Title of Lesson

A Practice Understanding Task

Purpose: Seqirus is a leader in influenza vaccine production. They are constantly using data to decide which strains of the virus to use and how to maximize their growth so they can produce more vaccines. Students will use 1-Proportion Z-test to determine which strains are significantly different from the control. They will then calculate which of the statically significant virus strains produce the most virus cells.

Career Field:
Biopharmaceutical Technology
Lesson inspired by Seqirus

WTCC Associate Program of Study and Contact Person:

NC Math 4 Standards:
SP.2.3 Implement a one proportion z-test to determine if an observed proportion is significantly different from a hypothesized proportion.

Unit Alignment:
NC Math 4 - Unit 7 Statistical Inference
WTCC Math 121
WTCC Math 110
WTCC Math 152

Common Core State Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Prerequisite Skills

- Scientific Notation
- Inference Test
    - Writing informal hypotheses, finding test statistics (z-scores for proportions), finding probability using normal distribution calculations.

Time Required
The time required to complete this activity is approximately ___90____ minutes.

Materials Needed

- Desmos Launch Activity
- Student Activity Sheet

The Teaching Cycle:

Launch: (10 - 15 min)

Assign the Desmos activity as homework the night before to help students with terminology and a refresher on Scientific notation.

Optional Warm Up:

Convert these numbers to scientific notation:

1) 21,000,000 2) 567,000 3) 0.000000976 4) 0.00000452

Convert these numbers to standard notation:

1) 2.6×10^{4} 2) 6.61×10^{-3} 3) 5.42×10^{5} 4) 9.2×10^{-5}

"Vaccines are a big deal." Ask students what they think of the following:

- What skills are necessary for producing a vaccine?
- What types of disciplines are needed when working to produce a vaccine?
- What math concepts that we've discussed do you think are relevant for producing a vaccine?

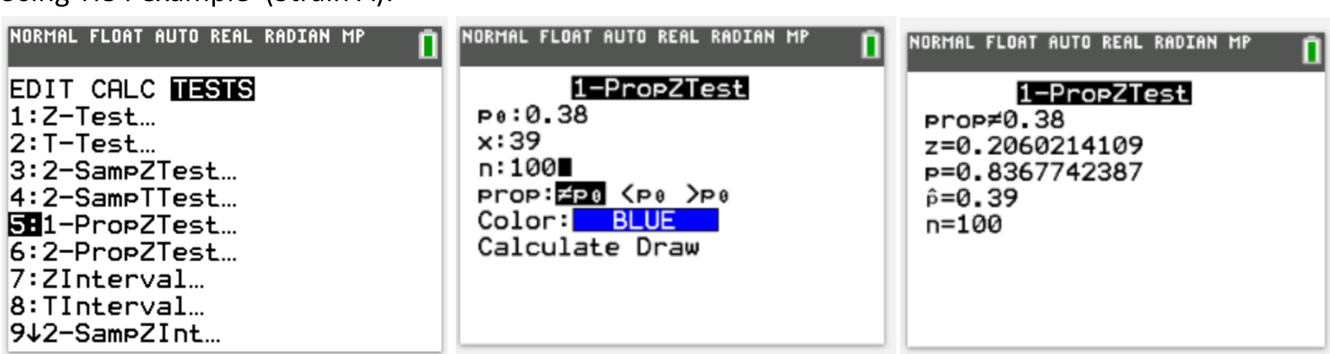
(Play Seqirus Video)

https://www.youtube.com/watch?v=peoSTT0T7u8&list=PLBdwIq8dHqDrmfaF2eESXyZlT9bBYyoYB&index=2

Explore: Students will work in pairs on the Student Activity Sheet for 60 minutes.

Part 1: Students should be able to read directions and complete it on their own in about 10 - 30 minutes based on whether you have them show work or use a website like infrrr.com or MedCal to find the calculations. Students should use a two sided test to find the difference. If they do a one sided test, they will still find B and C to be significant.

Using TI84 example (Strain A):



If you want students to show work:
They can find the test statistic using a graphing calculator, desmos or the formula $z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$

They can calculate the probability using normalcdf on graphing calc, normal distribution calculations in Desmos, or z-table.

Part 2: This may be a more difficult concept for students to understand but should take the pairs about 30 minutes.
You may want to discuss before they start how small Microliter (1/1,000,000 of a liter) and Milliliter are so they have a context of the size of the sample they are working with. You may also want to review scientific notation.

Explanation of the diagrams: In the test tube diagram students are starting with the virus stock which is highly concentrated, taking a small amount out and adding it to the next test tube that has only the dilution medium. They then take a small sample of the 2nd tube and put in the 3rd and it gets more diluted. When they get down to the last few tubes they take a sample, put it under a microscope to see if there are between 30 and 300 cells (that is the countable range). The purple dishes are images of what the virus cells look like as they become more diluted.

Part 2 calculations: Since in part 1 the students should have eliminated Strain A, we completed the calculations for them as an example. Students should follow the Strain A example and complete Strain B and C. There is scaffolding included that can easily be removed for honors classes. Finally students will make a recommendation to Dr. Johnstone as to which one will maximize their yield.

Discuss: After Part 1: Discuss the significance levels of B and C and if there is really a difference between them. If there is no difference between them, then we will need to look at other factors to determine which strain to use. Have students talk about what else Seqirus might look for to determine which strain they should use. Also discuss why it should be a two sided test instead of one sided.
Discuss after Part 2: Why does Seqirus want to maximize the virus if they are manufacturing flu vaccines? What other factors do they think Seqirus looks at besides the amount of cells?

Student Activity Sheet

Answer Key

Assessment Items:

Basic: In planning the transportation and parking needs for a school year, the school district expects 22% of the students to drive to school. During a recent survey of 400 students, they found that 80 were planning on driving to school. Is there evidence that the proportion of student drivers is different than what is expected?

- Why would the district care if more than 22% of the students are drivers? (not enough parking)
- Why would the district care if less than 22% of the students are drivers? (not enough room on the busses, decreased revenue from parking passes)

Honors: Explain why you are more likely to reject a null hypothesis for a two sided hypothesis test than a one sided hypothesis test.