NIMBioS Activities Connecting Math and Science in Middle School

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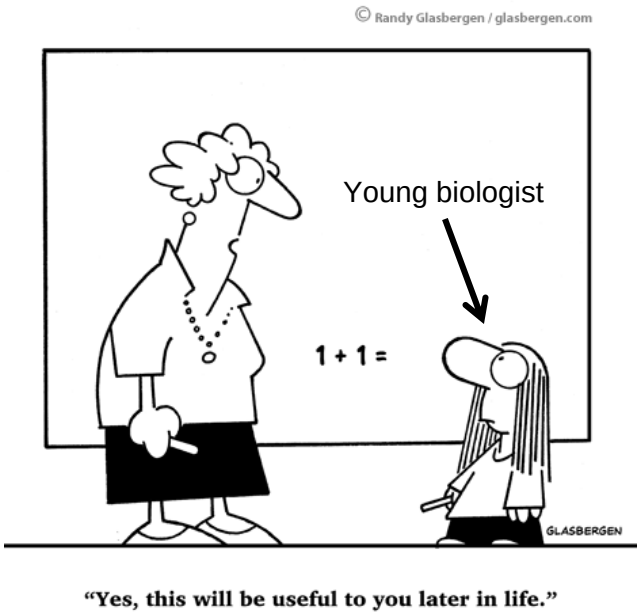
Teacher and Student Workshops



"Yes, this will be useful to you later in life."

Biology in a Box

- Hands-on, inquiry-based curriculum enrichment units for K-12
- Math and biology together

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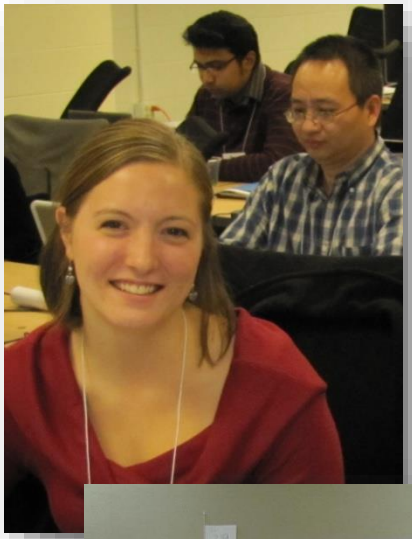
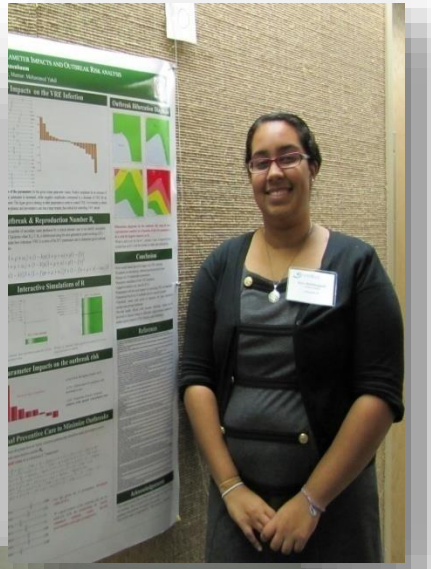
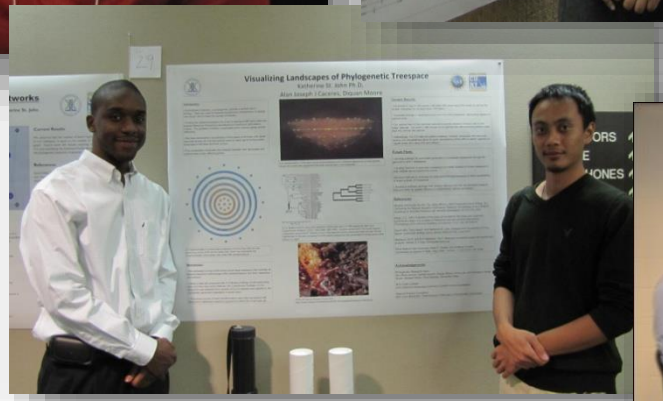
Undergraduate Programs







