

Teacher Instructions: The Number Cube Game

Grade Level: K - 2

Task: The Number Cube Game

Standard: Data Analysis, Statistics, and Probability

Task Scenario: Students will work in pairs and be instructed to make predictions about which sum will come up most often when rolling two number cubes (dice). The students will then roll the number cubes 20 times each and record the numerical results on the worksheet provided. Students will then graph their results. The students will use this data to predict the outcome of the next game. The second game is a repeat of the first game.

➤ See Student Task for student pages

Teacher Note: Make sure there are enough Number Cube Game Record sheets and graphs available for students for both games.

➤ Review “Teaching Tips” for information on how to introduce the game to the students.

Context – From the Task Author: This task was presented to first grade students who had been studying sums to 12. These students had little experience with problem solving, and the topic of probability.

What the task accomplishes...

- This task will assess student competence in addition facts to 12.
- The task will also act as a pre-assessment on student knowledge of probability concepts.
- The task will also introduce students to recording data on charts and graphs, and using graphs to draw conclusions.

What students will do...

- Students will work in partners, first making a prediction of the sum that will come up most often on the number cubes.
- Students will then toss the number cubes 20 times and record their sums in a chart.
- The students will then translate their chart to a graph and determine who is the "winner" of game number one.
- Students will hopefully use the information gathered throughout this experimental probability experiment to make a more informed prediction for game number two.
- Students are encouraged to make mathematically relevant comments and observations about the solution and process.

Time Required: The task will take approximately 45 – 60 minutes and can be conducted over one or two class periods.

Interdisciplinary Links: This task can be tied to a unit on games, or fairs and carnivals.

Teaching Tips...

- To help students understand the task I modeled the game with a student volunteer in front of the class.

- The student and I each picked a sum we thought would be most probable. We rolled the number cubes 20 times, and students in the class took turns figuring the sums.
- The sums were recorded on a piece of chart paper that took on the same format as the student worksheet.
- Then the sums were translated onto a graph, and students analyzed the graph to determine a winner, as well as practice making relevant mathematical observations about the data.
- Students then chose partners and went off on their own to complete the activity.
- To assist students in better seeing the experimental probability with a more accurate sample size, students could combine their sums on a class graph that should better reflect the theoretical probability.
- Teachers may also want to take the opportunity to discuss which number cube combinations result in which sums and which sums have the most combinations.

Suggested Materials: 2 number cubes per group, worksheets provided, pencils

Possible Solution...

The sum of 7 theoretically has the most probable chance of occurring, although experimental probabilities will vary, especially due to sample size.

Teacher Note: The worksheets were reformatted for this task, so the student work presented here looks slightly different.

Benchmark Descriptors:

- The benchmark descriptors and rubric are designed to help the teacher analyze student thinking and understanding at each of the four performance levels.
- The descriptors are generalizations of what student work could look like.
- It is not possible to anticipate every answer a student can give, so in scoring student work the teacher must use these generalizations to come to their own conclusions as to where a student is performing on the assessment.
- It is recommended that teachers create their own task specific rubric by listing the specific math skills that would make up each section of the four performance levels.

Novice

- ✓ The novice may or may not have correctly found the sums of the number cubes, and may incorrectly fill out the chart.
- ✓ The novice will transfer the sums to the graph and determine who won.
- ✓ On game #2 the novice will not use information gained from game #1 to make a prediction.
- ✓ The student's "I noticed.." statements are rudimentary.
- ✓ Little or no language of probability is used to communicate.

Apprentice

- ✓ The apprentice may make some flaws when determining the sums of the number cubes, but will correctly fill out the chart.
- ✓ The apprentice will transfer the sums to the graph and determine who won.
- ✓ On game #2, the student begins to show signs of basing a prediction on the mathematical experiment in game # 1.
- ✓ The student's "I noticed.." statements begin to become analytical in nature.
- ✓ A little probability terminology may be used by the apprentice.

Practitioner

- ✓ The practitioner accurately determines the sums on the number cubes, and correctly fills out the chart and graph.
- ✓ On game #2, the student bases a prediction on the mathematical experiment in game #1.
- ✓ The student's "I noticed..." statement shows evidence of understanding the underlying concepts of probability.
- ✓ Some probability terminology will be used by the practitioner.

