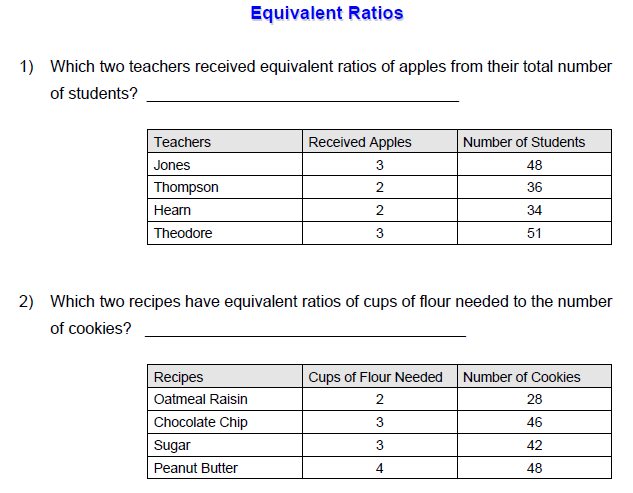
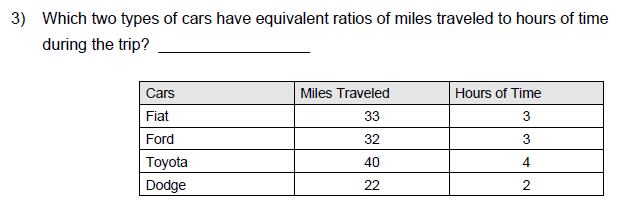
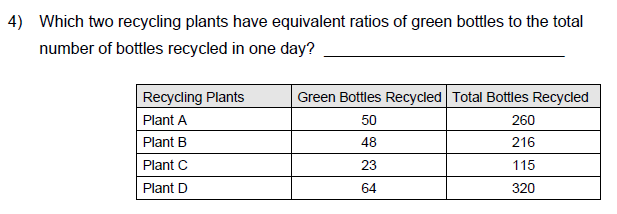
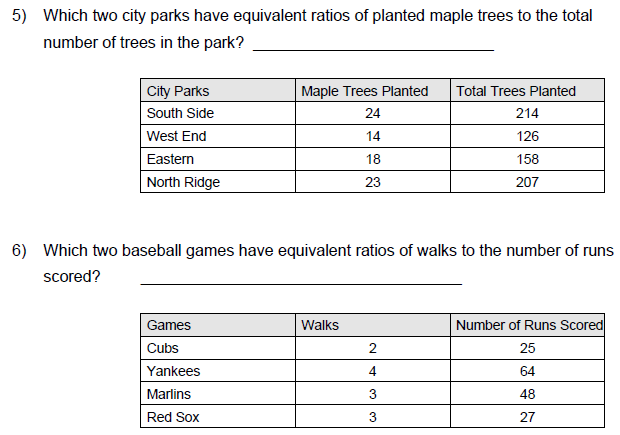
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| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| Teacher will read opening statement explaining that today the students will be learning about ratios and how they are used in the real world for measurement.    Teacher will write the ways the students come up with on the board and maybe add and/or guide them in the right direction.  The teacher will do examples of simplifying ratios on the board and finding missing parts. Explain the part and the whole.    The teacher will go over the answers to insure the skill is there. | Students will work in pairs to come up with a list of ways ratios are used in everyday life.  The students will complete the equivalent ratio worksheet independently numbers 1-3.  The students will complete numbers 4-6 for homework. |
| **WRAP UP RTOP (#14) EXTEND** | |
| After all students have had adequate time to complete numbers 1-3 and discuss their answers to the questions, as a class, they will complete numbers 4-6 for homework for extra practice.  Show the students how different professions would use ratios. For example, NASA, accountants, contractors, nurses, doctors, etc. | |

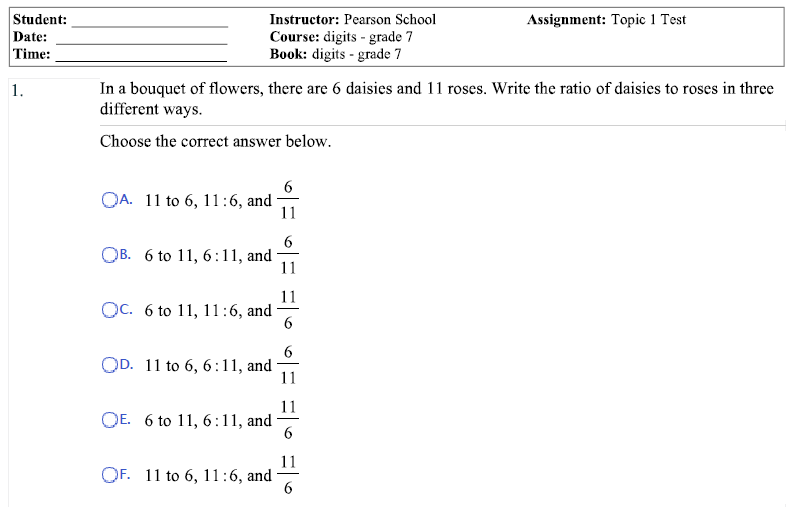
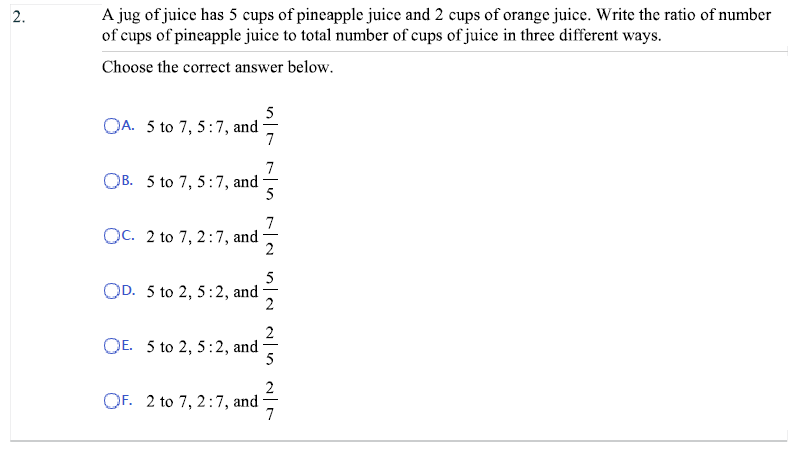
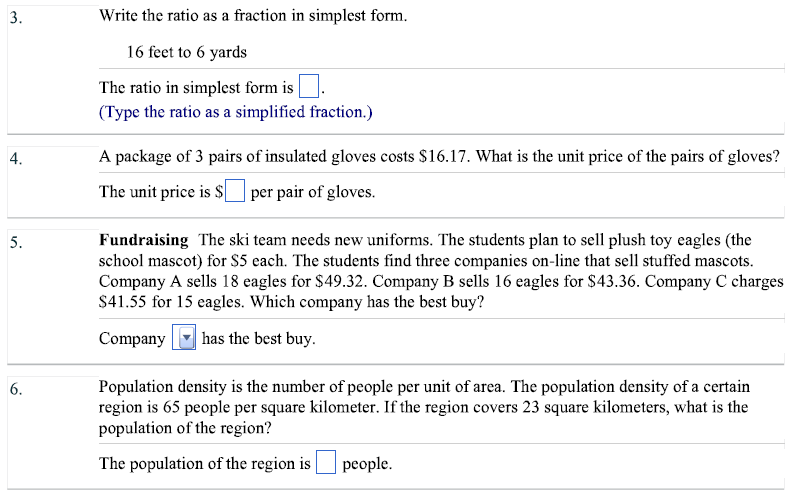
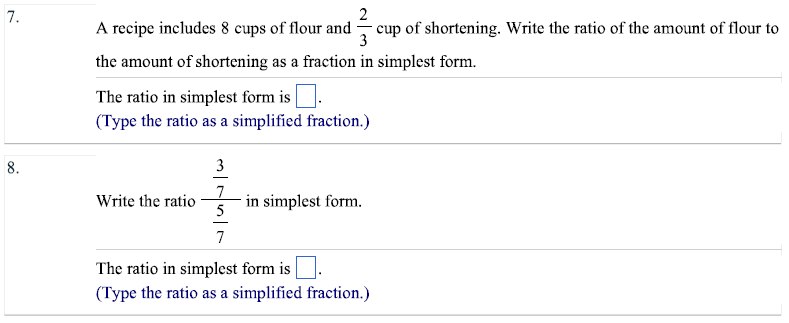
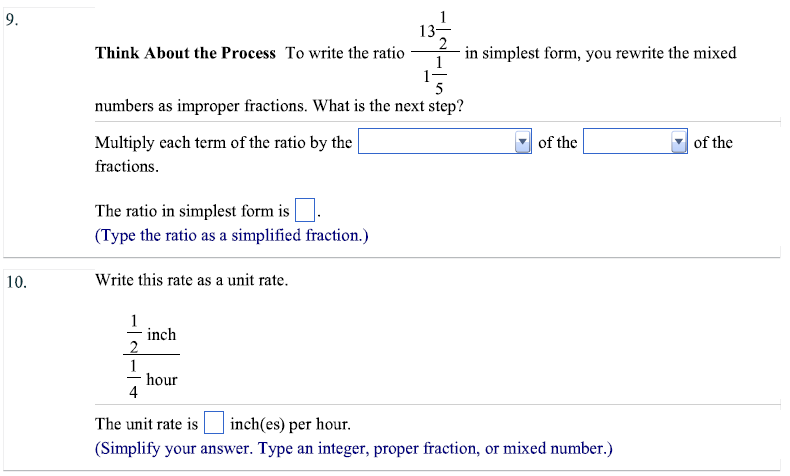
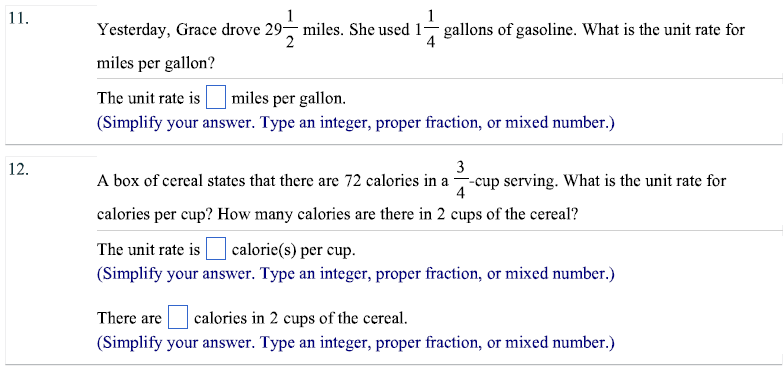
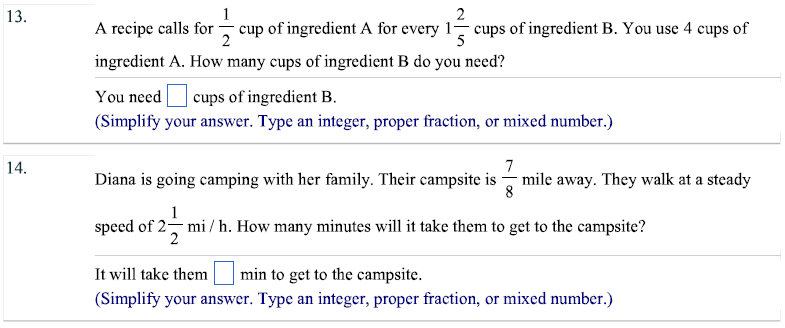
Refer to the RED text in the headings to see how the 5 E’s correspond to the lesson plan components. It is the teacher’s prerogative where extension activities are addressed.

