

Seminars on Teaching Mathematics

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A Collection of SMART and Engaging Classroom Activities

Led by Dr. Hasenbank & Dr. Kosiak

Wednesday, Nov. 5, 2008

4:00 – 5:00pm

Cowley 041

Abstract: We will present a wide variety of engaging, standards-based math activities that we have used with elementary, middle, and high school students over the years. SMART Board capabilities will be highlighted throughout the discussion. Examples of activities include: weighing a car using two sheets of paper and a tire gauge; finding a hidden treasure using triangulation; calculating the circumference of the earth with an old GPS unit; designing a cardboard boat big enough to hold six people; and more as time permits.

Nov 5-9:18 AM

Activities:

1. Find a hidden treasure.
2. Using GPS to measure the earth.
3. Weighing a car.
4. Designing a cardboard boat.

Nov 5-9:19 AM

Where on Earth? Locating a position on a map

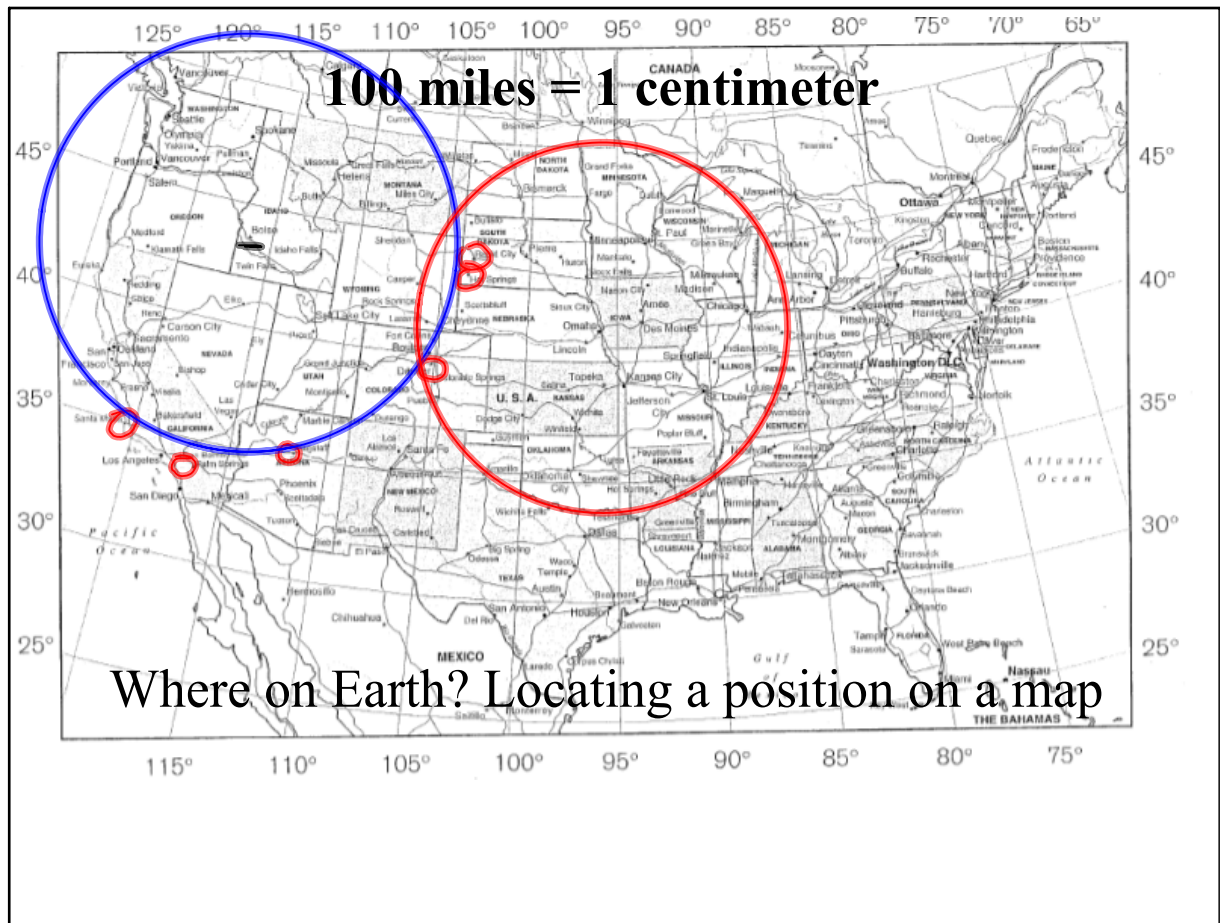
Clues: There is a treasure in a city that is ...