- Undergraduate Research Conference (annual in fall)
- Summer Research Experiences for Undergraduates and Teachers

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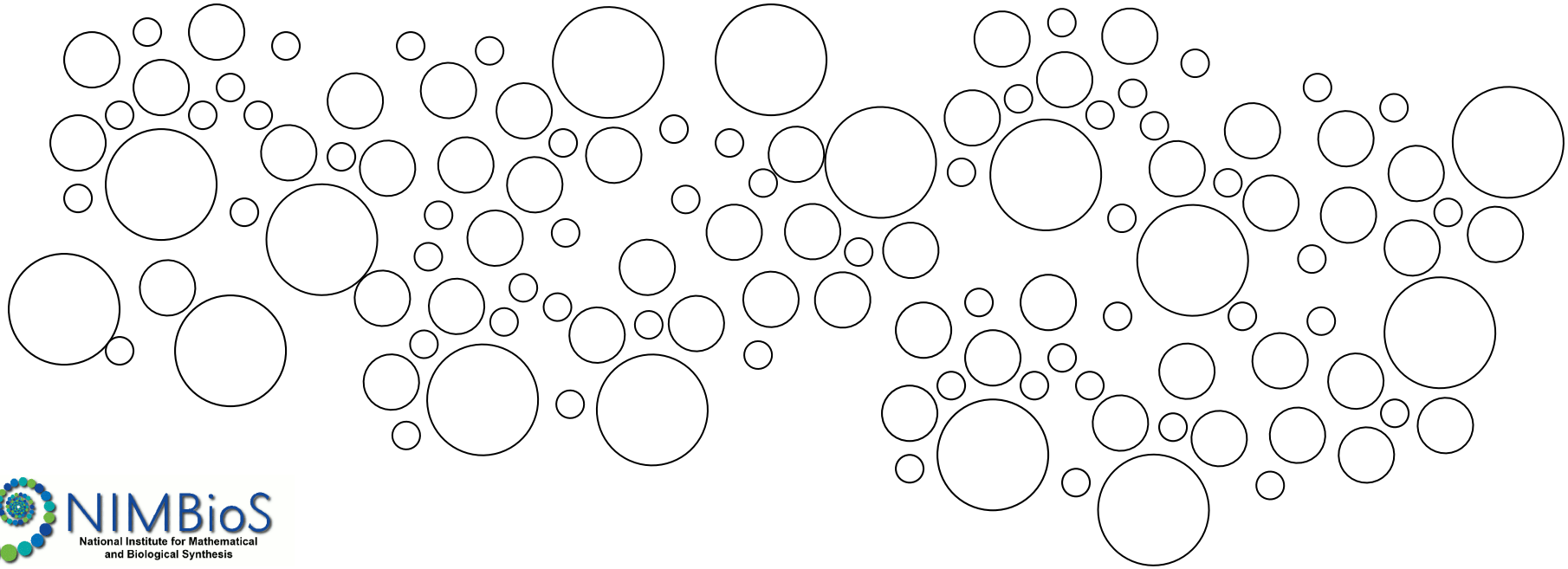
The importance of random sampling



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Goals:

- Demonstrate understanding of random and nonrandom sampling
- Discuss importance of random sampling
- Recall how to find mean/average, median, mode, range, and apply to data
- Use measures of central tendency to compare datasets

What is random sampling?

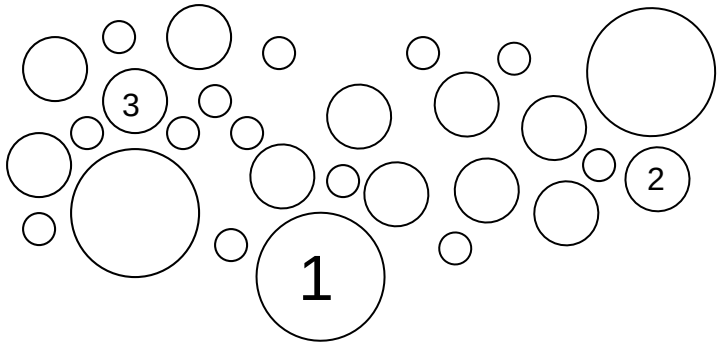
- Random sampling is a way to remove bias in a sample selection, and it tends to produce representative samples of a larger population.