**Rubric for Lesson Plan #2 of Unit #1**

***Instruction: Use the rubric below to review your lesson against the indicators listed below. Consider how someone unfamiliar with your unit would rate your work. Place a checkmark in the appropriate rating box.***

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| **RTOP**  **Indicator** | **Indicator Description** | **Thoroughly**  **Addressed** | **Adequately Addressed** | **Some Evidence** | **No Evidence** |
| \_ | Aligned with PA Core or Next Generation Science Standards | **X** |  |  |  |
| \_ | Strong correlation between lesson objectives and assessment methods | **X** |  |  |  |
| \_ | Incorporates NASA content and/or resources within the lesson |  | **X** |  |  |
| \_ | Integrates available technology |  |  | **X** |  |
| #1 | Provides opportunities to help students to activate prior knowledge | **X** |  |  |  |
| #2 | Structures lesson to engage students as members of a learning community | **X** |  |  |  |
| #4, #5 | Utilizes a problem based/inquiry learning model in which students make predictions, estimations and /or hypotheses with a means for testing them |  | **X** |  |  |
| #12, 14 | Describes structured activities requiring student exploration, self-assessment, elaboration and reflection |  | **X** |  |  |
| #11, 16 | Indicates how students will use a variety of means to represent phenomena |  | **X** |  |  |
| #10 | Connects with other content discipline and/or real world phenomena | **X** |  |  |  |
|  | Incorporates the use of modeling, guided practice and independent practice | **X** |  |  |  |
|  | Identifies and/or provides an authentic real-world problem relevant to the students for them to solve | **X** |  |  |  |
|  | Addresses each of the 5 E’s—engage, explore, explain, extend, and evaluate | **X** |  |  |  |

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**Lesson Plan #1 of Unit #1**

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| --- | --- | --- |
| **TOPIC/TITLE OF LESSON** | Measurement Comparisons (Customary & Metric) | |
| **AUTHOR(S)** | Julianne Kremer | |
| **GRADE LEVEL(S)** | 9-10 | |
|  |  | |
| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| **CC.2.1.HS.F.3**  Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.  **CC.2.1.HS.F.4**  Use units as a way to understand problems and to guide the solution of multi-step problems.  **CC.2.1.HS.F.5**  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| The student will be able to compare weight, distance, and capacity measurements in both the customary system and the metric system.  The student will be able to convert customary measures to metric measures and vice versa.  Instead of simply telling students how the metric system is related to the customary system (conversion factors), students will explore these relationships on their own and try to form conclusions about the relationships that exist. | | Students will be required to keep track of their findings and measurements on a table provided; they must complete the part of the table that matches the station they are at. Students must complete each station. Once students have attended all stations and completed the tasks, students will answer a series of questions provided to establish connections between systems. These will be used on the next lesson to convert between systems as well as within each system.  Throughout the lesson, teacher will informally observe and comment while students work through stations. |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| This is important in student lives because growing up in the United states, students have not been adequately exposed to the Metric system and find it difficult to understand, when often times, it is less complicated than the customary system. Unfortunately because of the lack of experience with the metric system, students and most US citizens never get an adequate understanding of the Metric system when in reality it is much less complicated since everything is related by powers of ten instead of the need to memorize so many different conversion factors for length, weight, and capacity.  Teacher asks: What do you know about the Customary (English) system of measurement?  (Students will respond with various measurements they are familiar with, such as measuring distance in inches, feet, yards, miles; measuring weight in pounds and ounces; measuring capacity in gallons, tablespoons, cups, etc.)  Teacher asks: What do you know about the Metric system of measurement?  (Students should be familiar with meters, centimeters, etc. to measure distance, but are probably less familiar with metric measures for weight and capacity.)  Teacher will explain to students that today they will be becoming more familiar with both systems of measurement and how they are related.  Students will be exploring the relationships between systems as well as how the systems work on their own.  Give students some background facts on the Metric system:   * Most of the world uses the metric system; the only countries that do not are the United States, Myanmar, and Liberia. * The Metric system has not been around forever; before it was several non-standardized systems. * The Metric system is all based on 10; fractions are unnecessary!   Although the US doesn’t use the metric system in its entirety, what is the thing we use it most for?  (ANSWER: Money!) | | |