610 miles from Boise Idaho

460 miles from Omaha Nebraska

580 miles from Tucson Arizona

Clues

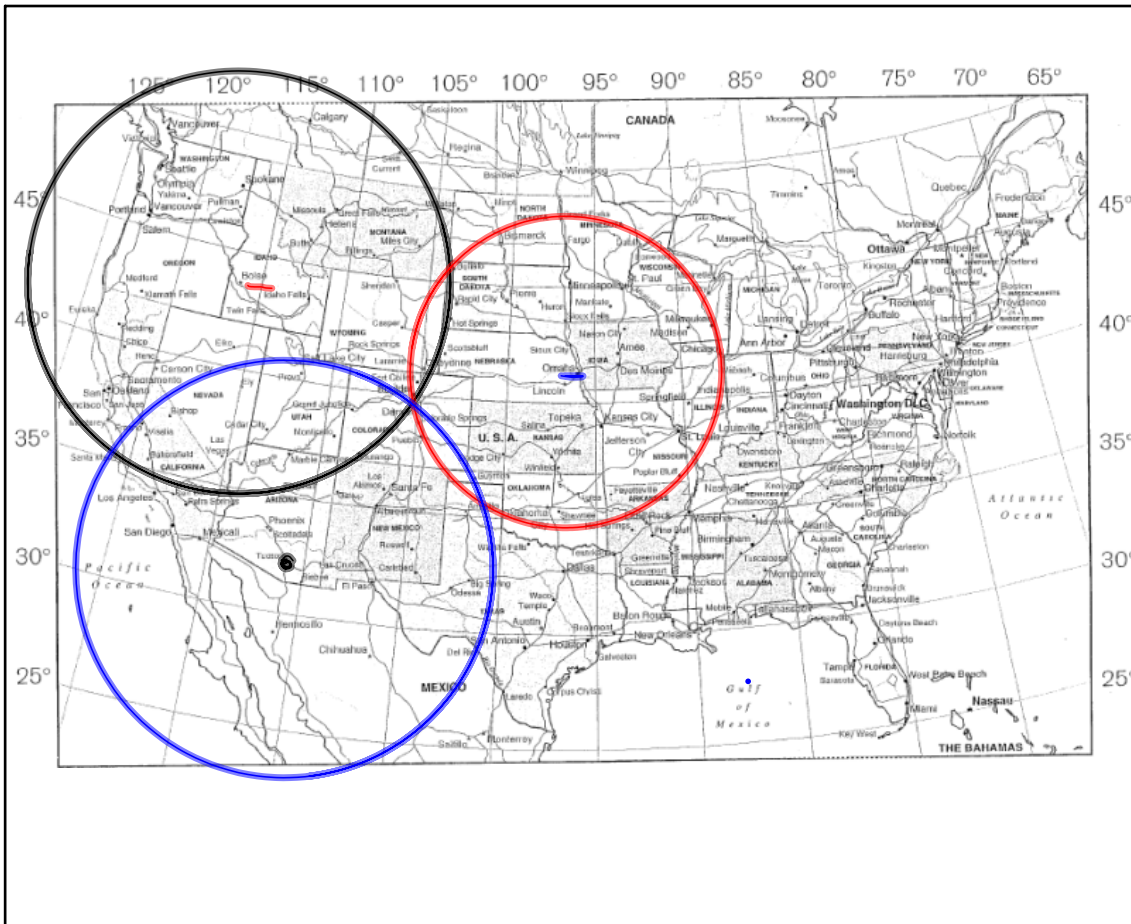


Hunt

Where on Earth? Boise Idaho: 610 miles = 6.1 cm



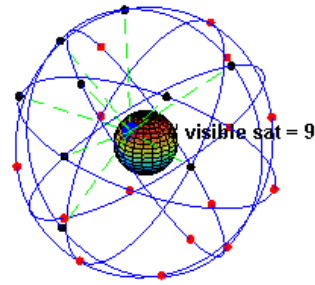
Blank Map



1 reasure!

GPS relies on similar technology to pinpoint locations on the Earth.

We can illustrate this principle in space using lengths of yarn.