- When is random sampling used?

- What happens when a personal or nonrandom selection happens instead of a random sample?

Circle Activity

- Step 1: Number the circles from 1 to 80.



- Step 2: Take 15 seconds and select five circles to use to estimate the average diameter of the 80 circles.

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Circle Activity

- Step 3: Find the diameter (in cm) for each circle.
- Step 4: Find the average diameter. Make sure to show your work.
- Example:

$$2+1+2+3+3=11$$

$$11/5=2.2$$

Average Diameter: 2.2 cm

Circle Activity

- Step 5: Find the average diameter for the class.
- Example:

  John's average diameter: 1.6 cm

  Your average diameter: 2.2 cm

  Sheri's average diameter: 1.8 cm

  Sam's average diameter: 1.4 cm

Their average diameter: 1.75 cm

Circle Activity

- Step 6: Use random number generator to pick 5 circles and find their diameters.
- Step 7: Find the average diameter of the random sample of circles.
- Step 8: Find the average diameter of the random sample of circles for the whole class.

Circle Activity

- Step 9: Find the median, mode, and range of the class' choice of circles and the class' random sample of circles. Then compare the median, mode, range, and mean/average.

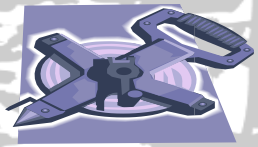
- Step 10: Describe and compare the class' mean diameter of their choice circles and the randomly selected circles.

Circle Activity

- The true average diameter is 1.25cm.
- Step 11: How is the true average different than your personal selection and your random sample mean diameter? Why?
- Step 12: What is bias? How did it appear in your personal selection? How does random selection help eliminate bias?

Biology Meets Math

MEASURING A FOREST



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Goals

- Be able to describe the area and distribution of forests in the United States
- Understand why it is important to measure and monitor forests
- Define terms: biomass, crown, dendrologist, DBH
- Find out what π has to do with measuring a tree
- Define and calculate stand density

Area of Forests in US

- In 2010, there were 304,022,000 ha of forest in the United States
- The United States is 982,667,500 ha
- What percent of the United States' area is forested?

$$\frac{Part}{Whole} \times 100\% = \frac{304{,}022{,}000}{982{,}667{,}500} \times 100\% =$$

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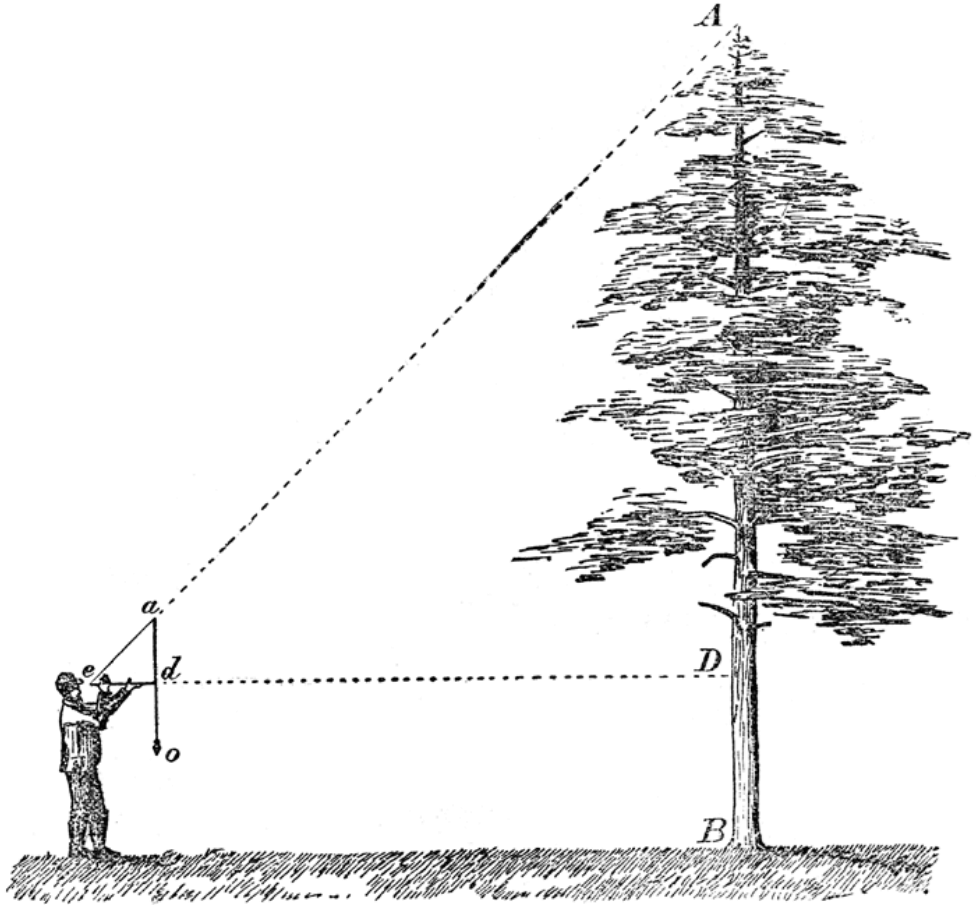
How do we measure something so big?