Expert

- ✓ The expert accurately determines the sums on the number cubes, and correctly fills out the chart and graph.
- ✓ On game #2, the student bases a prediction on the mathematical experiment in game #1.
- ✓ The student's "I noticed..." statement shows evidence of understanding the underlying concepts of probability and of statistics, as well as makes other mathematically relevant comments or observations.
- ✓ The expert will use the language of probability and statistics to communicate ideas.

APS Mathematical Standards...

- ❖ **The math standards stated for this task are aligned to the APS Draft Standards 2000.**

Data Analysis, Statistics, And Probability: Learners will identify patterns and special features of data and events of chance through experiences with meaningful mathematical problems while focusing on comparing, predicting, representing data, and making decisions to communicate mathematical understanding.

Kindergarten:

Statistics: Organize and make sense of data.

- **Collect** information through counting and tallying.
- **Describe, sort, and classify** objects or information using representations.
- **Organize and represent** categorical data.
- **Answer questions and interpret** information based on simple graphs and surveys prepared by students.

Probability: Explore and make predictions based on patterns.

- **Describe** patterns of regularity in nature and daily routines.
- **Make** predictions based on familiar situations and relate to the concept of chance.
- **Use** probability terms such as likely and unlikely.

First Grade:

Statistics: Collect and use data from classroom situations.

- **Conduct** simple statistics experiments.
- **Compare** different ways of sorting, organizing, and representing the same data.

Probability: Explore, describe, and make predictions based on patterns.

- **Describe** the results of simple probability experiments to explain the concept of chance using probability term such as likely and unlikely;
- **Describe** regularly occurring patterns in nature and in daily routines.

Second Grade:

Statistics: Collect, organize, and use data from classroom situations.

- **Conduct** a simple experiment which includes **identification** of a problem, **planning** data analysis, **collecting** and **recording** data using pictorial and symbolic graphs and charts, **describing** and **interpreting** data, and **developing** hypotheses and theories based on the data.
- **Identify** range and unusual data points.

Probability: Explore the concept of chance.

- **Describe** the results of simple probability experiments to explain **the** concept of chance.
- **Use** probability terms such as likely, unlikely, impossible, probable, and certainty.

Benchmark Papers

NOVICE

Game 1

I think the sum 12 will come up the most often.

My partner thinks the sum ~~12~~ 9 will come up the most often.

The winner of Game 1 is Keshav.

The winner's sum of 9 came up 4 times out of 20 times.

I noticed . . .

311 57 680 9

Student states results of the experiments.