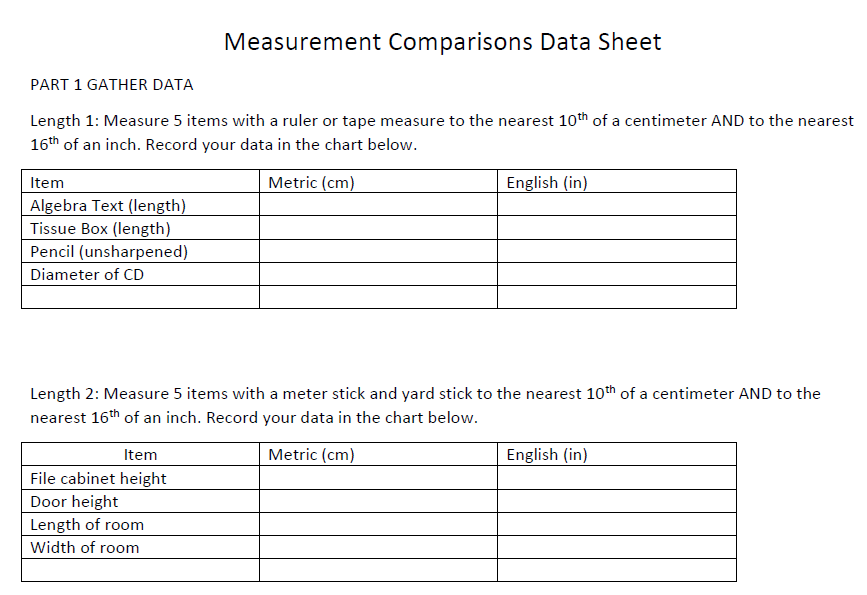
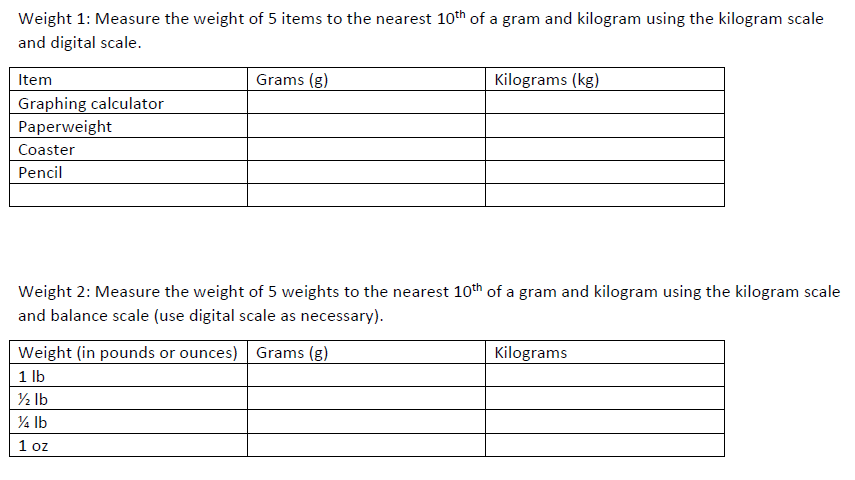
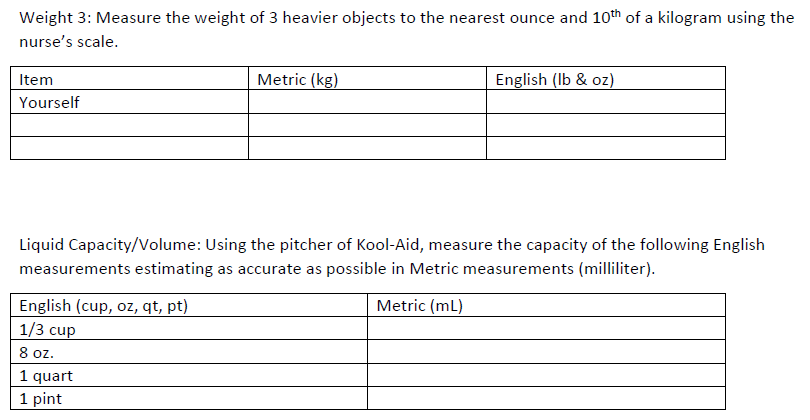
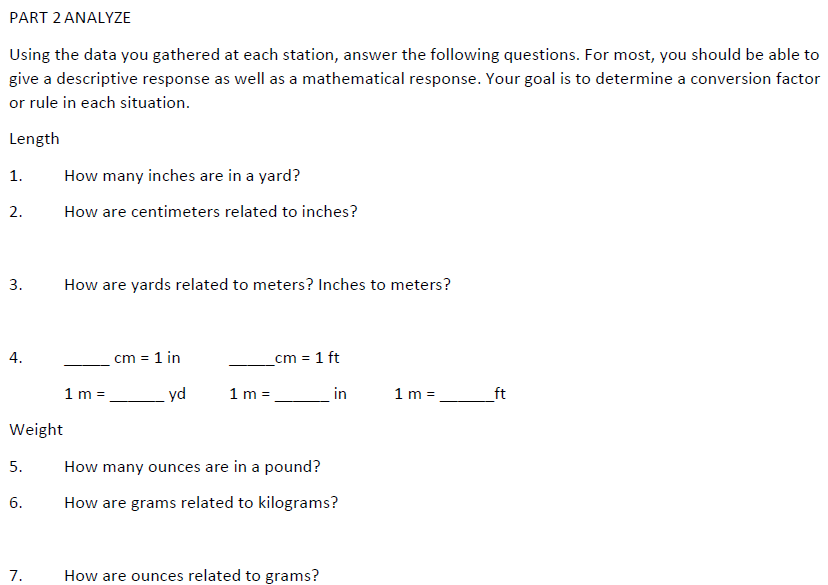
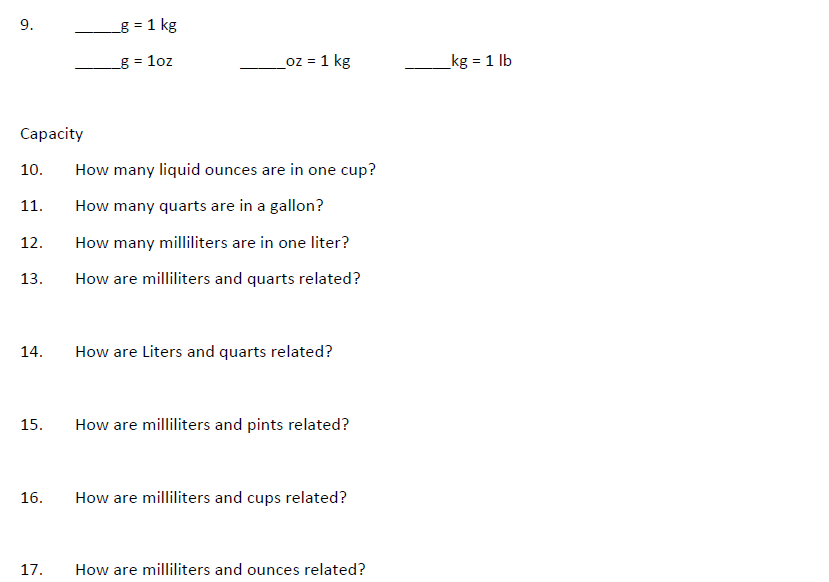
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| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| Activity #1: Review of the Customary (English) System  What do you like about the Customary system of measurement?  Remind students of the need for fractions, that they so dislike, in the Customary system and the need for MANY different conversion factors (to be further discussed during the next lesson on conversions).  Measure Length: Define length as the extent of something from end to end. Students can successfully measure length, often times to the nearest whole measurement, such as whole inch, whole foot, etc. Students will be shown how to measure to the nearest sixteenth of an inch. Various examples will be shown on the Smart board using an interactive ruler. Then, relate the interactive ruler to live rulers and yard sticks.  Measure Weight: Define weight as the heaviness (or mass) of an object. Students are most familiar with weight in terms of pounds because that is how their weight is measured. Remind students of a baby. Babies in the US are weighed in pounds and ounces to be more accurate. Review how to use each scale the students will be using to measure weights in the third activity.  Measure capacity: Define capacity as an amount that something can hold (volume). Explain capacity in terms of making a recipe to bake or cook something. When you are measuring the ingredients, you are measuring capacity. In the US, these are measured in gallons, cups, liquid ounces, tablespoons, etc. Review how to use the capacity measuring tools that students will need to use in the third activity.  Activity #2: Review of the Metric System  The most familiar and used prefixes in the metric system are kilo-, centi-, and milli-.  Measure length: Students can often successfully measure length to the nearest whole centimeter. Various examples will be shown to teach students how to measure to the nearest millimeter.  Ask students if a centimeter is more than an inch or less. (Most students will know this answer and be able to tell the teacher that there are about 2.5 centimeters in an inch.)  Measure weight: This is something students will be less familiar with. Ask students what units are used to measure weight in the metric system. Really the only unit used is grams; the prefixes are the same throughout the metric system. Ask students if they are familiar with anything that is often weighed in grams. (Students may respond with gold.) Review again how to use the scales to accurately weigh in grams and to the nearest, appropriately as the scale allows. Ask students if a gram is more or less than a pound. (This question will be explored during Activity #3.)  Measure capacity: This is also something students will be less familiar with. Ask students what units are used to measure capacity in the metric system. Really the only unit used is liters; the prefixes are the same throughout the metric system. Ask students to name an object that they are familiar with being measured using liters. (Most likely answer will be soda.)  Activity #3: Group Investigation  Split students into 6 groups.  NOTE: All groups should use the same items so that we have consistency and can discuss results and findings in the conclusion of the activity.  The teacher will offer the students the actual, although estimated conversion factors, once students have done this. | Students will probably respond to this questions that “it is easy,” but that is because they are familiar with the measures.  Students will practice measuring to the nearest sixteenth of an inch using an object at their desk, such as their ipad and a ruler. Students will also pair up and measure each other’s height to the nearest sixteenth of an inch.  Students respond to questioning by teacher.  Later, in groups, students will be weighing themselves and other objects to the nearest ounce, if possible.  Students will practice measuring to the nearest centimeter and millimeter using an object at their desk, such as their ipad and a ruler. Students will also pair up and measure each other’s height to the nearest centimeter and millimeter.  Students respond to questioning by teacher.  Students will be split into six groups of three.  Students will rotate with their group members through stations. At each station, they will have a task. Students will keep track of their measurements at each station on a table.  Group 1: Measure various items with a ruler to the nearest sixteenth of an inch. Measure the same items with a ruler to the nearest millimeter or centimeter.  Group 2: Measure various items with a yard stick to the nearest sixteenth of an inch. Measure the same items with a meter stick to the nearest millimeter or centimeter.  Group 3: Report to the nurse’s office to be weighed in pounds and ounces as well as kilograms and/or grams.  Group 4: Weigh the weights provided in pounds/ounces. Most of the weights should be written on with their gram weights; students will also weigh these weights in grams to verify (and in case they are not labeled or labeled appropriately). Students will then try to find other objects in the room to balance with the weights to bring reality to the metal weights.  Group 5: Weigh various items in pounds/ounces. Weigh the same items in grams/kilograms.  Group 6: Measure capacity. Students will have a variety of liquid measuring devices. Students will measure various amount of liquid comparing teaspoons and milliliters, cups and milliliters, and ounces and milliliters. Students will also measure with gallons and liters and compare their findings.  Once groups have progressed through all six stations and have gathered all of their data, students will work with their groups to discover relationships between the Customary system of measurement and the Metric system of measurement.  Questions for groups to consider:   * How are centimeters related to inches? * How are yards related to meters? Inches to meters? * How do grams compare to ounces? Kilograms to pounds? * Compare teaspoons to milliliters. Which is a larger measurement? How are the measurements related? How many milliliters fit into just one teaspoon? * Compare ounces/cups to milliliters. * Compare gallons to liters. Which container would hold more, gallon or liter?   Students will also try to identify the conversion factors to convert between systems using their data and answer the questions above.   * \_\_\_\_centimeters = 1 inch * 1 meter = \_\_\_\_ yards * 1 meter = \_\_\_\_ inches * 1 meter = \_\_\_\_feet * \_\_\_\_grams = 1 ounce * \_\_\_\_kilogram = 1 pound * \_\_\_\_milliliter = 1 teaspoon * \_\_\_\_liter = 1 gallon * \_\_\_\_milliliter = 1 cup |
| **WRAP UP RTOP (#14) EXTEND** | |
| After all groups have had adequate time to complete the activities and discuss their answers to the questions, as a class, we will discuss group findings and “conversion factors.” At this time, I will also give them the actual conversion factors to see how close they came.  Ask students to put the metric system in terms of their own life using real life objects now that they are more familiar since measuring various objects.  A meter is about the height of…  A centimeter is about as long as…  A gram is about as heavy as…  A milliliter is about as much as…  A liter reminds me of…  Remember: A meter is a little more than a yard. A kilometer is less than a mile. A liter is a little more than a quart.  Ask students:  Why do you think the United States has not completely adopted the Metric System?  What do you prefer to use in the metric system, versus the customary system? Is any part of it easier for you?  What professions use the metric system?  Same answers: NASA, nursing, doctors, carpenters, contractors  Use of Metric System in Computers and Electronics: (from <http://www.austincc.edu/mparker/0350/metric4.htm#facts>)  The goal of this lesson is to expose students and help them feel less threatened by change. Maybe someday the US will get on board with the rest of the world and fully adopt the metric system! | |

