What Are My Chances?

A lesson plan designed to teach students about **theoretical** and **experimental** probability

Enclosed is an exercise designed to give students a better understanding of probability. You may distribute all materials inside the lesson to the students. The introduction page can be read individually by students or you can utilize the following video which explains the lesson on Youtube.

https://www.youtube.com/watch?v=Ba4QhLV4XB4

The lesson is designed so that after a brief introduction, students will have the chance to perform 5 different experiments related to probability. Students will then complete an assignment and engage in discussion related to probability.

This lesson conforms to the following Common Core Standards:

Grade 6, Ratio & Proportion

CCSS.Math.Content.6.RP.A.1
Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."

Grade 7, Stats & Probability

CCSS.Math.Content.7.SP.C.5
Understand that 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 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

Grade 7, Stats & Probability

CCSS.Math.Content.7.SP.C.6
Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

PROBABILITY

Probability, in mathematical terms, is simply the likelihood of an event happening. It is one of the math concepts you will use for the rest of your life. Computing probability can be easily done by using the following formula:

P = # of desirable outcomes / # of possible outcomes

Have you ever picked heads during a coin toss? You have one desirable outcome, out of two possible outcomes. Your probability of guessing correctly is 50%.

You've likely heard probability used in your daily life. Sometimes it is referred to as the "odds" of something happening.

Here is the probability for different events:

Picking the ace of spades out of a deck of cards	**2%**
Getting struck by lightning	**1 in 960,000**
Becoming President of the United States	**1 in 10 Million**
Getting a Royal Flush in poker	**0.0032%**
Winning the Powerball	**1 in 292 million**
Being dealt BlackJack	**About 5%**

Probability can be represented in various ways. When playing games of chance, players regularly compute their odds. If you are playing any of a multitude of card games, you are interacting with probability constantly. Even popular board games likes Monopoly rely on probability to determine the outcome. Calculating the odds of an event happening is used in a variety of ways.

For our exercise, we will examine **experimental** vs. **theoretical** probability:

The theoretical probability of flipping a two sided coin and it landing on heads is 50%. There is only one desired outcome but two possible outcomes. The theoretical probability of rolling a six sided dice and it landing on the number one is 1 out of 6, or roughly 17%. In theoretical probability, you divide by the number of outcomes (e.g., There are 6 sides on a die so there are 6 possible outcomes). In experimental probability, you divide by the number of trials (e.g., If you only toss a die 4 times, then you divide by 4, not 6).

Remember, for this lesson, you will need to know that there are 52 cards in a standard deck. There are four suits and 13 cards of each suit. There are also 6 sides to a standard dice. And of course, 2 sides to a coin.

TEACHER INSTRUCTIONS

1 Distribute the Student Packet (contains Introduction & Activity Sheet).

2 Have students read the Introduction Sheet (they can read it individually, you can read it to them, or you can watch our pre-made introduction on YouTube).

Have students take out the What are my Chances Worksheet and complete it. The students will be responsible for completing 5 experiments, designed to give them a better understanding of experimental probability.

3 Whether you break the class into groups working at their desks or set up stations, each individual student should conduct each of the 5 experiments. This will give more data to pool later in the lesson. As students conduct their experiments, you can tie in the theoretical probability by asking students questions like these as a reminder:

What is the likelihood of getting a heads?	**50%.**
What is the likelihood of getting a 4 on the die?	**About 17%.**
What is the likelihood of picking a red card?	**50%.**
What is the likelihood of picking a diamond?	**25%.**
What is the likelihood of picking the 5 of diamonds?	**About 2%.**

4 When students finish the experiments in Questions 1–5, discuss their results and any observations they may have. Then, have students use their calculators to find the percentages for their experiments. Since the sample sizes are only 10 for each experiment, many will most likely not match the theoretical very well. This is expected and will enrich the discussion later when students combine all the class data. Ask students if it is useful or a good prediction for probability if they only use 10 samples. Have students share their thinking as to what number of trials may be needed to get a sample that could better be used to predict outcomes.

You can give several examples of times where small numbers are not good predictors of large numbers results:

- Would it be fair to give a report card grade based on 1 test? or 1 assignment?
- Would it be accurate to conclude that a coin will always come up heads after flipping it once?
- If 50% of students in a class said they like country music, do you think that means 50% of students in the whole school like country music?
- Could you assume that if a person throws a basketball once and makes a basket from half court, then they are a good shooter?

Combining their experimental results with the questions above, the class should agree that only a few trials is not enough to make predictions. This should motivate students to decide that combining the entire class data together will probably show more patterns. First, have students combine their group's data, and then have the groups share their data on the board to combine everyone's data together.