NOVICE

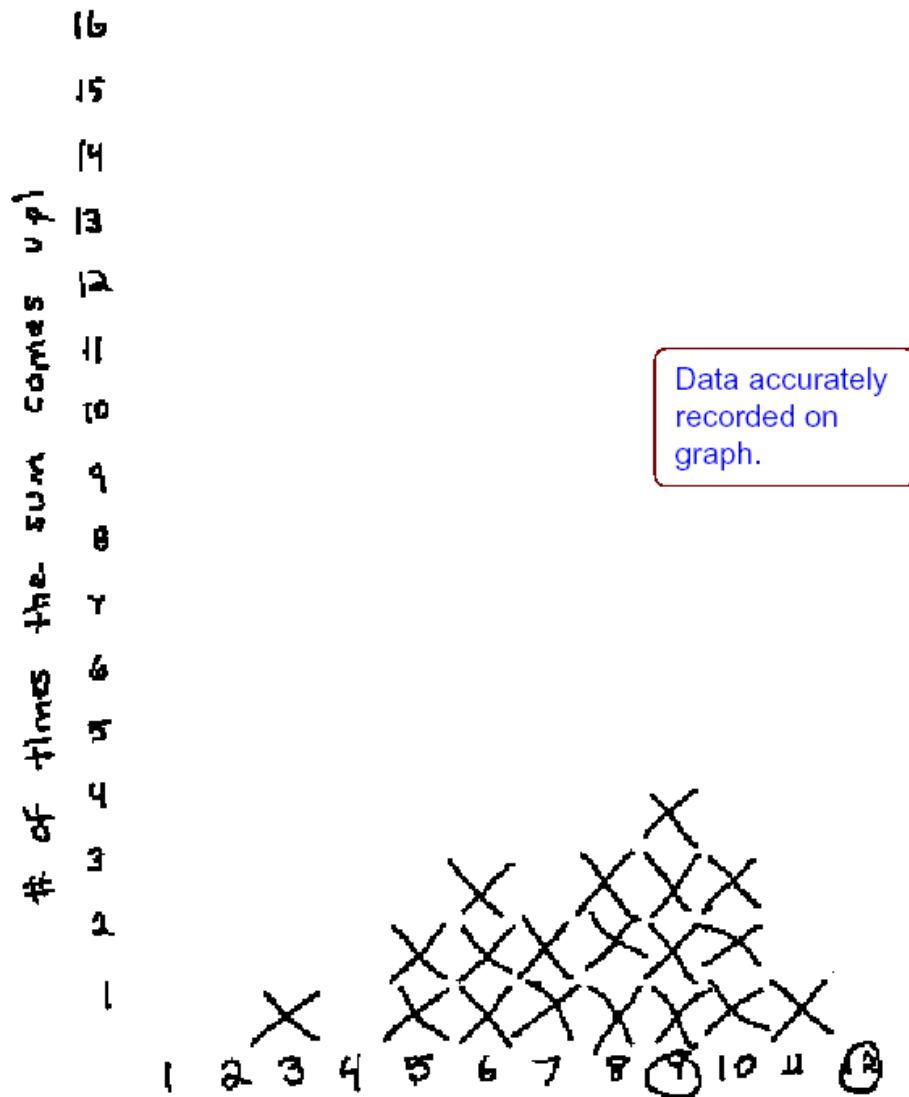
Dice Game Record

Roll #	Die 1	Die 2	Sum
1	1	1	2
2	1	1	2
3	1	1	2
4	1	1	2
5	1	1	2
6	1	1	2
7	1	1	2
8	1	1	2
9	1	1	2
10	1	1	2
11	1	1	2
12	1	1	2
13	1	1	2
14	1	1	2
15	1	1	2
16	1	1	2
17	1	1	2
18	1	1	2
19	1	1	2
20	1	1	2

Data is accurately recorded on chart and results of computation are correct.

NOVICE

The Dice Game



NOVICE

Game 2

I think the sum 10 will come up the most often because it is my favorite number

My partner thinks the sum 9 will come up the most often.

The winner of Game 2 is Kesha

The winner's sum of 10 came up 1 times out of 20 times.