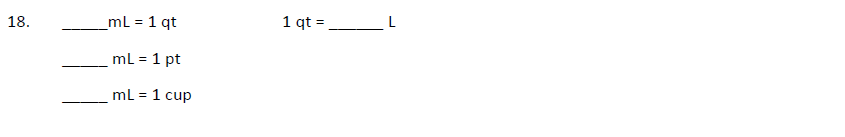
Refer to the RED text in the headings to see how the 5 E’s correspond to the lesson plan components. It is the teacher’s prerogative where extension activities are addressed.

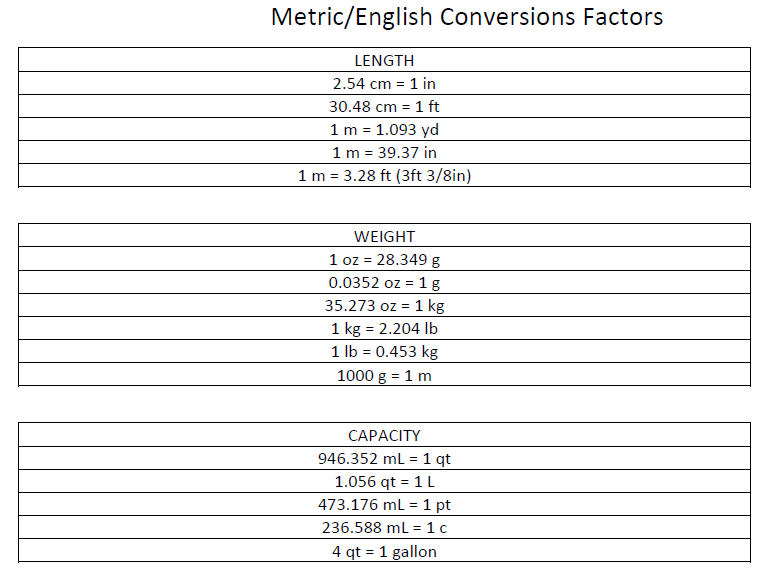
**Rubric for Lesson Plan #1 of Unit #1**

***Instruction: Use the rubric below to review your lesson against the indicators listed below. Consider how someone unfamiliar with your unit would rate your work. Place a checkmark in the appropriate rating box.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RTOP**  **Indicator** | **Indicator Description** | **Thoroughly**  **Addressed** | **Adequately Addressed** | **Some Evidence** | **No Evidence** |
| \_ | Aligned with PA Core or Next Generation Science Standards | **X** |  |  |  |
| \_ | Strong correlation between lesson objectives and assessment methods | **X** |  |  |  |
| \_ | Incorporates NASA content and/or resources within the lesson |  |  | **X** |  |
| \_ | Integrates available technology |  |  | **X** |  |
| #1 | Provides opportunities to help students to activate prior knowledge | **X** |  |  |  |
| #2 | Structures lesson to engage students as members of a learning community | **X** |  |  |  |
| #4, #5 | Utilizes a problem based/inquiry learning model in which students make predictions, estimations and /or hypotheses with a means for testing them | **X** |  |  |  |
| #12, 14 | Describes structured activities requiring student exploration, self-assessment, elaboration and reflection | **X** |  |  |  |
| #11, 16 | Indicates how students will use a variety of means to represent phenomena |  | **X** |  |  |
| #10 | Connects with other content discipline and/or real world phenomena |  | **X** |  |  |
|  | Incorporates the use of modeling, guided practice and independent practice |  | **X** |  |  |
|  | Identifies and/or provides an authentic real-world problem relevant to the students for them to solve | **X** |  |  |  |
|  | Addresses each of the 5 E’s—engage, explore, explain, extend, and evaluate | **X** |  |  |  |





**Lesson Plan #2 of Unit #1**

|  |  |  |
| --- | --- | --- |
| **TOPIC/TITLE OF LESSON** | Measurement Comparisons (Customary & Metric) | |
| **AUTHOR(S)** | Julianne Kremer | |
| **GRADE LEVEL(S)** | 9-10 | |
|  |  | |
| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| **CC.2.1.HS.F.3**  Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.  **CC.2.1.HS.F.4**  Use units as a way to understand problems and to guide the solution of multi-step problems.  **CC.2.1.HS.F.5**  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| The student will be able to compare weight, distance, and capacity measurements in both the customary system and the metric system.  The student will be able to convert customary measures to metric measures and vice versa.  The student will be able to find ratios and rates.  The student will be able to convert units and rates. | | Students will convert various measurements using the data collected on their tables from the previous lesson. They will convert both within each system and between systems.  Students will also complete various practice problems throughout the lesson.  A quiz will be given on rates, ratios, and conversions. |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| Begin class by discussing the results of the previous lesson’s activities. Compare student’s measurements and discuss the accuracy in measurement. Discuss student responses to the questions answered on the worksheet concerning the measurement activities from the previous lesson. This will include student observations and determinations of the estimates of various conversion factors. | | |

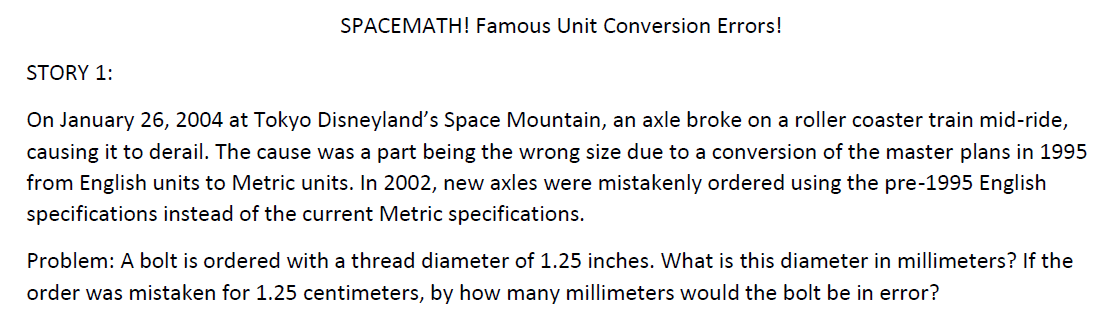
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| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| Define ratio as a comparison of two numbers by division.  Define a specific ratio that compares quantities measured in different units as a rate.  Define conversion factor as a ratio of two equivalent measures with different units that is always equal to 1. Discuss the need for such conversion factors, as explored during the previous lesson, to convert from one unit to another.  Model converting units using one conversion factor and within the same system of measurement, such as minutes to hours, feet to inches, or kilograms to grams.  This is called dimensional analysis, also called unit analysis, by including the units of each quantity in the calculations of the units for the end result.  Model converting to various units, within the metric system and English system, as well as between systems. For example, convert feet to meters.  Model converting multiple units in one problem to solve a problem, such as yards per second to miles per hour. In this type of situation, students will be required to use two conversion factors. | Using Lesson 2-6 from our Pearson Common Core Algebra 1 textbook as a guide, students will investigate ratios, rates, and conversions utilizing both the data gathered during the previous lesson as well as new data.  Practice converting units using one conversion factor and within the same system of measurement.  Practice converting to various units, within the metric system and English system.  Practice converting multiple units in one problem to solve a problem.  Students will build on the basics of this lesson by completing a series of unit analysis problem solving activities and practice:   * The speed of light is about 3.0x1010 cm/s. If a rocket car of the future can travel at the speed of light, what is this rate in miles per hour? * Suppose you are a gold miner in California in 1849. You have your tools in one hand. Can you use your free hand to carry a 4-liter bucket full of gold dust? The density of gold is 19.3 g/cm3. Use unit analysis to determine whether the bucket is too heavy to carry. * A popular racetrack is 2.5 miles long. A race is completed in 250 laps. One year, the winner’s average was 161 miles per hour. During cautionary lap runs, the speed was only about 80 miles per hour. If the race had 30 cautionary laps, about how long did it take the winner to complete the race? * Your gas tank holds 13.5 gallons of gas. Your fuel gauge shows that your tank is one quarter full. Your car gets an average of 25 miles per gallon. The GPS shows that you are 85 miles from your destination. Your brother says you will make it. Is he correct? Use unit analysis to justify your response. * A metal bar in the shape of a rectangular prism with dimensions 6cmx8cmx2cm has a mass of 53 g. The density of the metal is expressed in units of g/cm3. Use what you have learned about unit analysis to find the density of the metal. * According to the directions, a 12-ounce can of lemonade concentrate makes 64 ounces of lemonade. If each serving is 8 ounces, how many 12-ounce cans of concentrate are needed to make 120 servings? |
| **WRAP UP RTOP (#14) EXTEND** | |
| You can write ratios and find unit rates to compare quantities. You can also convert units and rates to solve problems.  Students will complete an activity to find their weight on all planets using a conversion factor.  This lesson can also be expanded to familiarize students with the measurement of a light year. Watch video from pbs.org explaining the light year (<http://www.pbslearningmedia.org/resource/lsps07.sci.phys.energy.lightyears/light-years/>). Students complete a brief activity to determine “How long is a light year?” They look at different situations being various light years away and answer questions about them. Students also determine how many kilometers something is away if the distance was originally given in light years. Students determine how many miles away something is if it was originally given in light years as a way to better understand the distance. | |

