From Another Dimension

Intro to Dimensional Analysis

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Grade Level	6th Grade	**Time Frame**	2-3 class period(s)
Subject	Mathematics	**Duration**	135 minutes
Course	Middle School Mathematics		

Essential Question

How does dimensional analysis aid scientists in translating data, uniting their data into one unit, and resolving issues of measurement beyond the classroom?

Summary

Students will be introduced to dimensional analysis by analyzing a veterinary lab result, focusing mainly on the metric dimensions of a tumor. Students use prior understanding of units to match a set of metric data to the English equivalents. Students will then determine the conversion factor that is needed to convert centimeters to inches. Lastly, students will read and analyze articles to determine the importance of the knowledge and use of dimensional analysis in the real world.

Snapshot

Engage

Student teams are given a lab report detailing a tumor in Aunt Bessie's dog, Fluffy Mae. The students must describe the size of the tumor for Aunt Bessie using the given dimensions.

Explore

Students sort and match metric measurements to their English counterparts. Student teams use the correctly sorted and matched cards to determine the relationship between centimeters and inches.

Explain

Student teams discuss the relationship between centimeters and inches with the entire class and are then led through teacher-guided questioning related to dimensional analysis. Student teams discuss and share their answers with the group.

Extend

Student teams pair with other teams and read selected articles that detail the importance of making conversions in the real world. Students construct a presentation about what they have read.

Evaluate

As an exit ticket, students answer four questions related to the lesson. As further evaluation, students take home a writing activity that is an extension of the beginning engagement activity.

Standards

Oklahoma Academic Standards for Mathematics (Grade 6)

6.GM.3.2: Solve problems in various real-world and mathematical contexts that require the conversion of weights, capacities, geometric measurements, and time within the same measurement systems using appropriate units.

Attachments

- Card Sort—From Another Dimension - Spanish.docx
- Card Sort—From Another Dimension - Spanish.pdf
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- Fluffy Mae Lab Report—From Another Dimension - Spanish.docx
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- Fluffy Mae Lab Report—From Another Dimension.pdf
- From the Desk Of—From Another Dimension - Spanish.docx
- From the Desk Of—From Another Dimension - Spanish.pdf
- From the Desk Of—From Another Dimension.docx
- From the Desk Of—From Another Dimension.pdf
- Lesson Slides—From Another Dimension.pptx

Materials

- Lesson Slides (attached)
- Fluffy Mae's Lab Report (attached; one per student)
- Card Sort (attached; one set per student pair)
- Hyperlinked or printed articles
- From the Desk of notecards (optional; attached; one per student)
- Student calculators
- Sticky notes
- Butcher paper
- Tape

Engage

Introduce the essential question and lesson objectives using **slides 3-4** of the attached **Lesson Slides**.

Place students in pairs for the Think-Pair-Share strategy.

Show **slide 5** of the attached Lesson Slides—the photo of the lady and her dog—to pique the students' curiosity as they enter the classroom. Hand each student a copy of the attached **Fluffy Mae's Lab Report**.

Set up the following scenario:

Your Aunt Bessie has just received a report from the vet that her beloved dog of 20 years, Fluffy Mae, has a tumor on her liver. Your poor Aunt Bessie has many questions. In particular, she wants to know about the size of the tumor, but she isn't familiar with centimeters. With your partner, discuss how you should describe the size of Fluffy's tumor to your aunt. Make notes on the ideas from your discussion.

Teacher's Note

Some students may remember the centimeters to inches conversion, but most will probably not. If you think that your class will find this too simple, change the size of the tumor to units that are more challenging, perhaps millimeters. An editable Word document version of the lab report is attached to this lesson for your convenience. The purpose of this lesson is primarily to get the students to think about and look forward to learning dimensional analysis, not to overwhelm them early in the unit.

Give the student pairs about five minutes to discuss and write down how to describe the size of Fluffy Mae's tumor. The pairs should then share out what they wrote. Mention that most lab report measurements are given in metric units, such as centimeters or millimeters. Students may want to share information from reports of their own, or from reports they've seen.

Explore

Teacher's Note

If you want to explain key terms, it would be excellent to mention the difference between "qualitative data" and "quantitative data." This may also be a good time to explain how using English measurements, rather than metric measurements, can cause confusion. Also introduce the term *International System of Units*.

Prior to the lesson, the attached **Card Sort** should be printed, cut apart, and placed in envelopes to provide one set to each pair of students. Do not give away the direct correlation between centimeters and inches. Instead, each pair of students should be given an envelope of cards and complete a Card Sort activity. Display **slide 6** and have students match the metric measurement cards with their English counterparts. Give student pairs only about two minutes to complete the activity. Walk around the room to assess progress.

Teacher's Note

Students who have no idea how to convert centimeters to inches will likely just arrange the cards in order from smallest to largest values. In the next part of this lesson, students analyze the measurements on the cards and find correlations.

