



# STEM SCHOOL CHATTANOOGA

## Mini-PBL

### Unit Plan Template

## Probability: Games of Chance

Algebra 2

### Standards (Learning Targets)

LT14 Probability: I can use probability to make decisions

Grade Level	10th	Unit Length	2 Weeks
Mini-PBL Overview	In this unit, students will design a game of chance and use that game as a platform to discuss one or more types of probability. In particular, students will focus on conditional probability, probabilities of unions and intersections, and probabilities of multiple events. Mutually exclusive events and independent vs. dependent events will also be addressed in student products.		
Mini-PBL Driving Question	How can we, as the lead organizer for Chattanooga's new Casino Night charity fundraiser, create a game of chance that embeds "and", "or" and "conditional" probabilities to the game players?		
Hook Event	<p>Students (assuming the role of planner for Chattanooga's Casino Night charity fundraiser) will be testing out potential games for the event. They will be evaluating the playability of the game, the odds for "winning" out in the game and the charitable payouts associated with those outcomes.</p> <p>Three games will be available for students to play. (For larger classes--two sets of the same three games could be set up and the class split in two with half rotating through set 1 and the other half rotating through set 2.)</p> <ol style="list-style-type: none"> <li>1. A game in which the player spins a spinner and rolls a die. The player may place a "bet" on certain outcomes and the payout is designated based on the odds.</li> <li>2. A game in which the player may draw three cards (without replacing them) from a deck of cards (a premade set with varying colors and numbers). Wagers/payouts will be based on a list of certain possible outcomes.</li> <li>3. A lottery type game in which the student chooses a series of numbers, and numbers are chosen randomly. Payouts are awarded based on the amount of numbers matched.</li> </ol> <p>Each student will have an evaluation sheet on which they will evaluate and reflect on the following questions:</p> <ul style="list-style-type: none"> <li>• How playable is the game?</li> <li>• Is it too easy/too hard to win? (rated on a scale with room to explain their response)</li> <li>• Are the payouts too big/too small/just right, with consideration toward making it a profitable event for charity?</li> </ul> <p>Following the period of gameplay, we will debrief as a group with a discussion of some of the probability vocabulary built into the games. We will discuss student responses to the game evaluation questions. Following the debriefing, the teacher will introduce the rubric and group students. Groups may begin writing contracts.</p>		
Scaffolding Activities	<p><b>Class Activities</b></p> <ul style="list-style-type: none"> <li>• Khan Academy: Students will complete lessons from Khan Academy as listed in the Digital Resources below.</li> </ul>		

- Product design time: student will spend time working on the design of their product
- Contract Writing: PBL Teams will write a contract to define group member participation and interventions for failure to complete assigned work.
- Quiz: In class assessment covering all probability topics.

#### **Station Activities**

- Review: There will be 1 day of review stations prior to the quiz which will each cover a feature of probability. Each station will have a problem set to work (from the mathbitsnotebook.com in Digital Resources below). The stations will cover the following topics:
  - Two way frequency tables
  - Sets and Probability
  - Mutually Exclusive Events
  - Independent and Dependent events

#### **Workshops**

The workshops will be optional activities offered to students who would like to ask questions and have more personalized instruction on the following topics.

- Conditional Probability: workshop-focusing on helping students understand the difference between and/or probability and conditional probability.
- And/or probability: workshop focusing on how to calculate probability of intersecting events.
- Venn Diagrams and two way frequency tables: A workshop focused on organizing probability information into Venn Diagrams.
- Independent vs dependent events: A workshop focused on determining whether a series of events is independent or dependent and using the information to determine the probabilities.

#### **Focus Groups**

Focus groups will be assigned first based on those students who have not completed Khan Academy lessons on the topics listed below. Completing the lessons includes completing all practices to the “practiced” level on Khan Academy.

Following the quiz, there will be another round of focus groups assigned based on those who do not achieve at least a PR on the assessment.

Focus groups will concentrate on the following topics:

- Venn Diagrams and Two Way Frequency Tables: A focus group on helping students organized probability information into Venn Diagrams.
- Conditional Probability: focus group centered on helping students understand the difference between and/or probability and conditional probability.
- And/or probability: focus group centered on how to calculate probability of intersecting events.
- Independent vs dependent events: A focus group centered on determining whether a series of events is independent or dependent and using the information to determine the probabilities.