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What is DBH?

Diameter at
Breast
Height

- Diameter of the tree 4.5 feet above forest floor on the uphill side
- Avoids the swell at the base of the trunk

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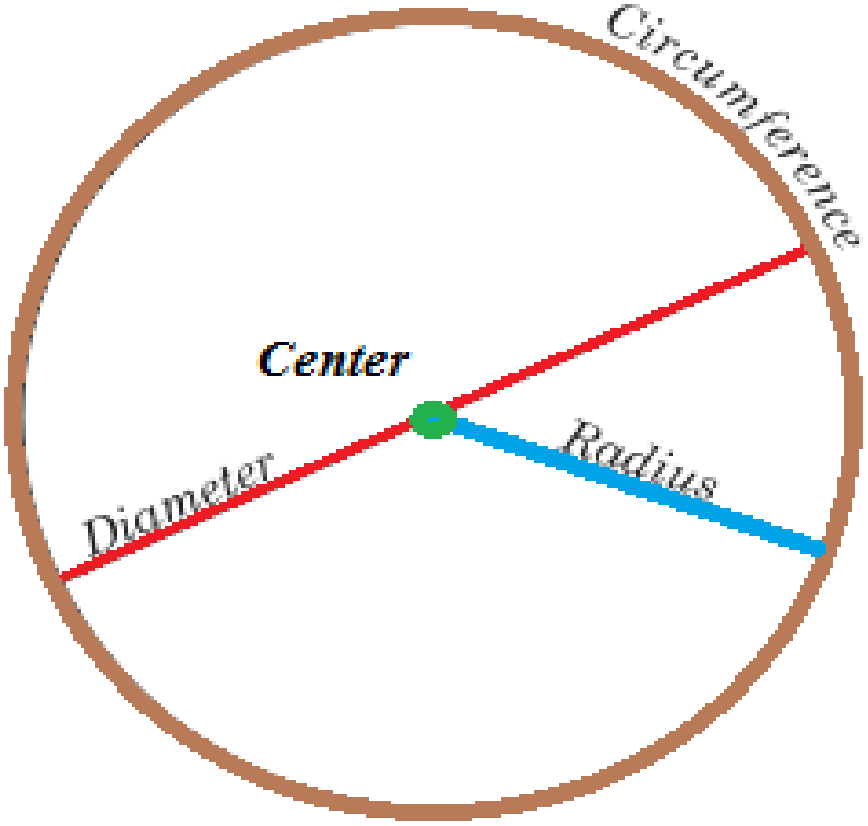
How can you use circumference to find diameter?



$$C = \pi D$$

$$C/\pi = D$$

Let's Practice!