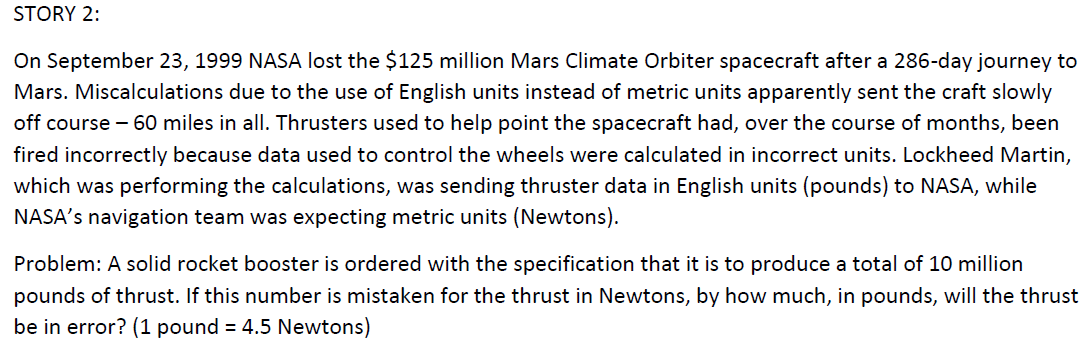
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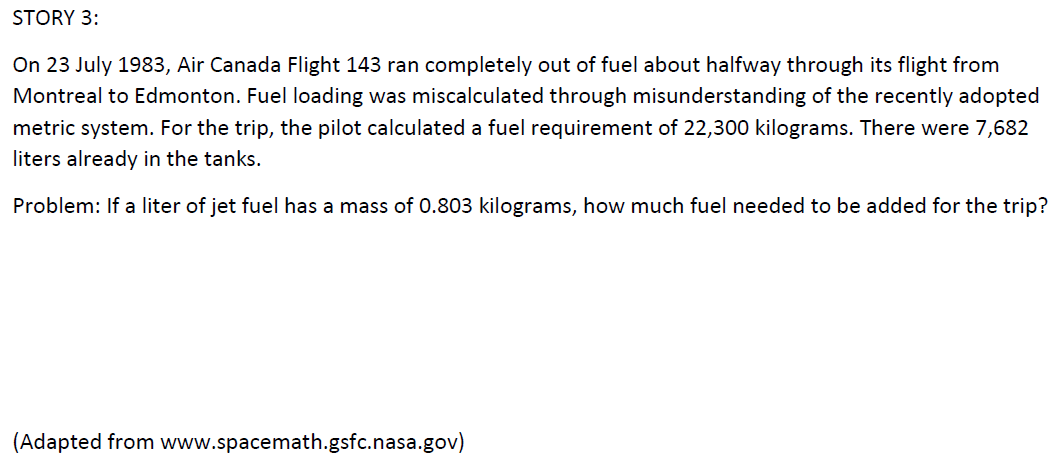
**Rubric for Lesson Plan #2 of Unit #1**

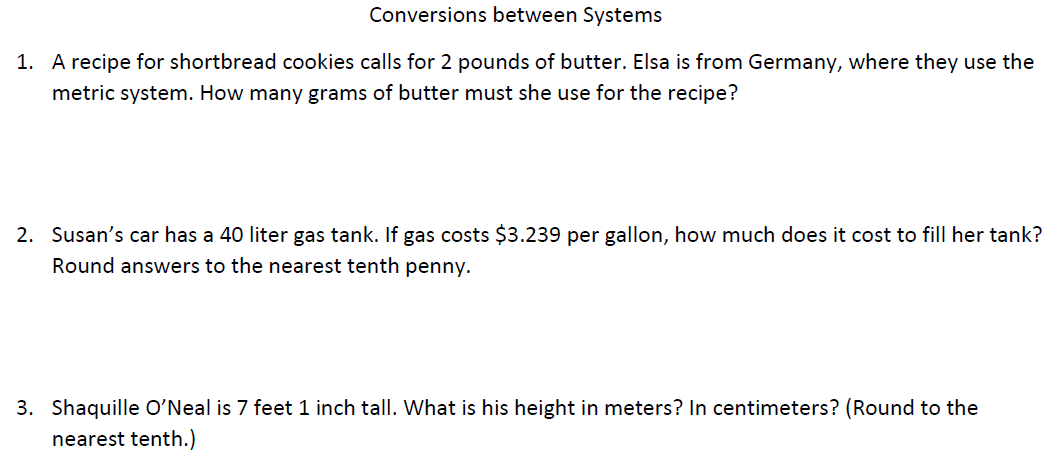
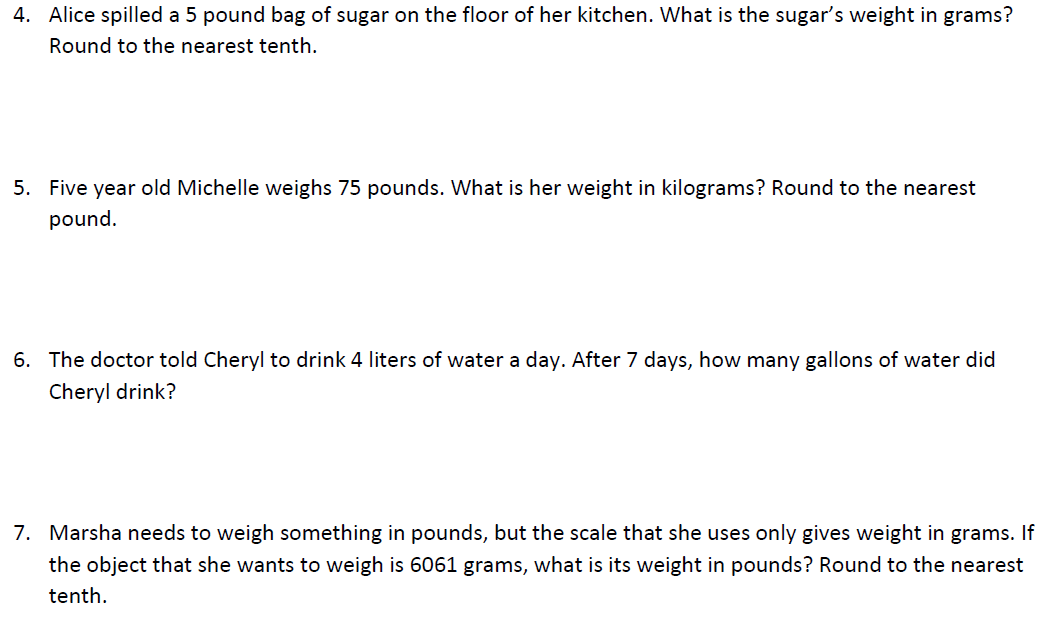
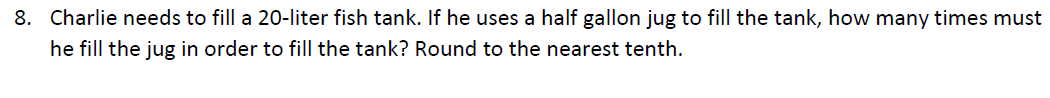
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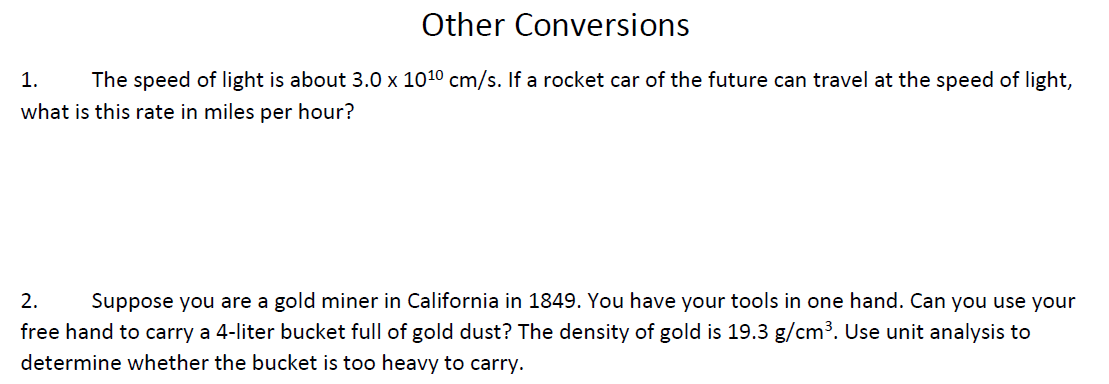
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| **RTOP**  **Indicator** | **Indicator Description** | **Thoroughly**  **Addressed** | **Adequately Addressed** | **Some Evidence** | **No Evidence** |
| \_ | Aligned with PA Core or Next Generation Science Standards | **X** |  |  |  |
| \_ | Strong correlation between lesson objectives and assessment methods | **X** |  |  |  |
| \_ | Incorporates NASA content and/or resources within the lesson | **X** |  |  |  |
| \_ | Integrates available technology |  |  | **X** |  |
| #1 | Provides opportunities to help students to activate prior knowledge | **X** |  |  |  |
| #2 | Structures lesson to engage students as members of a learning community | **X** |  |  |  |
| #4, #5 | Utilizes a problem based/inquiry learning model in which students make predictions, estimations and /or hypotheses with a means for testing them |  | **X** |  |  |
| #12, 14 | Describes structured activities requiring student exploration, self-assessment, elaboration and reflection | **X** |  |  |  |
| #11, 16 | Indicates how students will use a variety of means to represent phenomena |  | **X** |  |  |
| #10 | Connects with other content discipline and/or real world phenomena | **X** |  |  |  |
|  | Incorporates the use of modeling, guided practice and independent practice | **X** |  |  |  |
|  | Identifies and/or provides an authentic real-world problem relevant to the students for them to solve | **X** |  |  |  |
|  | Addresses each of the 5 E’s—engage, explore, explain, extend, and evaluate | **X** |  |  |  |

