How to hook students into learning.

(How I try to keep my students interested in studying Trigonometry.)

KAMIL SAFIN
NHECHS
During the first week:
Redefining: the definition of an angle as a result of rotation, (+,-)
sine and cosine of an angle as coordinates of a point on a Unit Circle

New terminology: angles in standard position,
positive and negative angles,
coterminal angles,
reference angles,
quadrantal angles,
new measurement of angles: DMS, radians

My experience tells me that from time to time I need to give my students an opportunity to know how it feels to have accomplished enormously difficult or even impossible (at a glance ☹) task of mental work. But that task has to be really meaningful for them!!!
Problem 1
You are in Quito, Ecuador. As Earth revolves on its axis,
What is the angular speed in rad/h?
What is your linear speed in mph?
Assume that radius of Earth is 3960 mi.
Angular Speed = ratio of the amount of rotation ($\theta$) in radians to the time elapsed.

$$\omega = \frac{\theta}{t}$$

Linear Speed = ratio of the arc length ($s$) to the time elapsed.

$$v = \frac{s}{t}$$

$\blacktriangleright$ $v = \omega r$

$\blacktriangleright$ Arc length ($s$):

$$s = \theta r$$

$\blacktriangleright$ $\theta$ - angle measure in radians, $R$ - radius
Students: We can not answer the question, because there is no data.
Teacher: What kind of knowledge about Earth could help?

1. It takes 24 hours to make one full revolution.
2. One revolution is $2\pi$ radian angle or 360 degrees.
3. The arc length for a full revolution becomes a circumference of the equator.
4. The radius of Earth is given 3960 miles.

\[
\omega = \frac{\theta}{t} = \frac{2\pi}{24} = \frac{\pi}{12} \text{ rad/hr}
\]

15 degrees per hour!

Linear speed?

\[
v = \frac{s}{t} = \frac{2\pi R}{24} = \frac{2\pi 3960}{24} \text{ mph}
\]

\[
\approx 1037 \text{ mph} \!
\]

Commercial jets cruise at about 550 mph (885 kmph), according to MIT.
72. **HEIGHT OF A MOUNTAIN** In traveling across flat land, you notice a mountain directly in front of you. Its angle of elevation (to the peak) is $3.5^\circ$. After you drive 13 miles closer to the mountain, the angle of elevation is $9^\circ$. Approximate the height of the mountain.
What is the approximate volume of a reservoir like this?
$AB = d$

$BB = x$

$cB = h$

$x = \frac{dt \tan \alpha}{\tan \beta - \tan \alpha}$

$h = x \tan \beta$
\[ \sin \theta = \frac{R}{x+R} \]

\[ R = \frac{x \sin \theta}{1 - \sin \theta} \]

\[ V = \pi R^2 \cdot h \]
Closure:
What do I observe in my classroom when I provide problem solving experiences like this?
Puzzlement
Engagement
Collaboration
Excitement
Ownership of learning
Connection with real life
This material is based upon work supported by the National Science Foundation under Grant No. 1556006.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.