I noticed

7 10 + 5 2 10 6
14 11

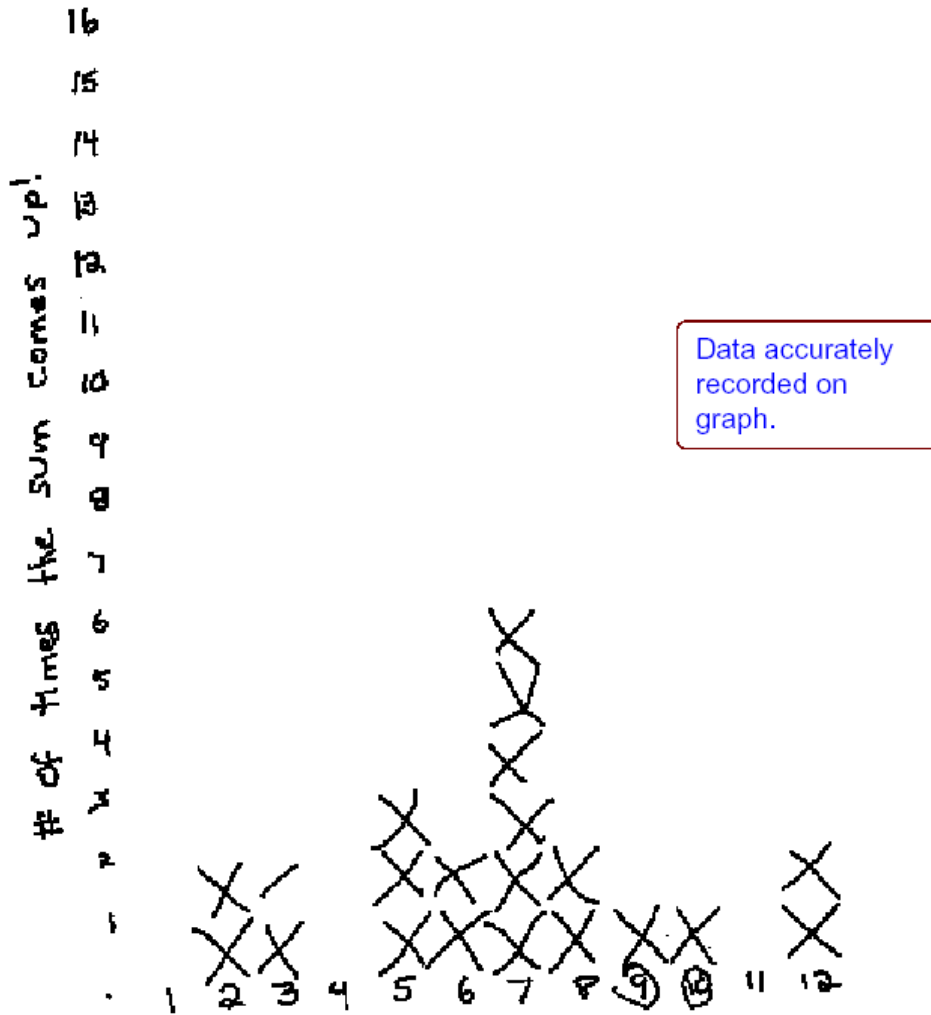
2 6 8 12 1 10 12

Student does not use results from 1st experiment to base second prediction.

Student is able to draw conclusions about the data.

NOVICE

The Dice Game



APPRENTICE

Game 1

I think the sum 12 will come up the most often.

My partner thinks the sum 4 will come up the most often.

The winner of Game 1 is Bo.

The winner's sum of 4 came up 2 times out of 20 times.

I noticed. 8

Here student shows some evidence of basing prediction on results of game # where 11 came up 3 times.

It is unclear what the student notices about "8."

