Lesson Title – How Big is an Acre?

Overview – The ability to envision the extent of an acre is not only a useful life skill, but it is a worthwhile outdoor group learning activity. Working cooperatively, students will apply basic math skills in determining and marking the bounds of an acre.

Class Objective -

1) employ basic math skills in a novel setting

2) get students outdoors

3) engage students in a cooperative activity with a definitive, visible result

4) facilitate a math activity with real-life application and relevance

Age – upper elementary and middle school

Materials -

100' tape measure (ideally)

Protractors or compasses

Flagging tape or flags; improvise with craft sticks with strips of plastic… anything that can mark a line and be readily visible

Sidewalk chalk will work too on a large, empty, safe, paved surface.

Lesson Plan -

1) Have students take our journals or paper and respond to the following:

Begin with a question to the students: what is an acre?

Ask students to describe what they think an acre would look like on their school grounds or neighborhoods.

How many steps do you think it will take to walk around an acre?

2) Describe the task to the students:

- Tell students they are going to work together to mark the perimeter of an acre-sized square.
- This depends upon class size, but one suggestion is to break students into 4 groups with the following responsibilities:
  - quality control
  - sides 1,2, 3 of the square (can also add a side 4 group)
- The formula for area of a square is $\{side\}^2$ and the area of an acre is 43, 560 square feet so taking the square root of 43,560 square feet yields 208.71 feet which translates to 208 feet and 8.52 (or 8.5) Inches. (Note that all of this can take place outdoors.)
  - present the question to students and have them figure out the dimensions
  - if there is not a square area available but there is a rectangular space, estimate the likely length of one side and calculate the adjoining side; for example, if a long 125-foot-wide space is available, divide the 43,560 feet by 125 feet to get the length of adjoining sides (about 348.5 feet)
  - the area measured can always be smaller – like a common lot size of a quarter acre, etc.
- Distribute/share tape measures, flags, etc. to each group.

- Side 1 will start by planting a marker at the start. This is (hopefully) where the square/shape will close. Quality control can assist in determining where side one will run to ensure that other sides will have adequate room.
- Side 1 will site a straight line to a distant point using student(s) to guide the placing of markers along the way while another student(s) measure the distance.
- Once side 1 is complete, side 2 takes over. Quality control will assist as side 2 measures the 90-degree angle they will take from side 1.
- Side 2 proceeds the appropriate distance. Side 3, again with quality control supervision, takes over and completes that side.
- Query students: how do we close this figure? What should happen to complete the shape?
- Quality control (or a side 4 group) can measure 90 degrees and hopefully see the starting marker right in that line of sight. They can then measure the distance back to the start where it will ideally land at the starting marker. Any deviations can be discussed and are, in themselves, useful learning opportunities.
- Have students could their steps as they walk around the acre.
- Ask them to respond again to the questions posed at the start.
- Ask students to reflect and share (by choice) other thoughts/insights gained from this activity.

<u>Notes and Extensions –</u>

An extension to this activity could be for students to measure the footprint of their house, school, house lot, etc. Alternately, students could explore other shares and using formulas, figure out and measure, for example, a circular acre-sized plot.

Please see attached sheets for another extension option involving erosion and runoff.

Extension:

1. After measuring an acre, ask students how much soil they think runs off their acre in a year (soil loss is measured in cubic meters (m3) or tons per acre or hectare)

USLE = Universal Soil Loss Equation – it predicts the annual soil loss per acre

(derived to determine cropland runoff but can be applied to many types of water erosion)

Ask your students what factors will play a part in determining the amount of soil that will erode.

$$A=R \times K \times L \times S \times C \times (P)$$

A = size of area

R = rainfall and runoff

K = soil erodibility

L & S = factors of slope (length and steepness)

C = crop management factor

P = not always applicable – factor for soil/land conservation practices

Challenge your students to come up with these factors. Ask them what they think the water and soil run off from their acre might be - - give a number 1 to 10 and have them defend their answer using the factors above. If they are able to defend their answer it shows they have a good understanding of erosion and run off. If you are ambitious, you can call your local soil conservation authorities and find out the USLE for the acre of land the students measured.

2. Continue the theme of runoff and soil erosion to ask your students where does the runoff from their measured acre go?

This will lead into a watershed lesson that can end at the Chesapeake Bay. This is a topic that can be covered quickly or in depth.

Some ideas:

Ask students how soil washing to the Bay may affect the Bay.

- It covers bottom feeders like oysters, clams and crabs
- It covers the vegetation on the bottom that animals need to eat and that young need for shelter
- It changes the chemistry of the water and contributes large amounts of plant nutrients (Phosphorus) – so floating algae begin to grow out of control. This shades plants on the bottom that die. When the surface algae dies, it falls to the bottom. Bacteria feed on the dead algae which makes the bacteria multiply uncontrollably. The bacterial use of the oxygen in the water depletes it, resulting in hypoxic or anoxic (low oxygen and no oxygen, respectively) bottom water. This is the cause of the “dead zones” frequently reported in the Gulf of Mexico and the Chesapeake Bay.

Graph showing comparison of runoff and soil loss between several different plots with different vegitation cover.