Wrapping up this lesson, discuss and make comparisons with the students about theoretical and experimental probability. Depending on your data, there should be a pattern as the experimental data begins to get closer to the theoretical calculations. It is possible that even with a class of data, some results will still be far from the theoretical probability. If this arises, it should add to the discussion of the nature of probability. **You never know what is going to happen with chance.** Probability is just a tool to make predictions.

ADDITIONAL ASSESSMENT OPTIONS

Ask the students to write a reflection about how theoretical and experimental probability are related and different.

Have students design their own experiment and go through the questions on the What Are My Chances? Activity Sheet.

Read to students a list of events such as the following and have them decide if each is theoretical or experimental:

- Maria flipped a coin and got 6 heads out of 10 flips.
- Carlos said the chances of rain today are 30%.
- James said he has a 70% chance of making a free throw because yesterday he made 7 out of 10.
- Six students out of 18 students in one classroom caught a cold, so the nurse said about 33% of the students in school would catch the same cold.
- Julia placed an eraser under one of four cups and told Patrick he had a 25% chance of finding the correct cup.

Probability and Gambling go hand in hand. By the end of the lesson, you should have a feel for the real odds of certain games and situations. Gambling establishments around the world make billions of dollars because of probability. The entire city of Las Vegas is a fixture in American culture because people have found a way to make money off probability. While gambling is illegal for minors, it is still important to learn about the odds and ways you can protect yourself.

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FLORIDA COUNCIL ON COMPULSIVE GAMBLING

Probability and Prediction

Understanding Probability

To make an informed decision about gambling, you need to understand the mathematical concept of probability. Known more commonly as "odds," probability is the likelihood that an event will turn out a certain way. In everyday life, doctors calculate the odds that a specific drug will be able to prevent or fight illness. A weatherman predicts a forecast based on the odds that weather fronts would move in an anticipated way. And in gambling, people risk their money or other items of value hoping that the odds of winning are greater than the odds of losing.

Describe a situation in which you've made a decision based on probability or "odds."

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Probability (P) is defined mathematically by the following equation:

$$P = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$

Use this equation to figure out the probability of guessing the right answer on a true-false test.

$$P = \frac{1}{2} \quad \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}} = \frac{\text{the right answer (1)}}{\text{true or false (2)}} = .5 \text{ or } 50\%$$

In other words, if you bet money that you could guess the right answer to a true-false question you did not know, the probability or chance of you guessing the right answer is 50 percent.

Now, use the above equation to determine the probability of guessing the right answer on a multiple choice test that gives you four answers from which to choose.

