Title of Lesson: Dimensional Analysis Relay Race

Abstract:

This game can be used as a discovery activity or a way to reinforce previously taught concepts. Students collaborate to manipulate units using dimensional analysis to work from a starting unit to a finishing unit, practicing algebraic manipulation skills and understanding how units are connected.

Game Instructions:

- Start by dividing the class into two or more teams of roughly equal size
- Each team stands in a single-file line at their team's station
- Place a central pile of unit cards in the middle of the room, equidistant from all teams
- The teacher writes a starting and ending unit on the board
- At the start of the activity, the first student in each line runs (or hops in potato sacks) to the unit pile
- The student selects one unit card and returns to place it in the team's chain of units where they believe it belongs
- They then move to the back of the line
- Students continue in a relay format, adding one unit card per turn, until the dimensional-analysis setup is complete. The first team to correctly solve the dimensional analysis wins.

Keywords:

- Dimensional analysis
- Ratios and units
- Middle School
- Unit conversion
- Active learning

Goal(s): The major goal of this lesson is for students to understand how to structure and interpret dimensional-analysis problems, recognizing how units convert and cancel. Students should walk away with an embodied sense of how unit relationships work.

Learning Objectives:

By the end of this lesson, students will be able to:

- Set up a dimensional-analysis problem using appropriate conversion factors.
- Identify and place unit cards in correct relational order.
- Explain how and why units cancel when performing conversions.
- Work collaboratively to check and revise unit-placement decisions.

If pressed for time, the collaborative explanation could be omitted, though it significantly enriches understanding.

Assessment:

Understanding will be evaluated informally throughout the relay as the teacher circulates and listens for reasoning behind card placement. At the end, teams will present a brief explanation of their completed dimensional-analysis setup. Optionally, a short exit ticket can ask students to solve a simpler conversion individually.

Purpose/Rationale:

Dimensional analysis is foundational in science and mathematics, allowing students to connect ratios, units, and real-world quantities. Physically acting out the process helps reinforce spatial and conceptual understanding, making abstract relationships more intuitive.

This approach aligns with common middle-school math and science standards involving ratio reasoning and unit conversions. Unlike traditional worksheet-based instruction, the embodied activity allows students to internalize how units relate and cancel, fostering deeper conceptual retention.

Prior Preparation:

Instructor Preparation:

- Prepare problem cards in advance (two copies of each problem so each team has the same challenge).
- Create or print unit cards.
- Set up stations and a central pile of unit cards.

- Ensure availability of an open court or field.
- Test layout for fairness (equal distance to center pile).

Student Preparation:

- Wear athletic shoes and comfortable clothing suitable for movement.
- No advance reading required, though a brief review of unit conversion may help.

Materials/Resources:

- Open court or field (approx. MAC court size or similar)
- Problem cards (2 copies per problem)
- Unit cards

These materials are low-cost, and the activity can be adapted for limited-resource schools by using paper slips instead of laminated cards, or by conducting a walking relay rather than a running one.

Bibliography and Sources for Further Reading:

- https://www.edutopia.org/article/turning-math-game/ - Has useful examples for teaching math through games
- https://www.youtube.com/watch?v=Ipy8adelKPo&t=1 - This video is an overview of a commonly taught dimensional analysis technique that is modeled in the game play in this lesson plan

PSET Questions: The following are examples of starting and ending units that could be used in the relay race.

1. Inches → Yards

2. Seconds → Years

3. Laps on an Outdoor Track → Kilometers

4. Meters/Second → Kilometers/Hour

5. mL → cm^3

6. g/cm^3 → kg/m^3

7. Moles of an element → Kg

8. Kilograms → Ounces

9. Gallons → Tablespoons

10. Kg*m/s → N*s