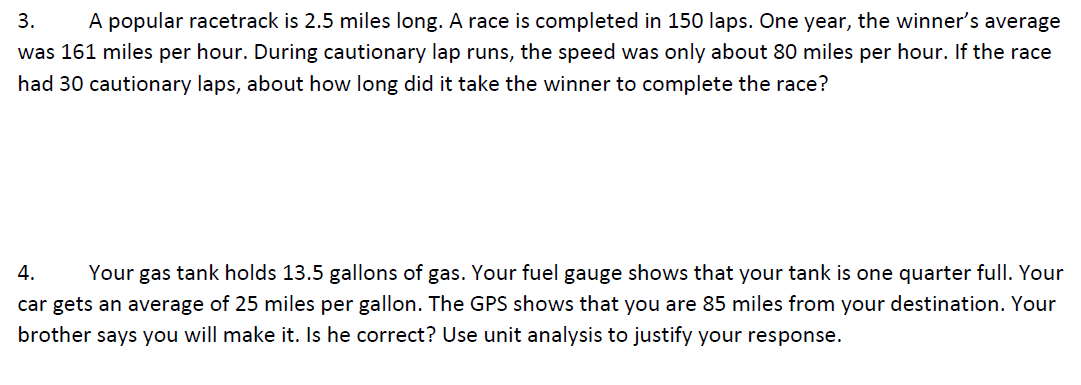


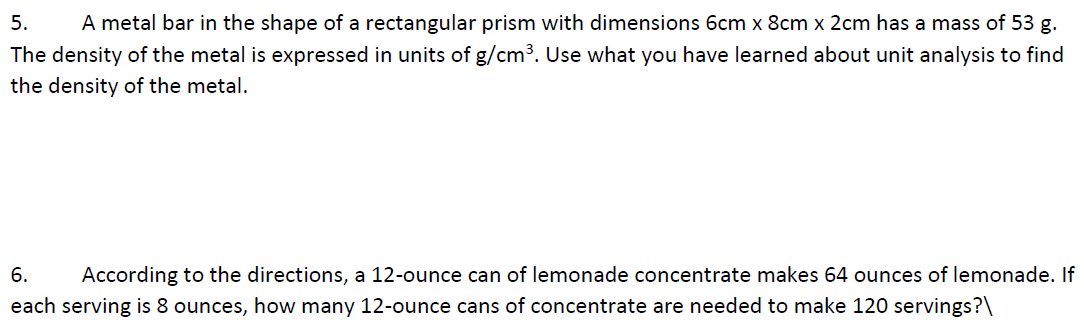




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**Lesson Plan #1 of Unit #1**

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| --- | --- | --- |
| **TOPIC/TITLE OF LESSON** | Large/Small Measurements (Scientific Notation) | |
| **AUTHOR(S)** | Kathy Muir | |
| **GRADE LEVEL(S)** | 8 | |
|  |  | |
| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| M08.B-E.1.1.3 Estimate very large or very small quantities by using numbers expressed in the form of a single digit times an integer power of 10 and express how many times larger or smaller one number is than another.  M08.B-E.1.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Express answers in scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology (e.g., interpret 4.7EE9 displayed on a calculator as 4.7 x 109). | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| SWBAT:  -review the order of the planets from nearest to farthest from the sun and compare the size of the planets using scientific notation.  -use scientific notation with positive exponents to represent large numbers.  -use scientific notation with negative exponents to represent small numbers  -use scientific notation with positive and negative exponents to represent numbers.  -students will convert numbers in scientific notation back to standard form.  - use scientific notation with positive and negative exponents to compare the wavelengths of different types of waves.  -multiply and divide scientific notation numbers with positive and negative exponents | | Students will be required to keep track of their findings and measurements on a table provided; they must complete the part of the table that matches the station they are at. Students must complete each station. Once students have attended all stations and completed the tasks, students will answer a series of questions provided to establish connections between systems. These will be used on the next lesson to convert between systems as well as within each system.  Throughout the lesson, teacher will informally observe and comment while students work through stations. |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| To begin this unit student will review the order of the planets from nearest to farthest from the sun and compare the size of the planets using scientific notation.  Teacher will have the name of each planet on a post-it note. One student volunteer will go to the board and arrange the planets in order from nearest to furthest from the sun. The student is encouraged to get help from his or her classmates. Once the order is complete briefly discuss the distances, mentioning that the Earth is approximately 93 million miles (150 million kilometers) from the sun. Leave the post-it notes on the board in order for later in the activity.  Students will then break into small groups. The students will try to make a model of the solar system using a marble, walnut, golf ball, raisin, acorn, basketball, soccer ball, softball, small grapefruit, kidney bean. Let them know the sun is represented by a ball 9 feet across. You may want to measure out 9 feet on the board. Each group will try to determine which common item corresponds by size with the actual planets. For example, the largest planet (Jupiter) will correspond with the largest object (Basketball).  Next have the student volunteer try to match the common objects with the correct planet. Again, the student is encouraged to get help from his or her classmates. Once the group believes it has the correct order you can give them the solution.  Mercury – marble  Venus – walnut  Earth – golf ball  Mars – acorn  Jupiter – basketball  Saturn – soccer ball  Uranus – softball  Neptune – small grapefruit  Pluto – kidney bean  Related links: <http://hea-www.harvard.edu/ECT/the_book/Chap5/Chapter5.html> | | |

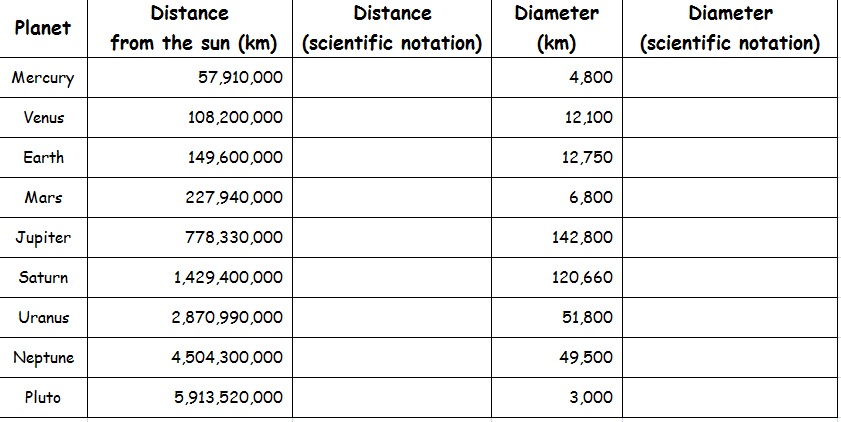
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| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| **Activity #1**  Write the following on the board:  Planet Distance (from sun) Diameter  Mercury 57,910,000 km 4,800 km  Students will have this information in a table.  Make sure you leave extra space behind the distance and the diameter to allow enough room for the scientific notation values.  Show how to change the distance into scientific notation and also the diameter as a second example. When finished with the examples have the students copy the values for Mercury on their own paper. Finally, have the students convert each of the distances and diameters into scientific notation.  If you need to do a quick check for understanding, have the students try Venus and Earth. After a few minutes go over those answers together before they finish converting the remaining planets.  Check solution together:  Solution:  Mercury 5.7x107  4.8x103  Venus 1.082x108 1.21x104  Earth 1.496x108 1.275x104  Mars 2.2794x108 6.8x103  Jupiter 7.7833x108 1.428x105  Saturn 1.4294x109 1.2066x105  Uranus 2.87099x109 5.18x104  Neptune 4.5043x109 4.95x104  Pluto 5.91352x109 3x103  **Activity #2 Deep Space Network**  To show the connectivity to the real world students will read through a web page to see where and how small numbers are used.  Together as a class, access <http://spaceplace.nasa.gov/en/kids/dsn_fact1.shtml>  Have the students take turns reading through the webpage. Towards the bottom focus on:    There are seventeen zeros before the 3.  Lead a class discussion on scientific measurements can be quite large like the distance to a planet but they can also be quite small like the amount of power the antenna delivers. Whether talking about large or small numbers they are difficult to work within normal notation.  Explain how to change small numbers into scientific notation using negative exponents.  **Activity #4**  Students will complete worksheets on scientific notation.  Show several examples of converting from scientific notation to standard form and vice versa.  **Activity #5**  Related Link:  <http://www.windows2universe.org/teacher_resources/galileo/6.html>  Students will look at a handout of the electromagnetic spectrum. Have students find waves 1m (100m) long on the sketch. Emphasize how each mark on the scale represents a change of 10 times larger or 10 times smaller. Show where kilometers and millimeters are found. It is also helpful to have the students write in common items that are the same size as the number on the scale.  You may also introduce terms such as micrometer, nanometer, and picometer.  **Activity #6**  Students will complete worksheets on multiplying and dividing scientific notation.  It might be easier to complete the multiplication worksheet prior to the division worksheet.  Have the students complete the multiply scientific notation worksheet. Compare the process to multiplying with normal form to show how much easier scientific notation is to use. Emphasize the front numbers are multiplied and the exponents are added.  After the students complete the multiplication worksheet, show how to divide scientific notation numbers. Emphasize the front numbers are divided and the exponents are subtracted. Compare and contrast the methods for multiplication and division. | Students will take notes on how to convert from standard notation to scientific notation.  Students should try Venus and Earth on their own.  After going over Venus and Earth students should convert the remaining distances and diameters.  After completing the table students should review their answers as a class.  Students will read through the webpage to understand how large and small numbers are used.  Students will participate in a class discussion of when large and small numbers are used.  Students will complete worksheet in a group or individually depending on the teacher’s directions.  Students will look at the handout and find the 1m wave.  They will also try to find common items that are the same size as the number on the scale.  Students will complete worksheets on multiplication and division worksheets. |
| **WRAP UP RTOP (#14) EXTEND** | |
| After completing all worksheets, students need to go over the worksheets as a class to make sure they have the correct answers.  After all concepts of scientific notation are completed a quiz will be given on scientific notation. | |