P= ___

Making Predictions

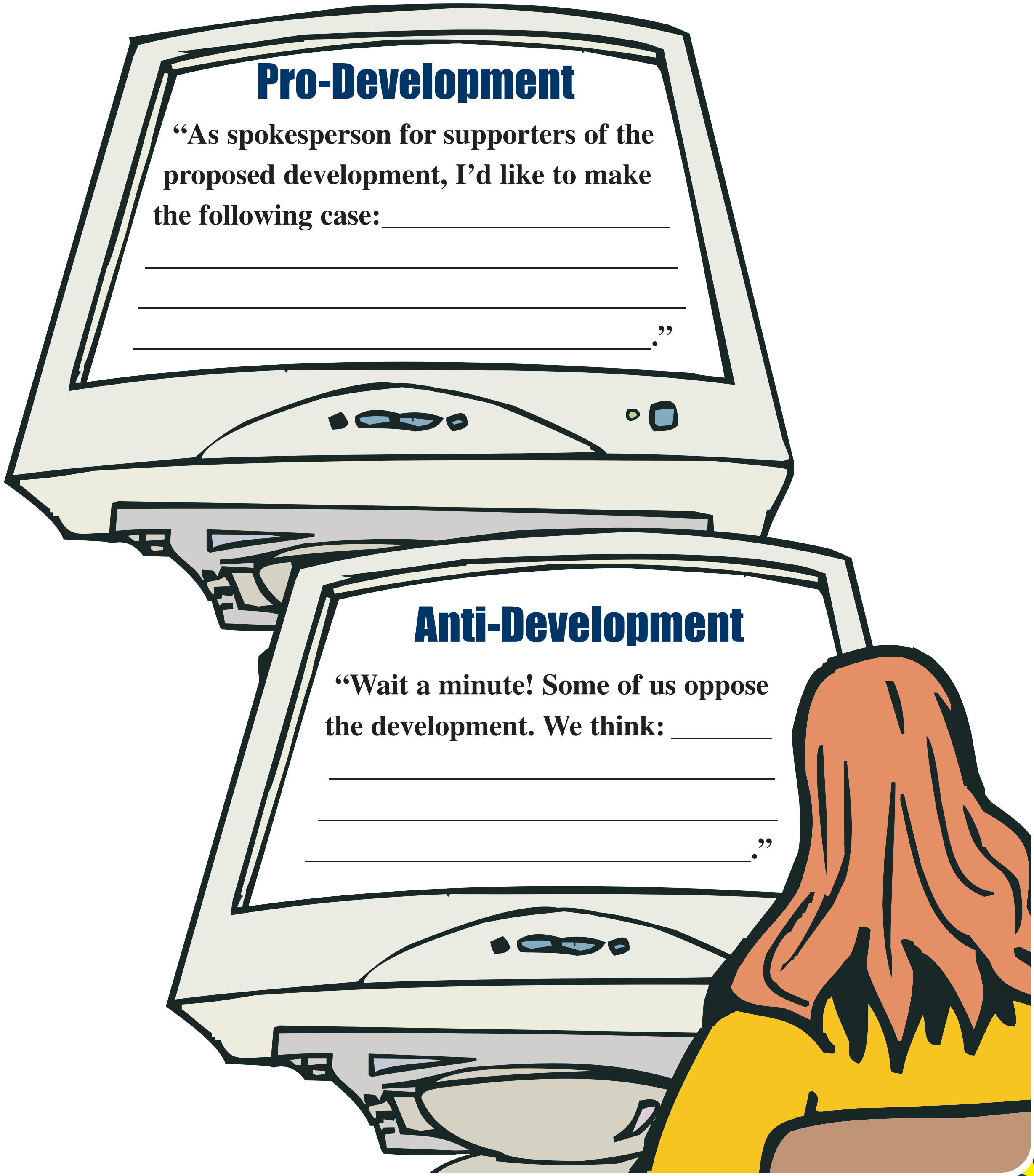
Every day, people use facts and statistics to help them make predictions. They decide on a course of action based on their understanding of a set of data. Using the facts presented in the fictional case below, test your own powers of prediction as you make a case both for and against a proposed gambling development.

Scenario:

The City of Oak Park has been deteriorating economically. The major manufacturing industry left the area five years ago and existing businesses are struggling. The mayor of Oak Park is making an effort to revitalize the area. One idea for development includes the building of a land-based casino with full resort and hotel. Use the following data to help formulate two arguments: one for the development and the other against.

Population	1 Million
Adolescents (under 18 years)	20%
Adults (18-54)	60%
Older adults (55+)	20%
Children living with two parents	65%
Children living with one parent	35%
Couples with no dependents	15%
Single persons (never married, separated, widowed or divorced)	32%

Prevalence of Problem Gambling (ranging from serious to severe difficulties)	
Adults (18+)	3.5%
Adolescents (under 18 years)	6.0%
Unemployment Rate:	10%
Bankruptcy Filings:	Increased 18% in the past 5 years



Which argument do you think is more convincing, the one:
❑ for or ❑ against the development? Explain your answer. ________________
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A Different Perspective

If you find yourself in a situation in which you're making predictions or figuring out the odds of something happening, don't forget to consider the ideas of randomness and independence. People who become problem gamblers often do not understand how these concepts affect their chances of winning.

Randomness means there is an equal chance of different outcomes occurring. For example, when tossing a coin, rolling dice or picking lottery numbers, any possible outcome has the same likelihood of taking place. Just as you made predictions about the effect of a gambling development on the fictional city of Oak Park, gamblers try to predict their chances of winning. Often, belief in luck or superstition will outweigh the mathematical logic of randomness. This is a mistake that can lead to problem gambling behavior.

Consider the prediction scenario from pages 2 and 3. In your opinion, was there an equal chance of the city's economy improving, staying the same or taking a downturn after the manufacturing industry left? ❑ yes ❑ no
Use the concept of randomness to explain your answer.____________________

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Independence means the outcome of one event does not affect the outcome of a later event. Rubbing the numbers off a scratch-off card and finding you've lost does not affect the likelihood of either winning or losing with the next scratch-off card you buy. In both games of chance and skill, problem gamblers mistakenly confuse independence with dependence. For example, just because you win one arcade game does not mean you're more likely to win the next time you play. However, someone might "up the stakes" on the second game, thinking the two events are dependent rather than independent.

If the mayor hopes the development of a casino will improve the economy, is this an example of independence? ❑ yes ❑ no Explain. __________________

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There is help

If you or someone you know has a gambling problem, don't try to handle it alone. Reach out and call the Florida Council on Compulsive Gambling's 24-hour toll-free confidential HelpLine: 888-ADMIT-IT.