Preassessment Activity

Teacher says: “I need a contestant for this game. Who would like to play?”

(Teacher chooses a student.)

Teacher says: “(student’s name here), come on down! You are the first contest to play the Number Cube Extravaganza!”

Teacher says: “I have a surprise wrapped in a box here worth between $1.11 and $6.66. You will roll the number cube. If you roll the 1st digit in the price of the surprise in the box, I will write it on the board. If you do not roll the exact digit, then you will need to decide if the true digit is higher or lower than the one that was rolled. If you are correct for all 3 digits, you win what is in the box to share with your classmates. Let’s play the game.”

The game is played. The answer is revealed, and hopefully the student wins!

Teacher says:

“Let’s write about how we made our decisions, using as much math language possible.”
“Did we win?”

“Did we make any poor decisions?”

“Which were the easiest decisions and why?”

“Which were the most challenging decisions and why?”

End of introductory activity. You can repeat this activity with students more than once if you think they need it.

You have just seen how to play the Number Cube Extravaganza.

I am planning on playing the Number Cube Extravaganza with Mr. Parkhurst’s class. Help me choose the items I should use from the catalog below. The price of the 1st item you choose should make it so Mr. Parkhurst’s students have the best chance of winning. The price of the 2nd item you choose should make it so Mr. Parkhurst’s students have the least chance of winning.

After choosing your items, write me a letter telling me about what you did to make your choices and how you know you made the correct choices. Support your choices mathematically. Show all of your work, and use as much math language as you can!
The Price Is Right, But Are You?
The Price Is Right, But Are You?

Suggested Grade Span

3–5

Task

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AlternativeVersions of Task

More Accessible Version

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More Challenging Version

The original version, and …

Another game on *The Price Is Right* asks contestants to predict the price of a prize using the digits 1–4, using each digit only once. If the price of the prize has 4 digits, how many different possible prices could the prize be worth?

$□,□□□□$

Context

This task was given to a group of third and fourth graders after doing some activities involving probability. Students had flipped a coin 100 times to see whether heads or tails comes up more often; they had also done some spinner activities. Many students have seen *The Price is Right* game show on television, and this provided the motivation for solving this problem.

What This Task Accomplishes

This task allows students to apply either an experimental or a theoretical probability model to solve a task. The teacher is able to determine which students have a true understanding of probability concepts and which students need more instruction.
Time Required for Task

Since students needed to be convinced that there is an equally likely chance of rolling all digits on a number cube, it took almost five class periods to solve the task. Although it did take a long time, it was worth it because students created for themselves their own knowledge of probability.

Interdisciplinary Links

This task could be linked to a study of games and game shows, state lottery systems and other games of chance.

Teaching Tips

Most students began by rolling a number cube 100 times to see which digit would come up most often. It was difficult for them to gather enough data to convince themselves that each digit had an equally likely chance of being rolled. Therefore some teacher intervention was necessary in getting students to move forward with the problem.

What I did was to ask the students to pool their rolls by making a group bar graph. It became apparent to most students that indeed there was an equally likely chance of rolling each number, so they needed to try working on a different approach to the task. Students who were not convinced were encouraged to bring dice home and increase their sample so they could see how eventually the number of times each digit is rolled will even out. This was an important lesson in sample size.

Finally, students will change their approach and create some sort of organizational model for recording the possible digits that could be rolled, the decision they would make if they had rolled any particular digit, and the likelihood that the decision would be correct. They then analyzed that data and drew conclusions.

To engage students in the problem I dressed up as Bob Barker, with a suit and tie, and used an egg beater as a microphone. Taping theme music to the show would add an extra flare! I also created a game sign, using gold sparkly letters, and used other fun props. It is important to take the time to do the preassessment activity so that you can be sure students understand the circumstantial situation of the task. Once the task is complete, students can each be contestants in the game, using their results as a “check” for correctness. Once they play the game, students will beg you to play it every day!

Instead of having you be Bob Barker, ask the principal or physical education teacher to be the guest M.C.! I used the following to assess students' knowledge of probability after using the Exemplars rubric to assess their mathematics problem-solving and communication skills.
**Probability Rubric**

<table>
<thead>
<tr>
<th>Just Getting Started</th>
<th>Not Yet ...</th>
<th>Got It!</th>
<th>Wow!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shows no evidence of using either an experimental or theoretical model to solve the problem</td>
<td>Shows evidence of using one or the other, but cannot follow through on its use to reach a solution.</td>
<td>Accurate and appropriate use of either experimental or theoretical models to support solution.</td>
<td>Accurate and appropriate use of both experimental and theoretical models to support the solution.</td>
</tr>
</tbody>
</table>

Many times teachers get frustrated when students say, “I’m done” when they indeed are not. Below are the directions I gave to students to avoid this false claim.

How do I know when I am done?

You are done when:

- You have found a solution to both parts of the problem.
- You have made a shopping list of supplies.
- You have used as much math language as you can to communicate your solution.
- You have attached to your shopping supply list: a graph, chart, table, diagram or model that accompanies your solution.
- You have attached all of your scratch work and this paper.
- You have included your name and the date on all pieces of your work.
- You have assessed your work using the tool below.

