How Big is a Mole? Number Sense

(2-3 50 minute class periods)

Authors

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SUBJECT/GRADE LEVEL

Subject Area: Chemistry, Physics

Grade Level: High School

Materials

- Computer
- Poster materials
- Class notebook

STANDARDS

Next Generation Science Standards

- HS-PS1-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Mathematics Standards | Common Core State Standards

- CCSS.MATH.CONTENT.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- CCSS.MATH.CONTENT.HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.L.9-10.1 Demonstrate command of the conventions of standard English grammar and usage when writing or Speaking.
- CCSS.ELA-LITERACY.L.9-10.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

LESSON OBJECTIVE(S)

Students will be able to make sense of very large numbers by comparing them to common objects.

CAREER CONNECTION(S)

STEM Careers: All professional chemists might use this topic in doing quantitative chemistry experiments.

ENGAGEMENT

Brief Description: Students will be able to make sense of very large numbers used in chemistry by comparing the mole to common objects.

Procedures:

How big is a dozen? Ask students how far a dozen candy bars, books or shoes would stretch. They can measure that, right? 12 isn't a huge number!

A mole is a BIG number: 6.02×10^{23} particles. We need this number in Chemistry to quantify how many atoms we have but how many is that? What if we had a line of candy bars, books or shoes that, instead of a dozen long, was a mole long. How far would that go?

EXPLORATION

Brief Description: Students will be able to make sense of very large numbers used in chemistry by comparing the mole to common objects.

Procedures:

Students will choose a common object: Snickers bars, textbooks, sticks of gum, bags of Cheetos, etc

They will use dimensional analysis to calculate how far, in kilometers, 1 mole of their object would stretch.

Then they will choose a distance - times around the Earth, trips to the Moon, distance to the Sun, etc., and, likewise, calculate how many times a mole of their item would complete their chosen distance.

Then students will create a poster to illustrate their comparison and document their calculations. The poster will include:

A large, appropriate title

A pictorial representation of their comparison

All conversion calculations

EXPLANATION

Brief Description: Debrief, reflect, discuss

Procedures:

Students will do a gallery walk of the posters and check each other's calculations, looking for errors as well as making note of the comparison described.

EVALUATION

Brief Description: Debrief, reflect, discuss

Procedures:

Students will be able to identify and correct any mathematical, computational or descriptive errors they find in other posters and correct those calculations on their gallery walk notes. Discuss with students if a mole was larger or smaller than they actually thought. Ask if they found anything surprising. Reinforce why the mole is used as a unit in chemistry because scientists use such large numbers of atoms and molecules in doing chemical analyses.