

USING BENCHMARKS TO TEACH METRIC MEASUREMENT

Audrey Bullock
Austin Peay State University

Session # 159

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ADVANTAGES OF THE METRIC SYSTEM

- ▶ Used internationally
- ▶ All conversions work with powers of ten (multiply or divide by 10, 100, 1000...)
- ▶ In the English System- multiply by 3, 12, 36, 1760, 5280, ...)
- ▶ Consistent prefixes applied to every base unit (millimeter; milliliter; milligram).
- ▶ In the English System- ounces, pounds, feet, yards, gallons, pints, Tablespoons, etc...

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WHY IS THE METRIC SYSTEM IMPORTANT FOR OUR STUDENTS?

- ▶ Global Economy
- ▶ STEM and Government Careers
- ▶ Increases understanding of place value
- ▶ Easy to use- conversions make sense

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COMMONLY USED METRIC PREFIXES

Prefix	Multiplier	Equivalent	Origin
Kilo (k)	Thousand	1 km= 1000 m	Greek
Hecto (h)	Hundred	1 hm= 100 m	Greek
Deca (da)	Ten	1 dam= 10 m	Greek
Deci (d)	Tenth	1 dm= 0.1 m	Greek
Centi (c)	Hundredth	1 cm = 0.01 m	Latin
Milli (m)	Thousandth	1 mm= 0.001 m	Latin

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WHY HAVEN'T WE ACTUALLY SWITCHED?

- ▶ Unfamiliarity
- ▶ Consumers are unaccustomed to the units of measure
- ▶ Cost to businesses and industry

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WHY BENCHMARKS?

- ▶ Personal Benchmarks/ Referents
 - ▶ What an individual pictures when they hear a certain unit
 - ▶ Examples
 - ▶ Liter-----→ 2 liter soda
 - ▶ Square foot-----→ One tile in my classroom
- ▶ Display examples in classroom
- ▶ Research from several sources indicates the use of benchmarks helps students make sense of measurement (NCTM, 2003; Sowder, Sowder, & Nickerson, 2010).

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COMMON MISCONCEPTIONS BENCHMARKS CAN HELP ADDRESS

- ▶ $3 \text{ cm} = \underline{\hspace{1cm}} \text{ m}$
 - ▶ Student: "I know you move the decimal twice, so 300.3 centimeters is 300 meters."
- ▶ $1 \text{ square foot} = \underline{\hspace{1cm}} \text{ square inches}$
 - ▶ Student: "There are 12 inches in a foot, so there are twelve square inches in a square foot."
- ▶ Find the area of your desk
 - ▶ Student: "It is 6 dm by 6 dm, so 12 dm^2 ."
- ▶ General Estimation Tasks
- ▶ Can create overall better understanding of the differences in length/ perimeter; area/ surface area, and volume measurements.

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BENCHMARKS AND ESTIMATION

- ▶ Estimate accessible and non-accessible items
 - ▶ Length of your writing utensil
 - ▶ Height of your refrigerator
- ▶ Reverse the Process
 - ▶ Find something that is about 3 decimeters long

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WHAT ARE YOUR PERSONAL BENCHMARKS?

- ▶ Meter
 - ▶ Height of a standard doorknob
- ▶ Decimeter
 - ▶ Length of a Base Ten "long"
- ▶ Centimeter
 - ▶ Length of one edge of a Base Ten "unit"
- ▶ Millimeter
 - ▶ Thickness of a dime
- ▶ Kilometer
 - ▶ A little over half a mile, or app. the length of APSU's campus along College Street

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BENCHMARKS AND CONVERSIONS

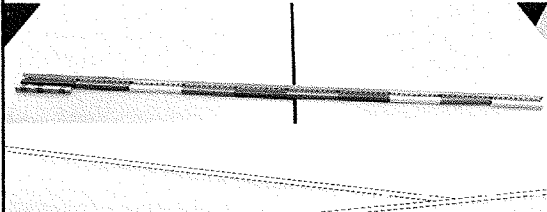
Use your benchmarks and number sense to complete the following equivalencies:

- ▶ $36 \text{ millimeters} = \underline{\hspace{1cm}} \text{ decimeters}$
- ▶ $5.2 \text{ meters} = \underline{\hspace{1cm}} \text{ centimeters}$

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

BENCHMARKS TO ESTABLISH RELATIONSHIPS

- ▶ $10 \text{ cm} = 1 \text{ dm}$
- ▶ $10 \text{ dm} = 1 \text{ m}$
- ▶ $100 \text{ cm} = 1 \text{ m}$



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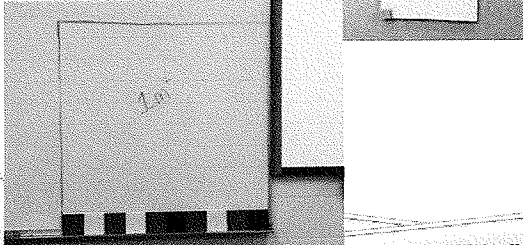
BENCHMARKS FOR UNITS OF AREA: STAMPS