Student pairs should then study the measurement values on the cards in centimeters and compare them to the values in inches. Using the Create the Problem strategy, student pairs must devise a method to convert centimeters to inches. After a few minutes, the student pairs should team with other pairs to form quads. Give the newly-formed quads another few minutes to work together and share their methods of converting from centimeters to inches.

Teacher's Note

This might be a good time to introduce the key term *conversion factor*, because that is really what the students are trying to determine. Walk around the room and assess the work of the teams. If the students figure the conversion quickly, you may want to present some other metric values and their English counterparts, then have the students find the way to make those conversions as well.

Explain

Next, give each quad a large piece of paper and tape. The students in each quad should decide how to create visuals that shows the method devised to convert centimeters to inches. Display **slide 7**. When the teams are finished, have them tape their visuals on the wall. Using a teacher-led version of the Gallery Walk, move from one visual to another and call on teams to share the reasoning behind the methods of conversion they devised.

Keep the quads together and display **slide 8**. Explain to students that converting from inches to centimeters is a common problem and that metric measurements are used in medicine. Student teams should jot down notes as they discuss other examples of units that can be converted. The teams should discuss what information is needed in order to convert units from one system into units from another system, and record the answers on paper.

Teacher's Note

Students might have difficulty thinking of other units to be converted. They will readily think of distance measurements, such as miles, feet, and inches, but may not think of gallons, liters, and pressure units.

At this point in the lesson, introduce and explain the term *dimensional analysis* and connect it to the previous activities. Then, each team should compose a list of the conversions that will be used for the course. As a class, narrow down the list.

Teacher's Note

FOR MORE INFORMATION ON DIMENSIONAL ANALYSIS, consult any/all of the following:

- http://www.clayton.k12.mo.us/cms/lib/MO01000419/Centricity/Domain/206/Real%20Life%20Dinensional%20Analys odf
- http://education.ed.pacificu.edu/sweb/537fri/dimensional/teacher.html
- http://www.yale.edu/ynhti/curriculum/units/1991/6/91.06.03.x.html
- https://www.youtube.com/watch?v=fEUaQdaOBKo

Give teams a few minutes to share out the information they identified as necessary to know in order to convert units from one system to another. Then, lead a class discussion about the topic.

Extend

Give each team a copy of one of the hyperlinked articles found below and display **slide 9**. For larger classes, some teams may need to work with the same article.

"Dimensional Analysis In Nursing"

"Out of Fuel"

"Not Ship Shape"

"Columbus: The Accidental Tourist"

Have the teams read and discuss the articles, making note of key points. The teams should then prepare Two Minute Documentaries for the class, highlighting the key ideas of the text. Allow students the freedom to decide how to do this. As the documentaries are presented, students should take notes on the highlights. These will be used for the final portion of this lesson.

Evaluate

Teacher's Note

Decide whether students will work individually or in groups to complete this section of the lesson.

Display **slide 10** to introduce the essential and final question: "How does dimensional analysis aid scientists in translating data, give them the ability to unite their data into one unit, and resolve issues of measurement beyond the classroom?" Students should use the Two-Minute Paper strategy to reflect on the documentaries from earlier in the lesson in order to answer the essential question.

Optional Evaluation

Give each student a copy of the attached **From the Desk Of** note card. Students should use the cards to compose notes to their Aunt Bessie. In the notes, students should give their aunt the dimensions, in inches, of the tumor. Students should show their work on the backs of the note cards and compare the tumor to an actual object, using rulers if needed.

Resources

- Chatterjee, R. & Mullins, L. (2012, February 23). "New clues emerge in centuries-old Swedish shipwreck." PRI's "The World." http://www.pri.org/stories/2012-02-23/new-clues-emerge-centuries-old-swedish-shipwreck
- K20 Center. (n.d.). Card sort. Strategies. https://learn.k20center.ou.edu/strategy/147
- K20 Center. (n.d.). Create the problem. Strategies. https://learn.k20center.ou.edu/strategy/149
- K20 Center. (n.d.). Gallery walk/carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.). Think-pair-share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (n.d.). Two-minute paper. Strategies. https://learn.k20center.ou.edu/strategy/152
- K20 Center. (n.d.). Two minute documentaries. Strategies. https://learn.k20center.ou.edu/strategy/177
- Lee, E. (n.d.) "Medication math and the nursing student." Alysion. http://www.alysion.org/dimensional/matherrors.htm
- Lloyd, R. (1999, September 30). "Metric mishap caused loss of NASA orbiter." CNN. http://www.cnn.com/TECH/space/9909/30/mars.metric.02/
- McCormick, D. (2012, October 9). "Columbus's geographical miscalculations." *Spectrum*. http://spectrum.ieee.org/tech-talk/at-work/test-and-measurement/columbuss-geographical-miscalculations
- Witkin, R. (1983, July 30). "Jet's fuel ran out after metric conversion errors." *The New York Times Business Digest*. http://www.nytimes.com/1983/07/30/us/jet-s-fuel-ran-out-after-metric-conversion-errors.html