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Problem & Solution

- You are a forester collecting tree DBH data
- You'd rather not bring a calculator into the field with you
- Can you invent something that, if you use it to measure the circumference, it automatically gives you the diameter?
- Discuss DBH tape measure.

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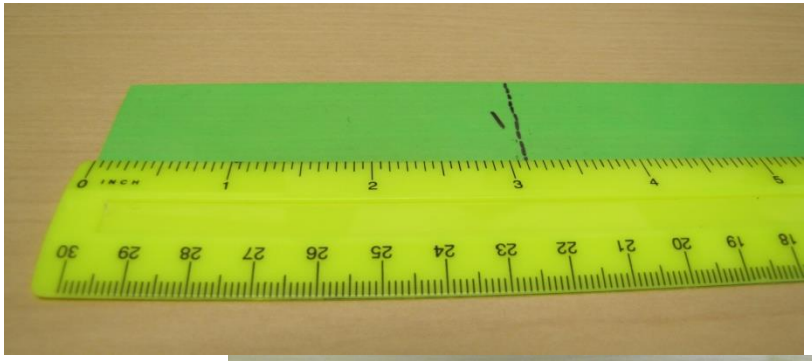
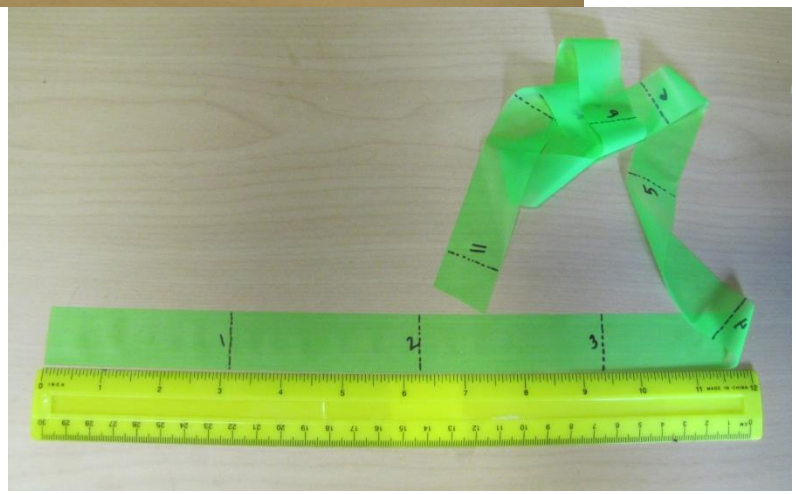
Make Your Own DBH Tape





- Mark off every pi (3.14) inches
- What is 0.14 of an inch?
- Somewhere in between 1/8” and 3/16”
- Test it out!

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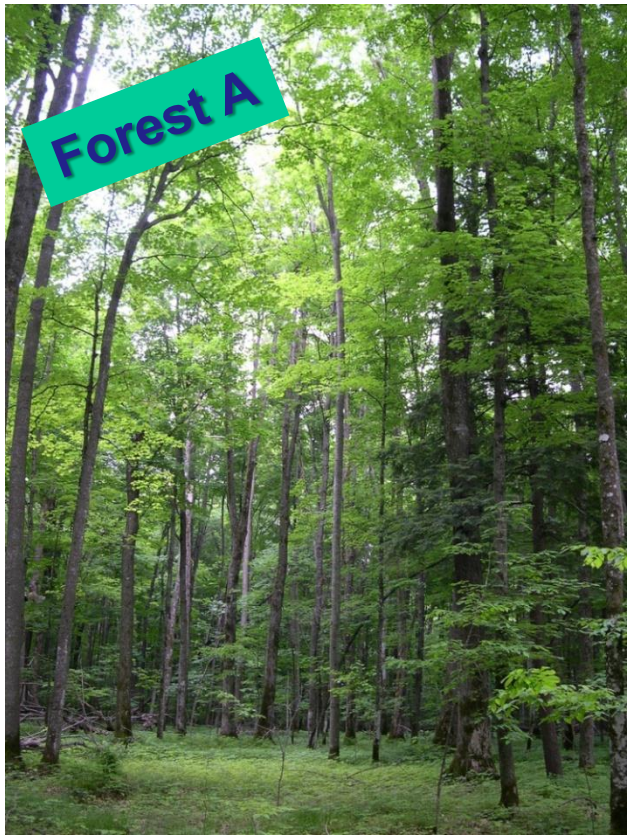
A Forest is Many Trees

Chequamegon National Forest, WI



Mendocino Pygmy Forest, CA

How to describe the difference with numbers?

