Hunger Games: What are the Chances

for 6th-8th Grade

Math Learning Goals:

- Discuss a probability continuum and the likelihood of an event.
- Design spinners that give specified outcomes.
- Construct a function that represents the probability a student might be selected to be a contestant in 'The Hunger Games'.
- Demonstrate an understanding of probability.
- Compute probabilities from simulations incorporating organized lists and tree diagrams.
- Develop a probability model and use it to find probabilities of events.

Materials Needed:

- Rope or string
- Clothespins (1/student plus some extras)
- Index Cards (1/student plus some extras)
- Many strips of color paper of the same size for the drawing (approximately 10/student – some will need more and others less)
- Two Containers
- Hunger Games Activity Sheet (1/student)

Before the Activity:

Probability Continuum Activity

Prior to working on the activity sheet, engage students' prior knowledge of probability by using a long piece of rope with cards labeled 0, 1/2, and 1 pinned to the rope with a clothes pin. Each student is given a similar card and instructed to write her name and then estimate where she thinks her chance of being selected (in the reaping) might be positioned on the probability continuum. This activity can be revisited later as more information is discussed so that students can reposition their names (individual card) and share why they felt they should move their card to another part of the continuum.

Discussion Questions:

- What part of the probability continuum represents an impossible event?
- What part of the probability continuum represents a certain event?
- What does the 1/2 represent on the probability continuum?
- How did you decide where to place your name?
- Can you predict a person in the class who might place their name between 1/2 and 1?
- Why do you think the person might belong in that area?

During the Activity:

1. Entries in the Reaping

Prior to the beginning of this activity, it is ideal for students to have read The Hunger Games or have watched the movie. Begin with a discussion of the storyline of The Hunger Games and ask students to share their own insights about the story. Using the random integer function on their calculator (or coins or number cubes), it should be determined whether students need tesserae (additional food sources). If the student received a 0 (or heads), then their family is not starving and

they do not have to submit extra entries in exchange for food resources. **If they received a 1 (or tails), then their family is starving, and they will have to submit the maximum number of extra entries each year since they were 12 to feed their family.** Next, specifically discuss the reaping process from the book. After all students calculate their final number of entries based on age and received tesserae,

Example: If you are 14, your baseline number of entries would be 3. If you have five family members, the entries at age 14 would be 5x3=15. Thus, the total amount of tesserae you need would be 18.

The students repeatedly write their first and last names on pieces of paper and place the determined number of entries with their name into either the boy reaping or the girl reaping lotteries (one of the two containers).

Discussion questions:

- What factors cause you to have a particular number of entries?
- Is it fair that some students must place entries into the reaping because they need tesserae for their family?
- Who of your classmates do you predict has more or less entries than you? Why?

2. What are the chances?
After all entries are placed into the "boys" and "girls" containers, ask students to identify what information they need to calculate their probability of being selected for The Hunger Games. For students to determine the probability, they need to know the total number of entries in each container. After finding the total number of entries for each of the containers for boys and girls, pose questions from the activity sheet items to engage students in thinking about the fairness (or unfairness), probabilities, and possible outcomes.

Items 1–2 align with Part 1: Entries in the Reaping.
Items 3–4 align with the individual student's chance of being selected for The Hunger Games.
Items 5–12 are follow-up questions that relate the mathematics to the story and help students imagine themselves as characters in the story.

Additional Questions:

- What operation occurs with that variable? (question 5)
- What if your calculator generated a zero, would your equation still work? (question 5)
- How would your answers to question 3 and question 4 have differed if you had instead received tesserae (or not received tesserae)?

We encourage strategically grouping students in pairs or groups of three to work on the activity sheet together. They will likely need guidance when thinking about these questions, but we recommend being cautious about giving them too much help as the activity sheet is much richer when they make the discoveries on their own.

3. Closure
After completing the activity sheet, discuss the questions, such as question 9 and question 12 because they lead to the most **misconceptions,** with the entire class. Samples of student work for question 5 and question 12 are shown in figure 3 and figure 4 in the article. Use this student work to engage your students in a discussion that critiques the reasoning of the other students demonstrated in the work samples.

Finally, engage students in a discussion on fairness. You may find that your students have two different ways to view the fairness of the reaping—as the fairness of one entry in the reaping as a random selection or as the fairness for the contestants competing in the games. This could lead to an engaging discussion about fairness in a context relevant to middle grades students.

Possible closure questions:

- Is the reaping fair?
- Is the reaping random? Does randomness ensure a fair game?
- Are The Hunger Games fair?

