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Helping Kids Learn – Post #10 4/27/20

STEM: Mathematics – Statistics and Probability

There are a lot of *statistics* in the news these days. Statistics are numbers – facts – about a specific topic. Even though statistics are facts, they can be *interpreted*, shown and thought about, in ways that help the writer's or speaker's point of view. It is important to understand where statistics come from and how they are used. This investigation can be used with a wide range of learners. See Lift the Level below.

Be a Statistician – Sampling

People who work with numerical facts are called *statisticians.* You will be a statistician working with data to do these investigations.

Almost anything you can think of may involve numerical (number) facts. They might be about people, animals, kernels in ears of corn, drops of rain that fall in a certain place, or other things from the natural world. Number facts are used everywhere in our created world, too. They can describe the value of cash (currency), price of stocks, ears of corn that will be harvested this year, or number of trucks in New Jersey. Some number facts are a reasonable size – how many students in your class or players on your favorite pro team. We can count and use those numbers in number operations without much trouble.

Other number facts are huge or difficult to count – how many people in the world, how many blades of grass on the field in a nearby park, how many sunflower seeds in the picture above, or how many pennies in circulation in the U.S, for example. We call them *big data* and statisticians have figured out special ways to work with them.

Investigation 1: Organizing Data Look at the top picture of bees. They are crowded together in what looks like a disorganized blob. If we want to know how many there are, we could try counting them or we could organize them first – the second picture.

Find out how many bees are in the second picture. Write your *method*, way of working it out, here: (Answers will vary with the knowledge of the learner.)

One way to solve the problem is to just count the bees. Mathematicians are always looking for a simpler way. They call it *elegant.* Count the bees in the red box to the left. *Assume* there are about the same number in each row. The red is half a row. There are 4 rows in the picture. So,

7 * 2 = 14 bees in 1 row; 14 * 4 = 56 bees

Younger children can count 1 row and add 4 times.

In the bee investigation, we *assumed* some things: same number of bees in each row and each half-row; and we *generalized*, assumed further that the second picture was an accurate representation of the first picture. That's where we can run into trouble!

Investigation 2: Representative Sampling *Botanists,* plant scientists, and sunflower farmers need to know how many sunflower seeds they can expect to harvest from a year's crop. (See Solutions below.)

Picture 1

1. **Need to Know:** a good approximation (smart guess) of the number of seeds
2. **What helps you?** Knowing how many seeds are in an average sunflower seed head and how many sunflowers you grew would give you a very accurate estimate. It could also take you hours or days. Time to sample!
3. **Where you sample** can make a difference: Compare the number of seeds in the white square to the number in the blue square.
4. **Suppose** there are 800 seeds in one sunflower and 15,000 plants in an acre. How many seeds are there?
5. You try a different kind of seed and get 22,000 plants in an acre but the seed heads have only ¾ as many seeds as in #4. Which crop gets you more seeds?

Picture 2

Lift the Level You can make this lesson deeper and/or suitable for older students by any of the following:

1. Sunflowers are grown for oil; eating by people, birds and other animals; seeds for new crops and home gardeners; flowers; natural dyes; and flour to name a few. The roots absorb radiation from the soil so they are used at nuclear clean-up sites. The formula for crop yield is actually much more refined than the one in Investigation 2. It involves multiplying 2,450 times a specific factor for each of the following: number of plants, size of seed head, size of seed, seed count and seeds in center of the seed head. This is a form of *weighted averaging.* See STEM Online.
2. A simple example of sampling is: cut apart the strip of 10 squares at the bottom of the page. Put an X on 3 of the squares. Otherwise, don't mark or bend any squares. Put all 10 in a container. Close your eyes and pull out one square. Record the result in the chart: X or No X. Put the square back in the container. If you stop with one sample, you won't have a very accurate idea of what's in the whole container (population). If you sample 10 times, you'll get a better idea. The more you sample, the closer your results will reveal the actual contents. You can graph the data, too.

Recording as ~~////~~ will samples easier to count

Sampling Results

X	No X

3. Sampling is used in many areas other than agriculture. Political polls use sampling techniques to predict the outcome of elections. The more complex the sample selection criteria, the closer the results will be to true outcomes. Explain how asking 10 of your classmates how they would vote on the school budget might be less accurate than asking 10 people who can vote and then how asking 10 people who actually voted (*exit poll*) could be more accurate than asking 10 random people. (See Solutions below.)
4. Sometimes polls are not accurate. They don't agree with actual votes or selections. Give three reasons why this might be the case and one idea of how to make a poll more accurate. (See Solutions below.)
5. Sampling involves finding out about a little of something and assuming the same thing will be true of all of that thing. Sampling won't work for every situation. If we need an exact answer, a sample may not work. What is a situation in which you would not want just a sample? (See Solutions below.)

STEM Online

Farmers who grow commercial crops are supported and regulated by state and federal agencies. For more information about calculating crop yields see https://www.ag.ndsu.edu/cpr/plant-science/estimating-sunflower-yield-8-16-12 or https://www.usda.gov/topics/farming/crop-production.

NJ Student Learning Standards Mathematics

3.MD.D, 4.MD.B

Statistics and Probability become formalized in grades 6-12: 6.SP.A, 6.SP.B, 7.SP.A.1 and 7.SP.A.2, 8.SP.A, and HS S-ID.A, HS S-ID.B, HS S-ID.C, HS S-IC.B

Solutions

Investigation 2:

3. There are approximately 14 seeds in the white square; about 25 in the blue square. The center of sunflower seed heads often contains no seeds.

4. 800 * 15,000 = 12,000,000 seeds

These are realistic numbers for sunflowers

5. ¾ * 800 = 600 seeds per plant; 600 * 22,000 = 13,200,000 seeds This crop has a higher yield.

Lift the Level – Answers involve your ideas and opinions; these are suggestions

3. Your classmates might not be as familiar with the issues regarding the school budget, how it would affect property taxes, for example; people who can vote may be better informed or they may not –

sadly, lots of voters do not participate in school elections. Those who actually voted should give you the most accurate survey results. Although, see #4.

4. People may not be well-informed, may change their minds, or may not tell you how they intend to (or did) vote because a voter does not have to reveal for whom or what they voted in the U.S. If you conduct an exit poll (asking people as they leave the voting place) and assure them their answers will be reported anonymously, they may be more likely to give you accurate information.

5. The COVID-19 Pandemic is a good example. If you want to know the likelihood that the people in a particular town or neighborhood have been exposed to the coronavirus, a sample may be useful. However, if you want to know if everyone in an office has no virus at present, you must check everyone, not just sample the group.