Nov 5-9:24 AM

Hanging Octahedron

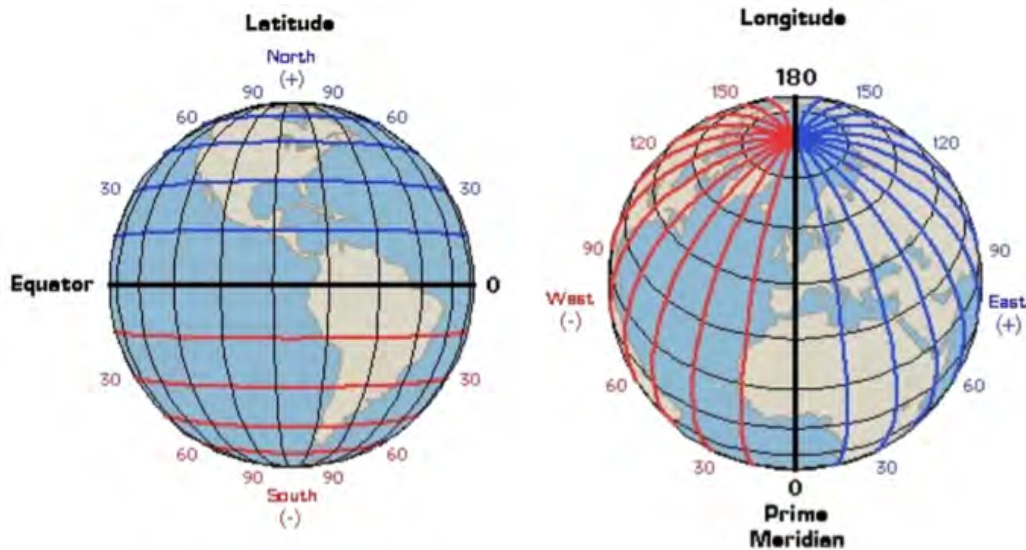
Your team will simulate one of six GPS satellite signals.

As a group, pick a random spot in room (floor or wall) and send a string signal to the Octahedron Receiver.

How many string signals are needed to pinpoint the location of the Octahedron?

Nov 5-9:27 AM

Using GPS to Measure the Earth



How many miles in one degree of latitude?
How many miles in one degree of longitude?

Nov 5-9:28 AM

We took 4th-8th grade students on a walk through the marsh trails, recording GPS coordinates and distances along each leg of the journey.

<http://earth.google.com/>

A: $43^{\circ}49' 22.31''\text{N}$
 $91^{\circ}13' 44.14''\text{W}$

B: $43^{\circ}49' 42.68''\text{N}$
 $91^{\circ}13' 43.12''\text{W}$

C: $43^{\circ}49' 21.33''\text{N}$
 $91^{\circ}13' 28.46''\text{W}$



Nov 5-9:31 AM

1. Calculate how many miles per 1° of **latitude**.
2. Calculate Earth's polar circumference. *24,811*

$$\frac{20.37 \text{ seconds}}{.39 \text{ mi}} \cdot \frac{1 \text{ mi}}{60 \text{ sec}} \cdot \frac{1 \text{ day}}{60 \text{ min}}$$

$$\left(\frac{20.37}{(.39)(60)(60)} \right)^{-1} = 68.92 \frac{\text{mi}}{\text{deg}}$$

Trig extension:

Let n = circumference at equator.

Prove: $n \cos(\theta)$ gives the circumference of the latitude circle at θ° N.

A: $43^\circ 49' 22.31''$ N
 $91^\circ 13' 44.14''$ W

B: $43^\circ 49' 42.68''$ N
 $91^\circ 13' 43.12''$ W

C: $43^\circ 49' 21.33''$ N
 $91^\circ 13' 28.46''$ W

AB \approx 0.39mi

AC \approx 0.22mi



Nov 5-2:00 PM

3. Calculate how many miles per 1° of **longitude** (at $\sim 44^\circ$ N latitude!)
4. Calculate the circumference of the 44° N latitude circle.

Trig extension:

Let n = circumference at equator.

Prove: $n \cos(\theta)$ gives the circumference of the latitude circle at θ° N.

A: $43^\circ 49' 22.31''$ N
 $91^\circ 13' 44.14''$ W

B: $43^\circ 49' 42.68''$ N
 $91^\circ 13' 43.12''$ W

C: $43^\circ 49' 21.33''$ N
 $91^\circ 13' 28.46''$ W

AB \approx 0.39mi

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Nov 5-2:00 PM

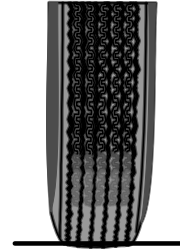
Weighing a Car - Using 2 pieces of paper and a pressure gauge!