#### **Mini-PBL Teams**

- Students will be in groups of three for this Mini-PBL. Students will choose their own groups.
- Fab Lab Work Time: students groups will each have scheduled time in the Fab Lab to complete work on their design. Fab Lab work times will be scheduled to give each team an equitable amount of time.
- Written report: teams will work together to create a report about the probabilities associated with their product, which outcomes will be considered a “winning” outcome, and the payouts associated with those outcomes.

#### **Digital Resources**

- <https://mathbitsnotebook.com/Algebra2/Probability/PBoutline.html>
  - Two way frequency tables
  - Sets and Probability
  - Mutually Exclusive Events
  - Independent and Dependent events
- [Khan Academy Lesson Guide:](#)
  - Basic Theoretical Probability
  - Probability Using Sample Spaces
  - Addition Rule
  - Multiplication Rule for Independent Events
  - Multiplication Rule for Dependent Events
  - Conditional Probability and Independence

<p>Calendar Overview</p>											
	<p>Monday</p>	<p>Tuesday</p>	<p>Wednesday/Thursday</p>	<p>Friday</p>							
<p>Hook Event</p>	<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Contract Writing</li> <li>Khan Academy</li> </ul>	<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Product design time</li> <li>Khan Academy</li> </ul> <p>Workshops:</p> <ul style="list-style-type: none"> <li>Venn Diagrams and Two-Way Frequency Tables</li> <li>And/Or probability</li> </ul>		<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Khan Academy</li> <li>Product Design Time</li> </ul> <p>Workshop:</p> <ul style="list-style-type: none"> <li>Conditional probability</li> </ul>							
<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Khan Academy</li> </ul> <p>Mini-PBL Teams:</p> <ul style="list-style-type: none"> <li>Fab Lab Work Time</li> <li>Written Report</li> </ul> <p>Workshop:</p> <ul style="list-style-type: none"> <li>Independent vs dependent events</li> </ul>	<p>Focus Group:</p> <ul style="list-style-type: none"> <li>and /or probability</li> <li>Venn Diagrams and two-way frequency tables</li> </ul> <p>Class Activity:</p> <ul style="list-style-type: none"> <li>Khan Academy</li> </ul> <p>Mini-PBL Teams:</p> <ul style="list-style-type: none"> <li>Fab Lab Work Time</li> <li>Written Report</li> </ul>	<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Khan Academy</li> </ul> <p>Mini-PBL Teams:</p> <ul style="list-style-type: none"> <li>Fab Lab Work Time</li> <li>Written Report</li> </ul> <p>Focus Groups:</p> <ul style="list-style-type: none"> <li>Conditional probability</li> <li>Independent vs dependent events.</li> </ul>		<p>Stations Activity:</p> <ul style="list-style-type: none"> <li>Review</li> </ul>							
<p>Class Activity:</p> <ul style="list-style-type: none"> <li>Quiz</li> </ul>	<p>Mini-PBL Teams:</p> <ul style="list-style-type: none"> <li>Fab Lab work time</li> <li>written report</li> </ul> <p>Focus groups:</p> <ul style="list-style-type: none"> <li>all topics</li> </ul>	<p>Culminating Event</p>									
<p>Culminating Event</p>	<p><b>Product</b></p> <ul style="list-style-type: none"> <li>The students will create a game of chance that requires the use of either conditional probability, compound probability, or intersection/union probability in order to calculate the probabilities of the outcomes.</li> <li>Students must use digital fabrication as a part of their creation. Examples include: cards, dice, spinners, a “The Price is Right” style game (like Plinko), etc. They may use the Carvey, ShopBot, laser cutter, or vinyl cutter in order to meet this requirement.</li> </ul> <p><b>Showcase</b></p> <ul style="list-style-type: none"> <li>Class will play the games created by the teams in a mini “Casino-style” event. One team member must man their game at a time while other students take turns visiting the games to play. Team members will each take an equal portion of the time at their game (for example a 3 member group in a 45 minute period will each take 15 min at their own game and 30 minutes playing other students games).</li> </ul>										
<p>Common Assessment</p>	<table border="1"> <tr> <td>  </td> <td colspan="3" style="text-align: center;"> <p>Mini-PBL Rubric</p> </td> </tr> <tr> <td></td> <td style="text-align: center;"> <p><b>Advanced</b></p> </td> <td style="text-align: center;"> <p><b>Proficient</b></p> </td> </tr> </table>					<p>Mini-PBL Rubric</p>				<p><b>Advanced</b></p>	<p><b>Proficient</b></p>
	<p>Mini-PBL Rubric</p>										
	<p><b>Advanced</b></p>	<p><b>Proficient</b></p>									