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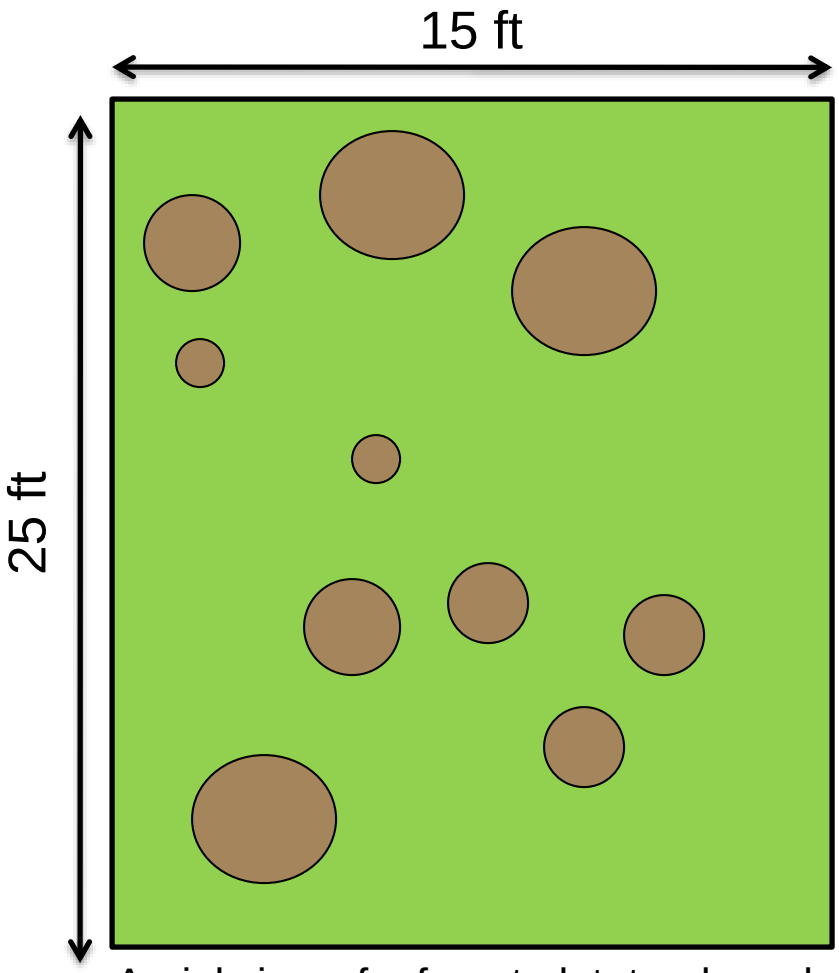
Stand Density



Aerial view of a forest plot, trunks only

$$\text{Stand Density} = \frac{\text{number of trees}}{\text{area of stand}}$$

1. Count the number of trees (10)
2. Find the area (L*W) of the stand (15 ft * 25 ft = 375 ft^2)
3. Divide the numerator by the denominator (10/375 = 0.03 trees/ft^2)

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A “Forest” of Humans

If the people in this classroom were trees, and this classroom were our plot …

What would be our stand density?

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Sources

Franklin, F., Kader, G., Mewborn, D., Moreno, J., Reck, R., Perry, M., and Scheaffer, R., Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K-12 Curriculum Framework, American Statistical Association, 2007.

K. Sturner, B. Golden, and S. Lenhart, Modeling the Forest, Science Scope, September 2013, 70-79.

Copies of this paper available now!

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