APPRENTICE

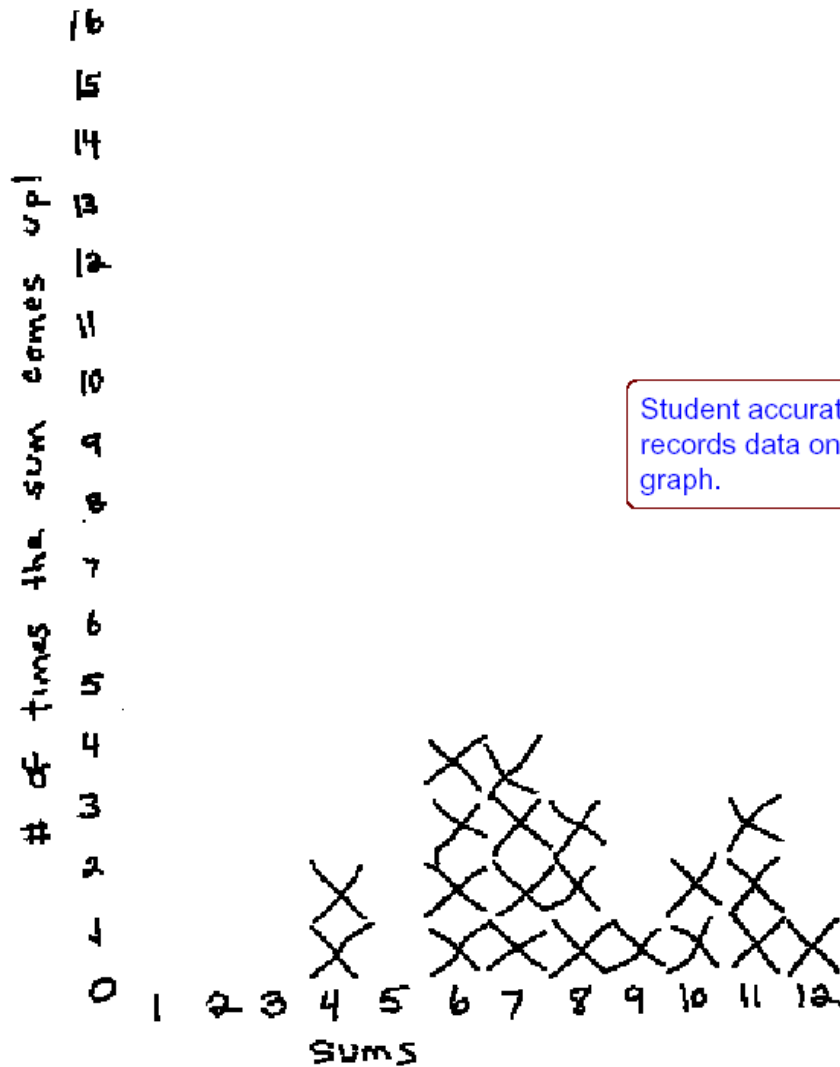
Dice Game Record

Roll #	Die 1	Die 2	Sum
1	1	1	2
2	2	2	4
3	3	3	6
4	4	4	8
5	5	5	10
6	6	6	12
7	1	1	2
8	2	2	4
9	3	3	6
10	4	4	8
11	5	5	10
12	6	6	12
13	1	1	2
14	2	2	4
15	3	3	6
16	4	4	8
17	5	5	10
18	6	6	12
19	1	1	2
20	2	2	4

Student accurately records facts on chart, although there is an error.

APPRENTICE

The Dice Game



Student accurately records data on graph.

APPRENTICE

Game 2

I think the sum 11 will come up the most often because plus 3

My partner thinks the sum 4 will come up the most often.

The winner of Game 2 is both

The winner's sum of 4 came up 11 times out of 20 times.

I noticed. . .

8 has the same

Again, it is unclear what the student is referring to here.