Alternate Reaping Simulation: Consider moving the reaping process to an alternative approach. In this case, pool the districts (all of the entries from the "boys" and "girls" containers from all of your class periods) as well as pool the boys and girls. This works best if you use different colored paper for each class period. A teacher can group together all results from their classes, or bring in other classes' entries to mix together making a total collection. Using the number of pooled classes will indicate how many girls and boys will be chosen. For example, if five classes are grouped, then ten entries selected will be pooled to represent the ten children that would have been selected from the five individual districts (two each).

Ask students to consider the following questions before names are drawn:

- Is it possible that not all [five] districts will be represented?
- What is the probability that one district will not be represented?
- How would we find that out?
- What is the probability that a district will be over-represented (have more than two students from their district)?
- Can you predict which one of the classes might be selected more frequently than another?
- What is the probability that all girls or all boys would be selected?

As you start to make drawings from the full pool of entries, you may want to consider asking the following questions:

- What do you think the chances are of [a particular student, a girl, a boy, a student from X's class] being drawn?
- What would happen if we selected more names than the ten?
- Are you more worried or less worried that your name will be selected with this reaping system than the reaping system in the book?
- How does the size of the trial (number of draws) matter?

Teacher Reflection

- To what extent did this lesson make the mathematics relevant? To what extent did this lesson build on students' prior knowledge?
- What adaptations might strengthen this lesson?
- In what ways did my students build understanding of the concept of fairness as a result of this lesson?
- In what ways did my students build understanding of the concept of chance probability as a result of this lesson?

TN Math Standards:

6th Grade:

Expressions and Equations

2a.) Write, read, and evaluate expressions in which letters stand for numbers. Write expressions that record operations with numbers and with letters standing for numbers.

6.) Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

7th Grade:

Statistics and Probability

5. Understand the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that neither unlikely nor likely, and a probability near 1 indicates a likely event.

7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observe frequencies; if the agreement is not good, explain possible sources of the discrepancy.

b.) develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.

Expressions and Equations

4. Use variables to represent quantities in real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

a. Solve word problems leading to equation of the form $px+q=r$ and $p(x+q)=r$, where p, q, and r are specific rational numbers. Solve equations of this form fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

8th Grade:

Statistics and Probability

4. understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

Adapted by Virginia Parkman, Kelly Sturner, and Suzanne Lenhart

Sources:

Bush, B. S., Karp,S. K., Hunger Games: What are the Chances, The National Council of Teachers of Mathematics, 2012.

Your Name: _____

Hunger Games: What are the Chances?

1.) On the basis of your current age and whether you need tessarae, calculate how many entries you would have in the reaping lottery this year. (If you needed tessarae for this year, do not forget to add the entries of tessarae from past years.) Show all work.

2.) Place your entries in the boy drawing or girl drawing (the total from question 1) using small pieces of paper from your teacher.

Check when complete ___

3.) Given the grand total number of entries in your class (district) and for your gender, what is the probability that your name would be selected? Express your answer as a percentage rounded to the nearest hundredths. Show work.

4.) Suppose you were a student in another class period. Would your chances (or probability) of being selected for the Hunger Games be the same? Why or why not?

5.) Write an algebraic equation representing a person's total number of entries for a given year. Define all possible variables, and write your equation below.

6.) If 11,500 total entries of your gender were in your district, and 42 of that number were your entries, what is the probability that your name would be drawn for the Hunger Games? Express your answer as a percentage rounded to the nearest hundredths. Show all work.

7.) How many entries would you have if you were 18 years old, had 9 family members (including yourself), and received tessarae for each of them (and yourself) every year starting when you were 12? Show all work.

8.) Suppose you were Katniss and the name of your same-sex sibling was drawn for the Hunger Games. Would you volunteer in his or her place? Why, or why not? Be serious.

9.) During the Hunger Games in the book, 24 contestants fight to the death until only 1 is standing. The last person standing is declared the winner. How many orders are possible in which the contestants could have been eliminated? Assume that only 1 person can be eliminated at a time. Show all work.

10.) Similar to horse racing, citizens at the capital placed bets on who would win and lose the Hunger Games. How many orders are possible for the first, second, and third person eliminated? Assume that only 1 person can be eliminated at a time. Show all work.

11.) Suppose you were in a mathematics class of 24 students, and each student randomly draws the name of a contestant from the Hunger Games. If your contestant wins the Hunger Games, you win a prize.

a.) Is this a fair game? Why, or why not?

b.) If it were a fair game, what is the probability of your contestant winning the Hunger Games? Assume that there is only one winner. Express your answer as a percentage rounded to the nearest hundredth. Show all work.

12.) Suppose that each contestant at the Hunger Games confronts all the other contestants but none die in the process. How many total confrontations would there be for each contestant to confront all the other contestants exactly one time? Use drawings or lists to help organize your thoughts. Show all work.