Unit 2A

The Problem-Solving Power of Units

Units

The **units** of a quantity describe what is being measured or counted.

Operation	Key word or symbol	Example
Division	*per*	Read miles ÷ hours as "miles per hour."
Raising to second power	*square*	Read ft × ft, or ft^2, as "square feet" or "feet squared."
Raising to third power	*cube* or *cubic*	Read ft × ft × ft, or ft^3, as "cubic feet" or "feet cubed."
Multiplication	*hyphen*	Read kilowatts × hours as "kilowatt-hours."

Unit Conversions

Convert a distance of 9 feet into inches.

$$9 \text{ ft} = 9 \cancel{\text{ft}} \times \frac{12 \text{ in.}}{1 \cancel{\text{ft}}} = 108 \text{ in.}$$

Conversion Factors

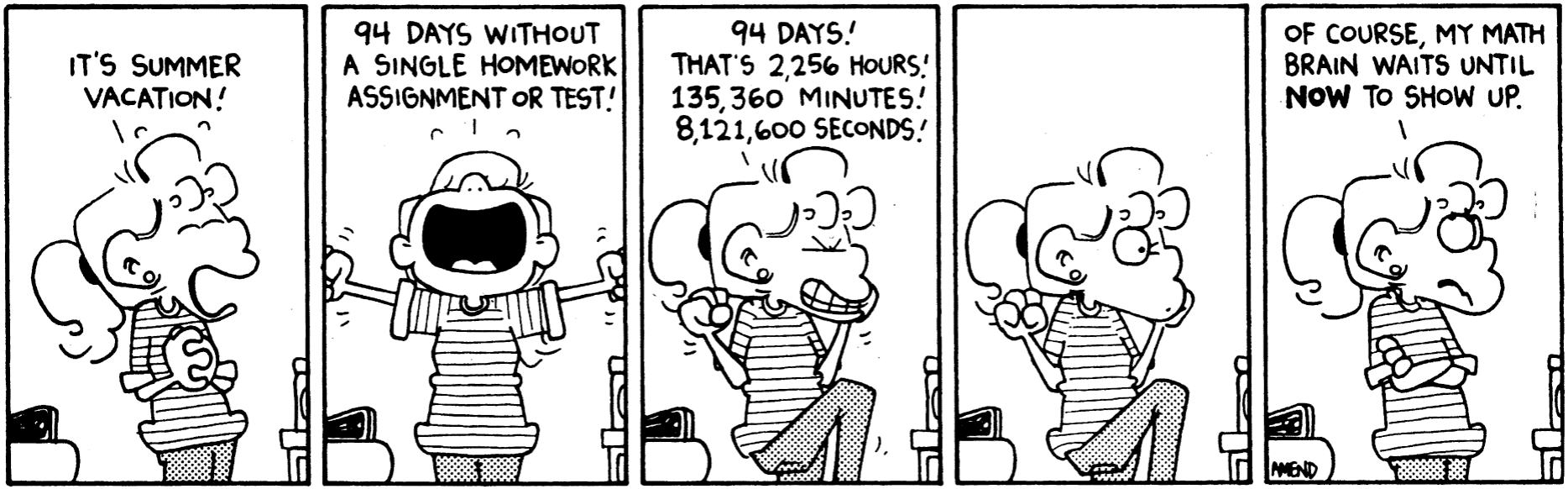
A **conversion factor** is a statement of equality that is used to convert between units.

Some conversion factors:

$$12\,\text{in.} = 1\,\text{ft} \quad \text{or} \quad \frac{12\,\text{in.}}{1\,\text{ft}} = 1 \quad \text{or} \quad \frac{1\,\text{ft}}{12\,\text{in.}} = 1$$

$$24\,\text{hr} = 1\,\text{day} \quad \text{or} \quad \frac{24\,\text{hr}}{1\,\text{day}} = 1 \quad \text{or} \quad \frac{1\,\text{day}}{24\,\text{hr}} = 1$$

Using a Chain of Conversions



$$94 \text{ days} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 8,121,600 \text{ sec}$$