APPRENTICE

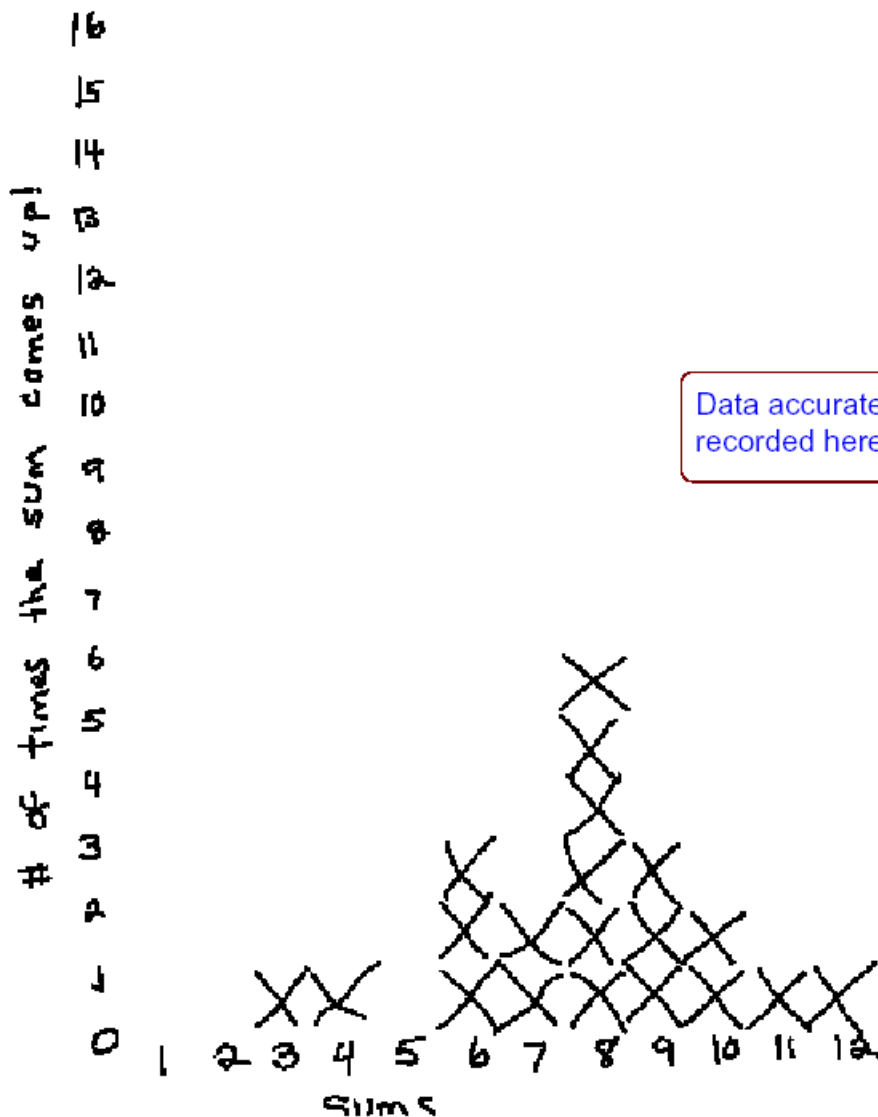
Dice Game Record

Roll	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Die 1	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2
Die 2	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2
Sum	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4

This data is accurately recorded, although student has difficulty writing numbers.

APPRENTICE

The Dice Game



Data accurately recorded here.

PRACTITIONER

Game 1

I think the sum 7 will come up the most often.

My partner thinks the sum 4 will come up the most often.

The winner of Game 1 is Tom.

The winner's sum of 7 came up 3 times out of 20 times.

I noticed...

I didnt like Math but this was fun. 10 came up alot.

Student makes a relevant comment.

PRACTITIONER

Dice Game Record

Roll #	Die 1	Die 2	Die 3	Die 4	Die 5
1	4	+	5		6
2	2	+	5		6
3	3	+	1		6
4	4	+	1		6
5	5	+	6		6
6	6	+	1		6
7	1	+	4		6
8	2	+	1		6
9	3	+	4		6
10	4	+	4		6
11	5	+	6		6
12	6	+	6		6
13	1	+	3		6
14	2	+	3		6
15	3	+	3		6
16	4	+	3		6
17	5	+	3		6
18	6	+	6		6
19	1	+	5		6
20	2	+	5		6

Data accurately recorded, with a few computational errors.

PRACTITIONER

Game 2

I think the sum 10 will come up the most often because Last time it won

My partner thinks the sum 10 will come up the most often.

The winner of Game 2 is 10.

The winner's sum of 10 came up 2 times out of 20 times.

Student bases prediction based on results of last experiment.

I noticed...

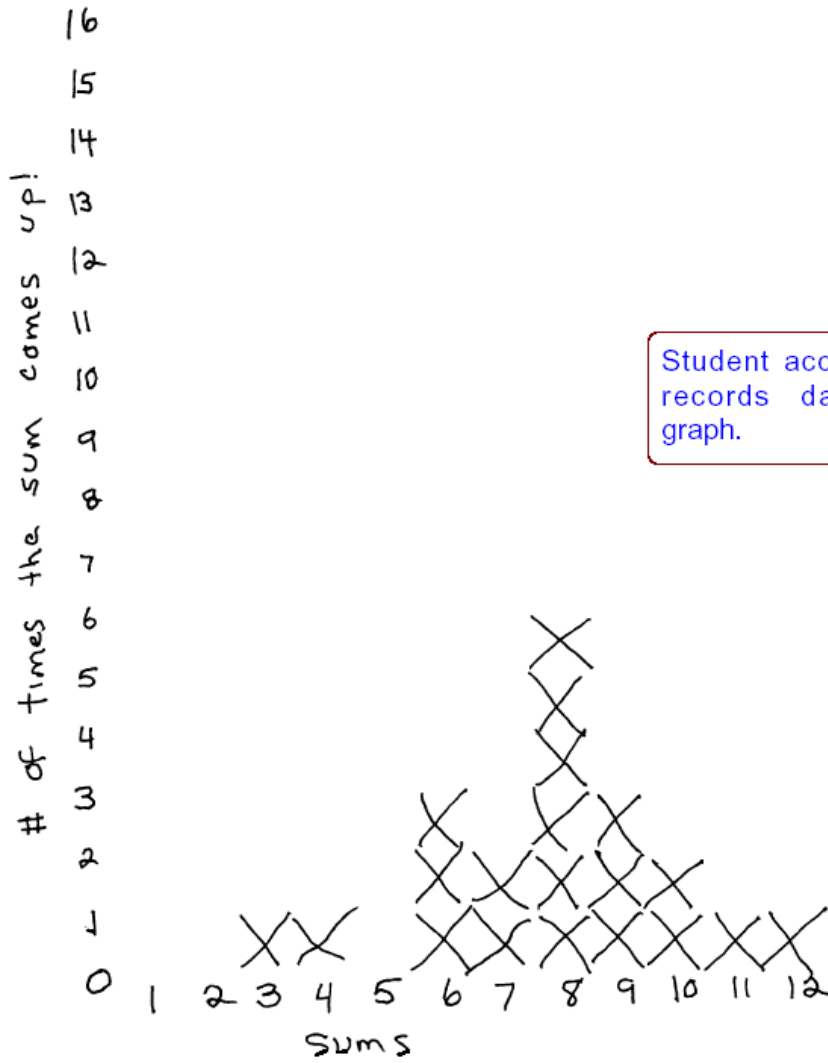
"I could have been the winner if I picked 7 again 4 got more this time than last time. You never know if you're going to win."