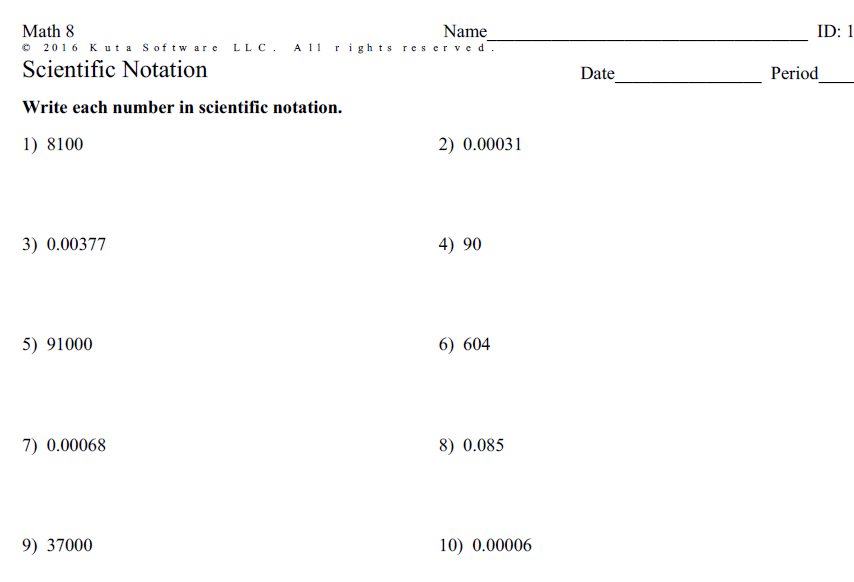
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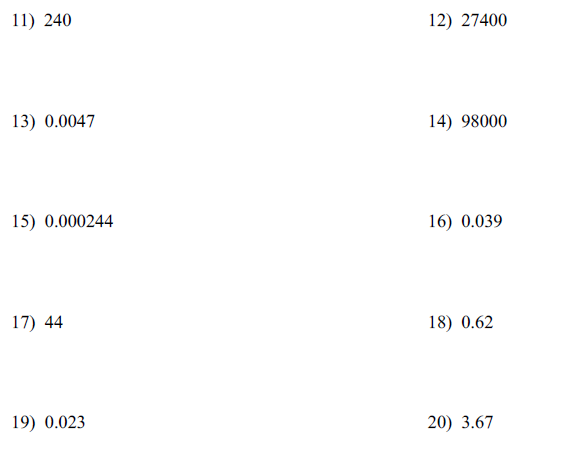
**Rubric for Lesson Plan #1 of Unit #1**

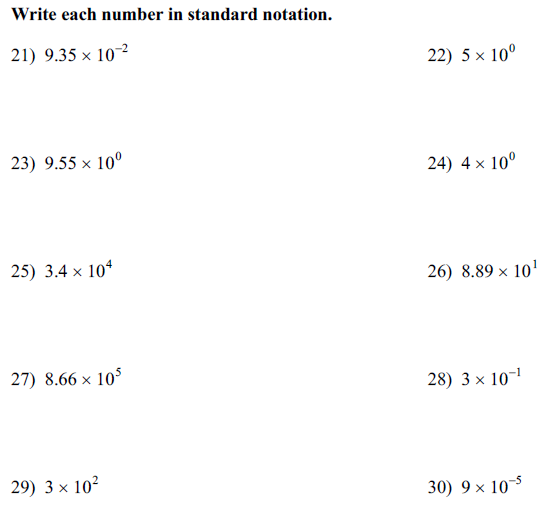
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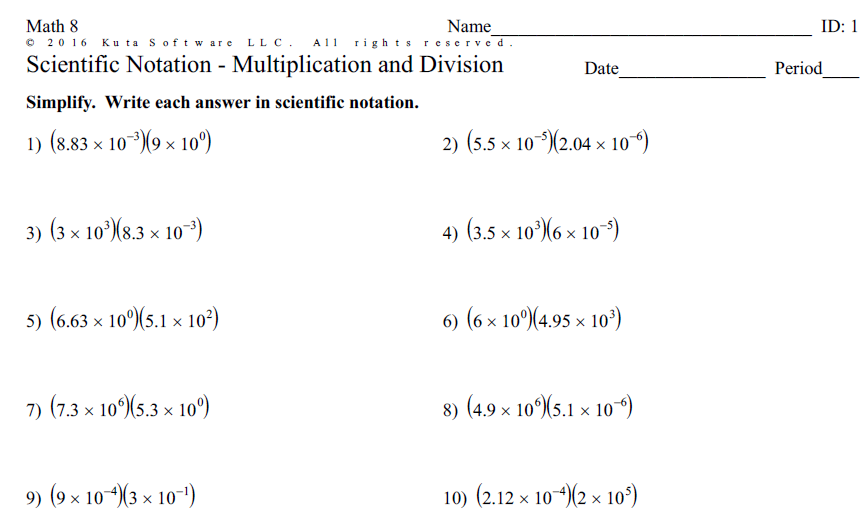
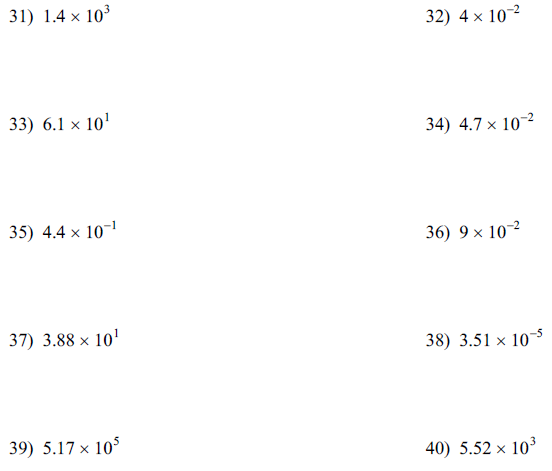
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| **RTOP**  **Indicator** | **Indicator Description** | **Thoroughly**  **Addressed** | **Adequately Addressed** | **Some Evidence** | **No Evidence** |
| \_ | Aligned with PA Core or Next Generation Science Standards | **X** |  |  |  |
| \_ | Strong correlation between lesson objectives and assessment methods | **X** |  |  |  |
| \_ | Incorporates NASA content and/or resources within the lesson |  | **X** |  |  |
| \_ | Integrates available technology |  |  | **X** |  |
| #1 | Provides opportunities to help students to activate prior knowledge | **X** |  |  |  |
| #2 | Structures lesson to engage students as members of a learning community | **X** |  |  |  |
| #4, #5 | Utilizes a problem based/inquiry learning model in which students make predictions, estimations and /or hypotheses with a means for testing them | **X** |  |  |  |
| #12, 14 | Describes structured activities requiring student exploration, self-assessment, elaboration and reflection | **X** |  |  |  |
| #11, 16 | Indicates how students will use a variety of means to represent phenomena |  | **X** |  |  |
| #10 | Connects with other content discipline and/or real world phenomena | **X** |  |  |  |
|  | Incorporates the use of modeling, guided practice and independent practice |  | **X** |  |  |
|  | Identifies and/or provides an authentic real-world problem relevant to the students for them to solve | **X** |  |  |  |
|  | Addresses each of the 5 E’s—engage, explore, explain, extend, and evaluate | **X** |  |  |  |