- ▶ $1 \text{ square centimeter} (1 \text{ cm}^2)$

 - ▶ One face of a base ten "unit"
- ▶ $1 \text{ square decimeter} (1 \text{ dm}^2)$
 - ▶ Largest face of base ten "flat"
 - ▶ Piece of toast
- ▶ $1 \text{ Square Meter} (1 \text{ m}^2)$
 - ▶ Top of a card table

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USE BENCHMARKS TO FIND RELATIONSHIPS: AREA

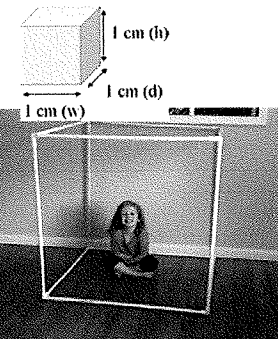
- ▶ $1 \text{ m}^2 = 100 \text{ dm}^2 = 10\,000 \text{ cm}^2$
- ▶ $1 \text{ dm}^2 = 100 \text{ cm}^2$



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BENCHMARKS AND UNITS OF VOLUME

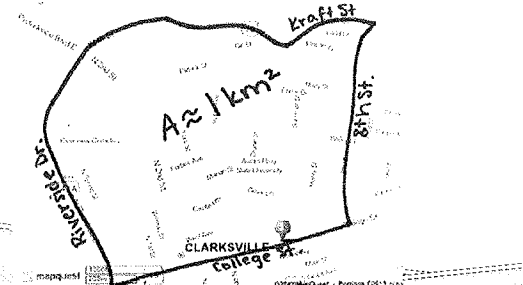
- ▶ 1 cubic centimeter (1 cm^3)
 - ▶ One base ten "unit"
- ▶ 1 cubic decimeter (1 dm^3)
 - ▶ One base ten "cube"
- ▶ 1 cubic meter (1 m^3)
 - ▶ PVC Pipe Cube



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BENCHMARKS FOR UNITS OF AREA: STAMPS

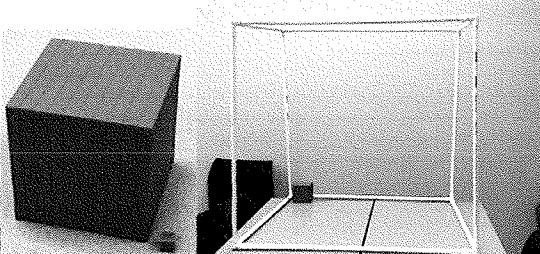
- ▶ 1 square kilometer (1 km^2)



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BENCHMARKS TO FIND RELATIONSHIPS: VOLUME

- ▶ $1 \text{ dm}^3 = 1000 \text{ cm}^3$
- ▶ $1 \text{ m}^3 = 1000 \text{ dm}^3 = 1000\,000 \text{ cm}^3$



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MORE ESTIMATION

- ▶ Find something that is about 40 cm^2
- ▶ Estimate the area of the presentation screen
- ▶ Convert using your benchmarks and/or number sense

$0.3 \text{ m}^2 = \underline{\hspace{2cm}} \text{ dm}^2$

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ESTIMATION WITH VOLUME

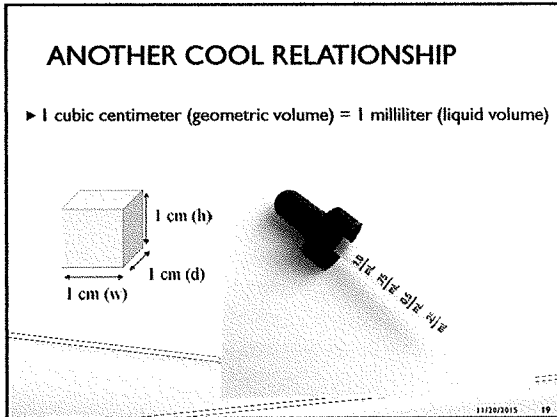
- ▶ Estimate the volume of a water bottle
- ▶ What is something that is about 15 dm^3 ?

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ANOTHER COOL RELATIONSHIP

► 1 cubic centimeter (geometric volume) = 1 milliliter (liquid volume)



REFERENCES

- Joram, E. (2003). Benchmarks as tools for developing measurement sense. In D.H. Clements & G. Bright (Eds.), *Learning and teaching measurement* (pp. 57-67). Reston, VA: The National Council of Teachers of Mathematics.
- Sowder, Sowder, & Nickerson. (2010). *Reconceptualizing mathematics for elementary school teachers*. New York: W.H. Freeman and Co.

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QUESTIONS?

Thank you!

bullocka@apsu.edu

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