

Name of Lesson	Mystery Disease: A Probability Simulation
Grade Level	Middle School
Subject	Math
Length	1-2 hours
Learning Objective(s)	
<ul style="list-style-type: none"> • Students will be able to use sampling to identify trends in data. • Students will develop an understanding of how probability works. • Students will discuss the benefits/tradeoffs of using sampling to gather scientific data. 	
Materials	
<ul style="list-style-type: none"> • Student handout (accompanying document, MD Handout) • Colored pencils (optional) • Blood profile graphs (accompanying document, Profiles) • Mystery Disease: a Probability Simulation and (STELLA® 8.0 or higher or web access to: http://forio.com/service/netsims/alavigne/myst_dis_intro/index.html 	
Instruction and Assessment	
<p>Introduce Probability</p> <ul style="list-style-type: none"> • Ask students what they know about probability. Use a KWL chart if desired. • Discuss how probability sounds like “probably” and that’s what it is, the study of uncertainty. • Have students tell you where they see probability used in everyday life. Discuss where probability is in each item they bring up. <p>Introduce the Simulation (15-20 minutes)</p> <ul style="list-style-type: none"> • Explain the scenario described on the handout to students (accompanying document, Mystery Disease: a Probability Simulation) 	

Instruction and Assessment (continued)

- Discuss how the simulation works including the importance of recording information during the simulation. Hand out blood profile graphs and the handout, Mystery Disease: a Probability Simulation (accompanying documents). Discuss as needed for clarification.

Have students run the Mystery Disease Simulation (\approx 30 minutes)

- Students should follow directions and respond in their handouts as they work through the computer simulation. They should record their predictions as to what they feel the blood profile would be for the Mystery Disease.
- Assist individual students in running the simulation as needed.
- Note: Do not share the answers below or even hint that a student's diagnosis for a patient may be incorrect while running the simulation. Based on the discussion, the teacher can decide whether or not to share the actual patients' diseases during the debrief conversation.
 - Patient 1: 60% Red, 30% Blue, 10% Yellow (cancer)
 - Patient 2: 40% Red, 50% Blue, 10% Yellow (mono)
 - Patient 3: 50% Red, 10% Blue, 40% Yellow (mystery disease)
 - Patient 4: 80% Red, 20% Blue, 0% Yellow (strep throat)

Closure/Debrief (40-50 minutes)

- Have students meet in small groups (3-4 students) and compare their results. They should discuss why different diagnoses may have occurred and try to come up with what they feel is the correct diagnosis for each patient.
- Discuss some of the following questions with the whole class:
 - Why did some people have a different diagnosis for the same person? e.g. Not enough sampling or inaccurate results even with enough sampling. How might the patient respond to this conflicting information? e.g. He might be very upset or confused.
 - If a patient is misdiagnosed, what effect might that have on his/her life? e.g. Could cause mental trauma and anguish.
 - Explain and give examples of positive and negative tradeoffs.
 - What are the positive and negative tradeoffs involved in making a diagnosis early in the sampling procedure vs. later? e.g. If early, then you can begin treatment sooner, but you could have a misdiagnosis. If later, then treatment cannot begin as soon, the condition could be too far advanced, accurate diagnosis is more likely. Also consider what the tradeoffs would be as related to the costs e.g. patient's ability to pay, doctor's reputation, health care organizations, etc.

Instruction and Assessment (continued)

- What made you decide when you had taken enough samples to make a diagnosis? e.g. The shape of the data was the same as one of the blood profile graphs.
- Why do we use random sampling? e.g. To get a picture of what the “whole” looks like even though you cannot see the “whole” at the same time. What are the benefits and tradeoffs of random sampling? e.g. benefit: fairly accurate picture of the “whole” tradeoff: Always a chance that you will always pull out the exact same piece of information e.g. red
- Have students complete the last four questions on their handout. If they have already answered them, have them self-assess and make additions/changes based on new understanding developed during the debrief discussion.

Assessment:

- Formative:
 - Based on information they gather during the sampling process, have students make predictions as they are running the simulation.
 - Have students respond (orally and/or in writing) to a variety of questions during the debrief conversation.
- Summative:
 - Assess the last four questions on the handout for the students’ ability to explain their decision-making process and at least one benefit and one tradeoff of taking many vs. few samples.

Extension(s):

- A 26-minute video, entitled “Understanding: Probability and Odds” is available online (unitedstreaming.com) as one potential resource for introducing the concept of probability.
- The graphs can be disabled within the simulation, allowing students to see only how many of each color are being drawn. This would then force students to create their own versions of displaying the data, as well as make the diseases harder to diagnose.
- Orally or in writing, have students reflect upon the process from a variety of perspectives: that of the researcher/doctor; that of the patient; and that of the insurance company.

Acknowledgements

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