The student attempts to show his reasoning for the values of some pieces.

Student makes a profound statement about probability.

PRACTITIONER

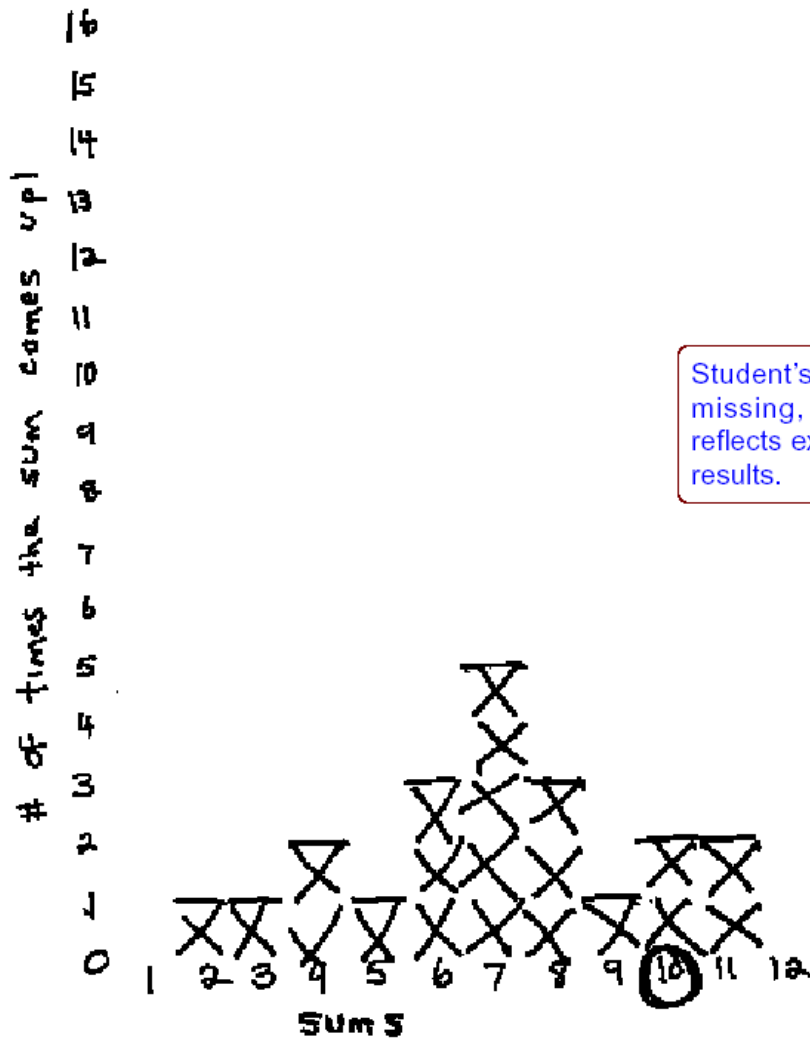
The Dice Game



Student accurately records data on graph.

PRACTITIONER

The Dice Game



Student's page 5 is missing, but graph reflects experimental results.

EXPERT

Game 1

I think the sum 6 will come up the most often.

My partner thinks the sum 4 will come up the most often.

The winner of Game 1 is Bo.