<p><b>LT14 Probability</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Earn Advanced on LT14 Quiz</li> <li><input type="checkbox"/> Written report addresses the following: <ul style="list-style-type: none"> <li><input type="checkbox"/> Whether or not the events are Mutually Exclusive.</li> <li><input type="checkbox"/> Whether a series of outcomes is Independent or Dependent.</li> <li><input type="checkbox"/> Whether the game could be adapted to change the status from Independent to Dependent or vice versa.</li> <li><input type="checkbox"/> The payouts associated with winning ensure that the "house" will still be profitable.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Earn at least PR on LT14 quiz</li> <li><input type="checkbox"/> All assigned Khan Academy lessons are complete</li> <li><input type="checkbox"/> At least five of the outcomes in the game require one or more of the following types of probability: <ul style="list-style-type: none"> <li><input type="checkbox"/> Conditional probability</li> <li><input type="checkbox"/> Addition rule for And/Or probability</li> <li><input type="checkbox"/> Multiplication rule for a series of events</li> </ul> </li> <li><input type="checkbox"/> Include a written report that does the following: <ul style="list-style-type: none"> <li><input type="checkbox"/> Determine the probability of at least five non-simple outcomes (from the previous bullet point).</li> <li><input type="checkbox"/> Describe the type of probability required to determine each of the probabilities and explain how you know.</li> </ul> </li> <li><input type="checkbox"/> Each student in the group takes a turn running their game and explaining to players the probabilities associated with their game.</li> <li><input type="checkbox"/> Game includes payouts for winning outcomes based on the odds of winning.</li> </ul>
<p><b>Collaboration: Accountability</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Group Evaluation form shows evidence of the following: <ul style="list-style-type: none"> <li><input type="checkbox"/> Interventions were used (if needed) to keep group members accountable.</li> <li><input type="checkbox"/> Each student in the group had an equitable role in completing the project.</li> <li><input type="checkbox"/> Each student worked collaboratively with the other students on at least one part of the project (no one worked completely independently).</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Group Participation Evaluation Google Forms shows evidence of the following: <ul style="list-style-type: none"> <li><input type="checkbox"/> Each group member participated in completing the project.</li> <li><input type="checkbox"/> Students had a system of interventions in place for holding each other accountable.</li> </ul> </li> </ul>
<p><b>Minimum Requirement Components: Must be included to be graded</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Complete LT14 quiz.</li> <li><input type="checkbox"/> Complete all Khan Academy Lessons.</li> <li><input type="checkbox"/> Make a playable game of chance.</li> <li><input type="checkbox"/> Write a report to calculate the probabilities of at least 5 of the outcomes for your game.</li> <li><input type="checkbox"/> Each group member must complete the Group/Peer Evaluation Google Form.</li> <li><input type="checkbox"/> Digital Fabrication must be used in the creation of your product.</li> </ul>	
<p><b>Grades</b></p>	<ul style="list-style-type: none"> <li>• If the Mini-PBL work is all advanced according to the rubric criteria above, the grade is a 100.</li> <li>• If the work meets all the proficient criteria and not all of the advanced criteria, the grade is an 85.</li> <li>• If the work does not meet all of the proficient criteria, the grade is a 50.</li> <li>• If the grade does not meet the minimum requirements, the grade is a 0.</li> </ul>	

**Vocabulary**

<p>Mathematics - Algebra 2</p>	<ol style="list-style-type: none"> <li>1. Probability</li> <li>2. Theoretical Probability</li> <li>3. Experimental Probability</li> <li>4. Event</li> <li>5. Mutually Exclusive</li> <li>6. Independent</li> <li>7. Dependent</li> <li>8. Intersection</li> <li>9. Union</li> <li>10. Conditional Probability</li> </ol>
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