**Student Self-Assessment Tool**

**Language of Probability**

I used: ___ none ____ a little ___ a lot

**Math Representation**

I used a: ___ graph ___ chart ___ table ___ model ___ diagram

My representation: ___ had no labels ___ had some labels ___ had all labels

“I noticed ...” Statements

I made: ___ none ___ one ___ more than one

**Documentation**

I showed: ___ none of my work ___ some of my work ___ all of my work
Suggested Materials

For the demonstration game, I wrapped a package of pencils so that when the first contestant won s/he could share the prize easily with the rest of the class. I wrapped the gift in fun paper with a big bow for added attraction. The M.C. will also need props such as a microphone, suit and tie, etc. Students will need number cubes and graph paper.

Possible Solutions

Key:

Win = Automatic win because the digit itself is rolled
H = Predict higher when rolled
L = Predict lower when rolled
(wr) = Prediction will be wrong

Statistically sound choice: 1–3 always predict higher, 4–6 always predict lower. So...

<table>
<thead>
<tr>
<th>Digit Needed</th>
<th>1 Rolled</th>
<th>2 Rolled</th>
<th>3 Rolled</th>
<th>4 Rolled</th>
<th>5 Rolled</th>
<th>6 Rolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Win</td>
<td>H (wr)</td>
<td>H (wr)</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>H</td>
<td>Win</td>
<td>H (wr)</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>3</td>
<td>H</td>
<td>H</td>
<td>Win</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>4</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>Win</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>5</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L (wr)</td>
<td>Win</td>
<td>L</td>
</tr>
<tr>
<td>6</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L (wr)</td>
<td>L (wr)</td>
<td>Win</td>
</tr>
</tbody>
</table>

Conclusion:

If you always make the statistically sound choice, you have a 4/6, or 2/3 chance of successfully rolling or predicting a 1 or 6 in a price and a 5/6 chance of success with a 2 or 5 in a price. You are guaranteed to roll or successfully predict a 3 or 4 in a price. To get the probability of ultimately winning the game with a given price, you must multiply together the "success probabilities" of the individual digits in the price. Therefore, a three-digit price composed entirely or 1s or 6s will give the lowest chance of winning (2/3 x 2/3 x 2/3 = 8/27 29.6% chance), whereas a price composed entirely of 3s or 4s will give the highest chance of winning (100% chance).

More Accessible Version Solution

See the solution to the original version.
More Challenging Version Solution

4! = 4 x 3 x 2 x 1 = 24 different combinations

Task-Specific Assessment Notes

Novice
The Novice will not be able to find a strategy that will result in a correct solution. There will be no work to support the solution, and only basic math language will be used.

Apprentice
The Apprentice will attempt to address both aspects of the problem. S/he identifies which would give the most chance and least chance of winning. The student will more likely use an experimental model that may not get at the underlying mathematics in the task. The Apprentice may not have a full understanding of the task and focus only on the chance of each digit being rolled and not on the potential correctness of the guesses.

Practitioner
The Practitioner will solve the problem theoretically, finding correct answers to both parts of the problem. The Exemplar benchmark shows an incorrect answer due to a minor error, but the mathematics the student did was correct for the mathematical situation. The Practitioner will use the language of probability to communicate and will create an accurate and appropriate representation to record her/his approach and decision making.

Expert
The Expert will solve the problem theoretically and may even verify the solution experimentally. The Expert will make mathematically relevant observations and will use precise and accurate math language. The representation will be complete and accurate.
Dear Carol,

The most likely number to come up is two. Because when me and Stephnie rolled the die and two came up the most. Because out of 35 times I got 2's the most. So the answer is 2.
Dear Card,
I have more chances of getting the baseball and I have less chances of getting the calculator, because I rolled the number six more than any other number between six. I rolled the number three less than any other number between six.

The student addresses both aspects of the problem and utilizes some probability knowledge but fails to comprehend the complexity of the task.
Apprentice

The student attempts to make a mathematically relevant observation.

The student creates a labeled representation which is accurate to her/his solution.
The student has an approach that would work for solving this problem.

This representation could be better labeled one piece of data is inaccurate on #5, if you rolled a four, you should go with the odds and guess lows.

The student accurately uses the language of probability.
Dear Ms. Amico,

The most likely ones to guess would be 3, 4, and 5. The percentage is 100% that you will get them right if you are following the chance. The most unlikely ones are 1 and 6.

I noticed on the table I made the equal sign go diagonal and there is sort of a pattern.

Both parts of the task are addressed.

The student explains her/his solution using precise math language.
Expert

This representation is accurate and well labeled.

The student makes a mathematically relevant observation.

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I noticed a pattern

1, 2, 3 always guess up

4, 5, 6 always guess down

I used this to fill in the rest of my chart.
Dear Carol,

I think the greatest one to get is $3.33. The least to get is $16.66. If you would want them to win, you should buy the calculator. If you don't want them to win, you get the baseball. I know it is right because I did an experiment. The probability for getting the $3.33 is greater than the chance of getting $6.66.

The student uses accurate and appropriate math language.

The student explicates her/his reasoning and begins to describe experimental verifications of his/her solution.