The winner's sum of 5 came up 5 times out of 20 times.

I noticed.

It looks like

"The graph looks like a triangle"

Student has difficulty writing numbers correctly.

Student observes the bell curve that is created by graphing this type of probability activity.

EXPERT

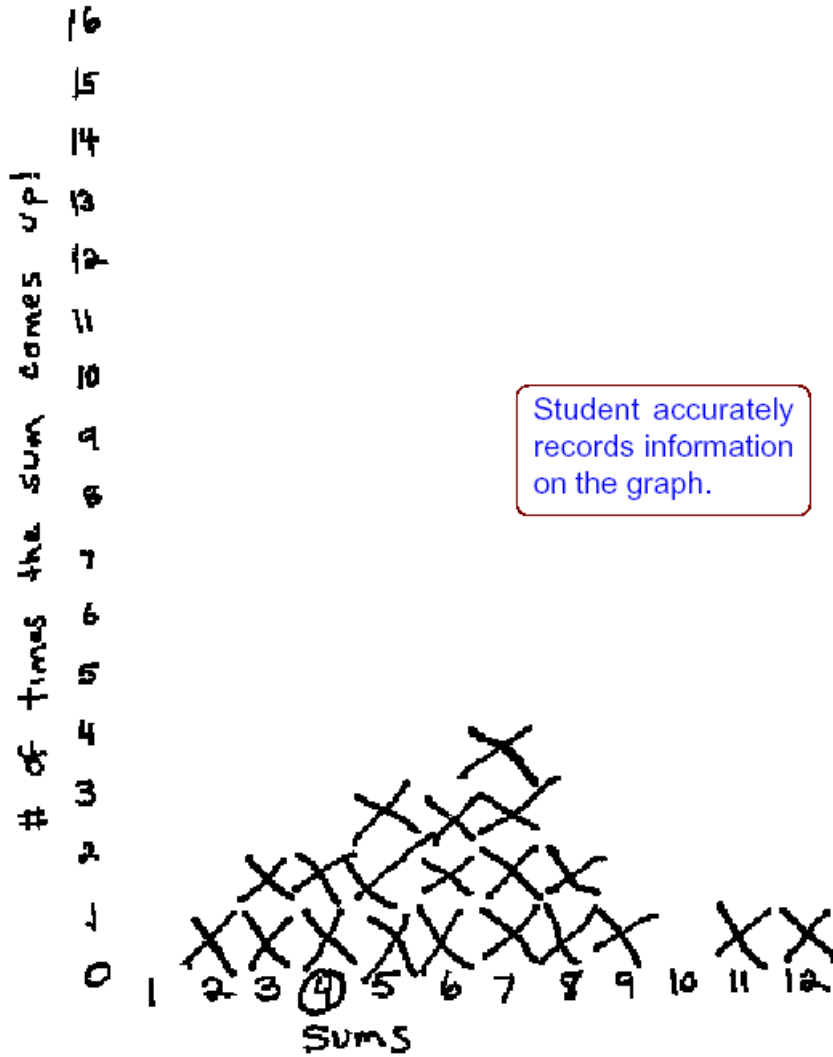
Dice Game Record

1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Student accurately finds sums of dice.

EXPERT

The Dice Game



EXPERT

Game 2

I think the sum 7 will come up the most often because "It came up most last time"

My partner thinks the sum 3 will come up the most often.

The winner of Game 2 is Bo

The winner's sum of 3 came up 2 times out of 20 times.

I noticed . . .

"You can never get 1"

"This time 7 only came up once"

Student makes mathematically relevant comments.

Student uses results of first experiment to make prediction.

EXPERT

Dice Game Record

Roll #	Roll 1	Roll 2	Roll 3	Roll 4	Roll 5	Roll 6	Roll 7	Roll 8	Roll 9	Roll 10	Roll 11	Roll 12	Roll 13	Roll 14	Roll 15	Roll 16	Roll 17	Roll 18	Roll 19	Roll 20	
1	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
2	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
4	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
5	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
6	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
7	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
8	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
9	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
10	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
11	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
12	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
13	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
14	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
15	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
16	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
17	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
18	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
19	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5
20	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5	1	4	3	6	2	5

EXPERT

The Dice Game