The weight w that a given tire supports varies directly with the tire's "footprint" A (the rectangular area where the tire contacts the ground).

In other words:

Weight is proportional to Area, and the constant of proportionality is the tire's air pressure p .

Simply put, $w = pA$.



Oct 29-9:02 AM

How to weigh a car...

...using two pieces of paper and a pressure gauge!



Oct 29-9:07 AM

Weighing a Car - Rainy Day Variation

Devise a method based on this technique to find the **pressure** inside an exercise ball.



Nov 5-9:25 AM

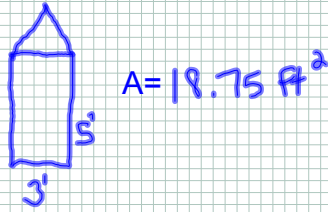
Building a Cardboard Boat

Task: Use the grid paper to design the cross section of a cardboard boat that will hold six people. (For simplicity, your boat will have *vertical* sides.)



Nov 5-9:32 AM

Design your boat's base, and estimate its area in [square feet](#).

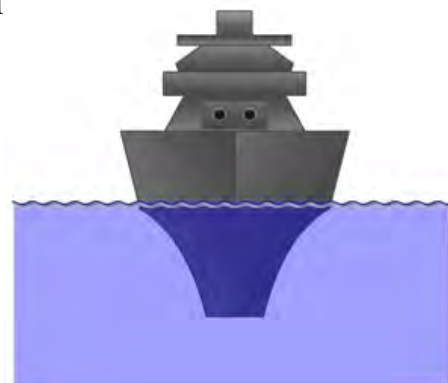


Nov 5-2:29 PM

Archimedes' buoyancy principle states:

An object submerged in water will displace a volume of water equal to the weight of object submerged.

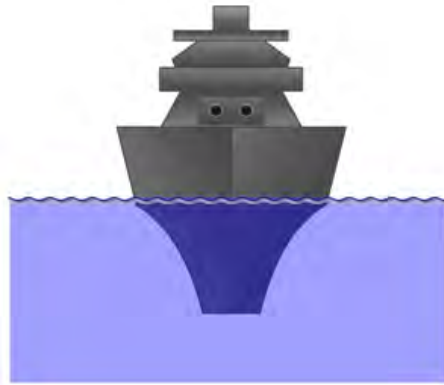
This explains why a heavy object (like a steel ship) can float -- it must simply have enough internal volume to displace enough water to compensate for its weight.



Nov 5-2:35 PM

Water's density is approximately 62.3 pounds per cubic foot.

So a 24,000 ton aircraft carrier needs to displace more than 24,000 tons of water if it is going to float.



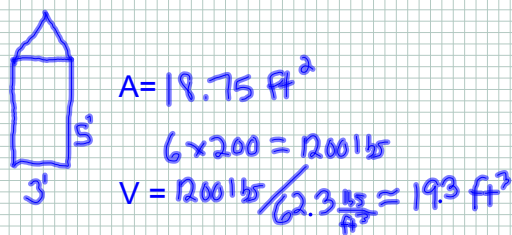
$24,000 \text{ tons} \times 2,000 \text{ pounds / ton} = 48,000,000 \text{ pounds.}$
So it must displace more than:
 $48,000,000 / 62.3 = 770,465 \text{ cu. ft.}$
of water if it is going to float.



So... How high do the sides of your cardboard boat need to be to support the weight of six people? (Remember, the higher the sides, the harder it is to paddle your boat!)

Nov 5-2:54 PM

Perform the appropriate calculations to estimate the number of ft^3 of water that your boat will displace if six 200 lb people are in it. How high will the water rise up the sides of the boat?



$19.3 \text{ ft}^3 / 18.75 \text{ ft}^2 = 1.03 \text{ ft} \rightarrow$ the water will rise 1.03 ft up the sides of this boat if six 200 lb people sit in it.

Nov 5-2:29 PM

<http://www.gabr.com/2002%20Archive/hougpics.html>



He would have won if he could have just reached the pedals!



The tortoise & the hare?



Aren't they supposed to be in the boat, not under it?

Nov 5-3:08 PM

Other activities if time permits:

- Show GSP Toolkit: *3D Gallery*.
- Smartboard demo.

Nov 5-9:36 AM