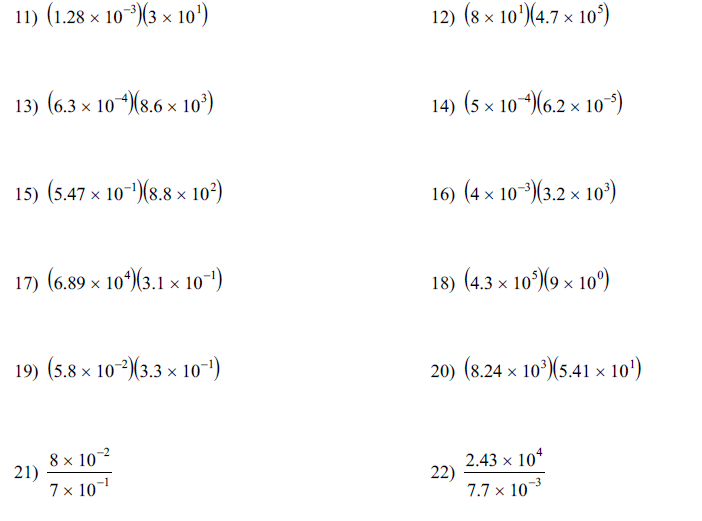


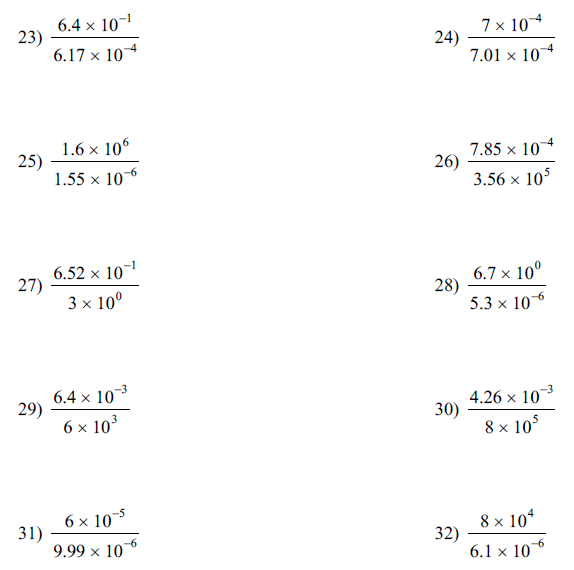


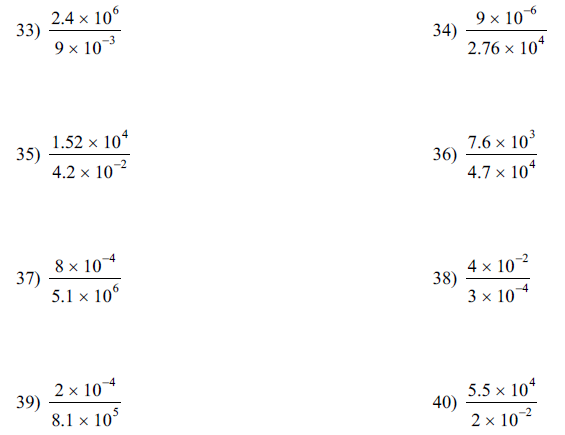












**Lesson Plan # 2 of Unit # 1**

|  |  |  |
| --- | --- | --- |
| **TOPIC/TITLE OF LESSON** | Large/Small Measurements (Scientific Notation) | |
| **AUTHOR(S)** | Kathy Muir | |
| **GRADE LEVEL(S)** | 8 | |
|  |  | |
| **APPLICABLE PA CORE OR NEXT GENERATION STANDARDS:** | | |
| M08.B-E.1.1.3 Estimate very large or very small quantities by using numbers expressed in the form of a single digit times an integer power of 10 and express how many times larger or smaller one number is than another.  M08.B-E.1.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Express answers in scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology (e.g., interpret 4.7EE9 displayed on a calculator as 4.7 x 109). | | |
| **LESSON OBJECTIVES:** | | **ASSESSMENT(S) EVALUATE**  **(formative and/or summative)** |
| SWBAT:  -use scientific notation with positive exponents to represent large numbers.  -use scientific notation with negative exponents to represent small numbers  -use scientific notation with positive and negative exponents to represent numbers.  -students will convert numbers in scientific notation back to standard form.  -understand numbers, ways of representing numbers, relationships among numbers, and number systems.  -develop an understanding of large numbers and recognize and appropriately use exponential, scientific, and calculator notation. | | Students will be complete the worksheet as they go through the problems in class.  Students will also work in groups to discuss the concepts when necessary. Throughout the lesson, teacher will informally observe and comment while student work through their problems. |
| **ACTIVATION OF PRIOR KNOWLEDGE (RTOP #1) ENGAGE** | | |
| Students will complete a warm-up activity on small and large numbers. Teacher will facilitate the activity. | | |

|  |  |
| --- | --- |
| **TEACHING AND LEARNING APPROACHES EXPLORE, EXPLAIN, EXTEND** | |
| **WHAT IS THE TEACHER DOING?**  **RTOP (# 2-10; #9-12; #21-25** | **WHAT ARE STUDENTS DOING?**  **RTOP (#11-19)** |
| **Activity 1:**  **Questions 1 – 4 on worksheet**  Have students write their answers and check them on the calculator. Help students understand the form for scientific notation.  Students can enter scientific notation number two different ways, using 10 or E. Note that the key is labeled EE but the display is E.    Please check the students work by entering one of the above methods and making sure the student’s answer matches.  Be careful, some calculators won’t let it write the answer in expanded form. In that case have the students enter their answers in expanded form and see if they match the original.  **Activity 2:**  (Questions 5 & 6)  Student can change the mode to “SCI” when converting numbers to scientific notation.  MMSci e  The answer should appear with an E. Explain to the students that this represents x 10 and the number that follows the E is the exponent.  Students should not enter the commas into the calculator when converting the salaries.  Discuss with the students how to compare numbers with the exponent. What is different between Carson’s salary and SStacy’s salary?  Questions 7 &8  Students will need to change the calculator mode back to Normal:  Me`î  This will take them to the home screen.  Students should fold a piece of paper in half to understand how the thickness doubles. Ensure students understand that the x 2 represents the doubled thickness.  Calculator entry:  0.004e\*2eee  Continuing to press enter to solve the problem. Students will have to count the number of times they hit enter.  They also need to be careful that when they hit enter the calculator actually multiplies it again.  Students should not count the first entry as a fold.  Question 9 & 10  Place students into groups of 2 to discuss the probability of a head when tossing one coin. When you toss the coin twice, what is the probability? Discuss as a class if this number is getting larger or smaller. Let students guess how small the answer may be.  Solve the problem with the following key presses:  .5e\*.5eee…  They need to count the first entry because it is a flip.  Students are to then write the answer in expanded form.  For the first few flips you can ask the students to convert the decimal to a fraction and/or a percent.  **Activity 3**  Ordering Numbers in Scientific Notation  Students often confuse a negative number with a negative exponent. Using a number line to look at relative location can help student understanding.  Question 11 & 12  If students have difficulty placing the numbers on the number line, have them convert the tick marks to expanded form for assistance.  Students should ensure that the calculator is in NORMAL mode. Press Me`î.  Enter the first number, 1.25 x 10-3, or 1.25`£\_3 and then press e. Students can repeat this process for each of the numbers. | Students will follow along the worksheet and fill in their answers using the calculators.  Students will use their graphing calculator to answer questions 5 and 6.  Students will fold a piece of paper in half to see how the thickness doubles. They can continue folding the paper for a few more times.  Once they finish they will use their graphing calculator to answer the question.  Students will work in groups to discuss the probability of flipping a head when tossing one coin, then two coins, etc.  Then students will use their graphing calculator to answer the questions.  Students will use a number line to place numbers in scientific notation on the number line. |
| **WRAP UP RTOP (#14) EXTEND** | |
| After completing all worksheets, students need to go over the worksheets as a class to make sure they have the correct answers.  After all concepts of scientific notation are completed a quiz will be given on scientific notation. | |

Refer to the RED text in the headings to see how the 5 E’s correspond to the lesson plan components. It is the teacher’s prerogative where extension activities are addressed.

**Rubric for Lesson Plan #1 of Unit #1**

***Instruction: Use the rubric below to review your lesson against the indicators listed below. Consider how someone unfamiliar with your unit would rate your work. Place a checkmark in the appropriate rating box.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RTOP**  **Indicator** | **Indicator Description** | **Thoroughly**  **Addressed** | **Adequately Addressed** | **Some Evidence** | **No Evidence** |
| \_ | Aligned with PA Core or Next Generation Science Standards | **X** |  |  |  |
| \_ | Strong correlation between lesson objectives and assessment methods | **X** |  |  |  |
| \_ | Incorporates NASA content and/or resources within the lesson |  |  | **X** |  |
| \_ | Integrates available technology | **X** |  |  |  |
| #1 | Provides opportunities to help students to activate prior knowledge | **X** |  |  |  |
| #2 | Structures lesson to engage students as members of a learning community | **X** |  |  |  |
| #4, #5 | Utilizes a problem based/inquiry learning model in which students make predictions, estimations and /or hypotheses with a means for testing them |  | **X** |  |  |
| #12, 14 | Describes structured activities requiring student exploration, self-assessment, elaboration and reflection | **X** |  |  |  |
| #11, 16 | Indicates how students will use a variety of means to represent phenomena |  | **X** |  |  |
| #10 | Connects with other content discipline and/or real world phenomena |  | **X** |  |  |
|  | Incorporates the use of modeling, guided practice and independent practice |  | **X** |  |  |
|  | Identifies and/or provides an authentic real-world problem relevant to the students for them to solve | **X** |  |  |  |
|  | Addresses each of the 5 E’s—engage, explore, explain, extend, and evaluate | **X** |  |  |  |