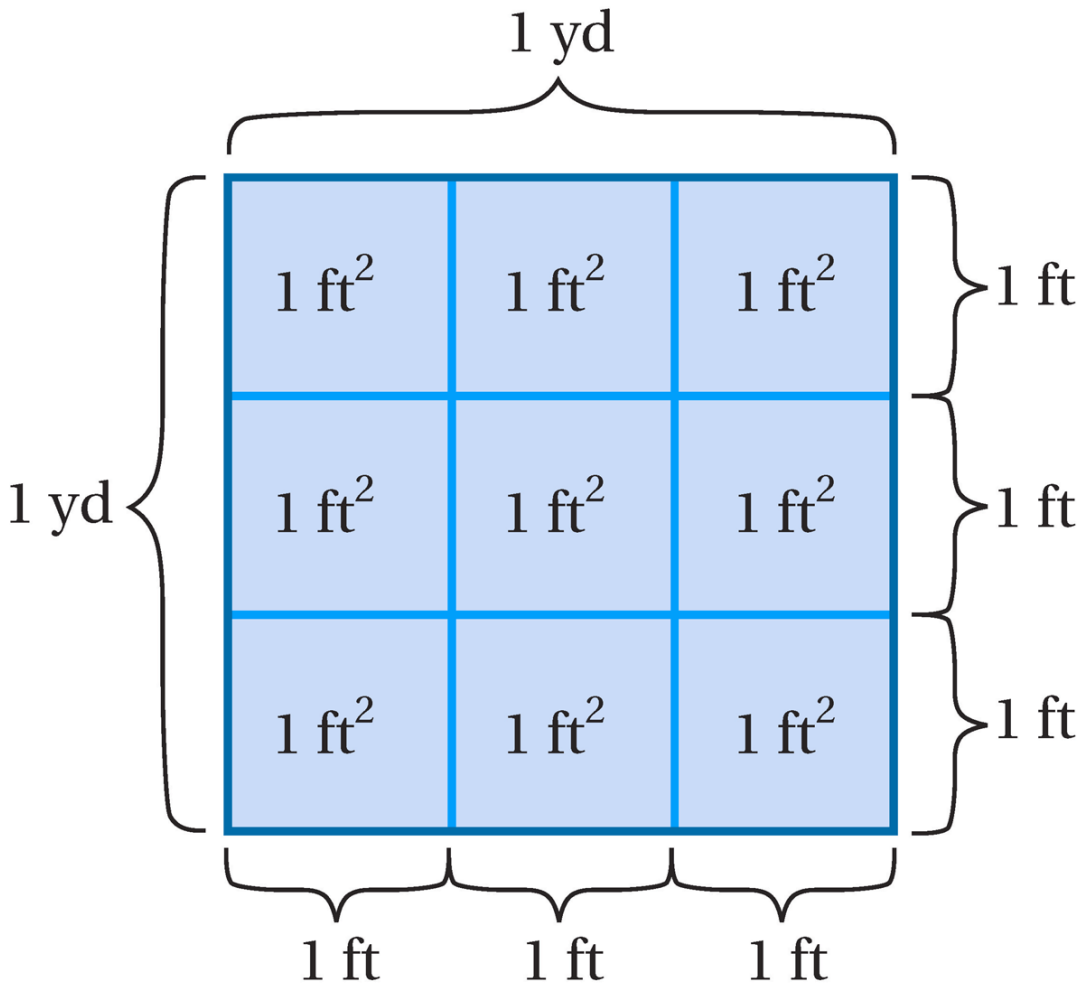
Conversions with Units Raised to Powers

$1 \text{ yd} = 3 \text{ ft}$

$1 \text{ yd}^2 = 1 \text{ yd} \quad 1 \text{ yd}$

$= 3 \text{ ft} \quad 3 \text{ ft}$

$= 9 \text{ ft}^2$



Cubic Units

How many cubic yards of soil are needed to fill a planter that is 20 feet long by 3 feet wide by 4 feet tall?

The volume is 20 ft 3 ft 4 ft = 240 ft^3

1 yd = 3 ft, so $(1\ yd)^3 = (3\ ft)^3 = 27\ ft^3$

$$240\,\text{ft}^3 \times \frac{1\,\text{yd}^3}{27\,\text{ft}^3} \approx 8.9\,\text{yd}^3$$

Currency Conversions

TABLE 2.1 Sample Currency Exchange Rates (March 2009)

Currency	Dollars per Foreign	Foreign per Dollar
British pound	1.414	0.7072
Canadian dollar	0.7834	1.277
European euro	1.256	0.7965
Japanese yen	0.01007	99.34
Mexican peso	0.06584	15.19

You return from a trip to Europe with 120 euros. How many dollars do you have?

$$120 \text{ euros} \times \frac{\$1.256}{1 \text{ euro}} = \$150.72$$

Problem Solving with Units

1. Identify the units involved in the problem. Use them to
   - decide how to approach the problem;
   - and determine what units to expect in the answer.
2. Perform any operations on both the numbers and their associated units.
   - Numbers with different units cannot be added or subtracted.
   - Combine different units through multiplication, division, or raising to powers.
   - Replace division with multiplication by the reciprocal.
3. Make sure your answer is in the units you expected.

Problem Solving with Units

You are buying 50 acres of farm land at a cost of $12,500 per acre. What is the total cost?

The answer should be in dollars. We multiply the acreage by the cost per acre:

$$50 \text{ acres} \times \frac{\$12,500}{1 \text{ acre}} = \$625,000$$