

**Title: Sampling for a Rock Concert**

**Brief Overview:**

Students will design and critique surveys based first upon prior knowledge and then upon principles of simple random sampling learned throughout the unit. Additionally, students will use results from surveys in order to make predictions about a population.

**NCTM Content Standard/National Science Education Standard:**

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Develop and evaluate inferences and predictions that are based on data.

**Grade/Level:**

Grades 7 – 12/Algebra I; Data Analysis

**Duration/Length:**

Three 50 – minute class periods

**Student Outcomes:**

Students will:

- Identify simple random samples.
- Use sample data to make predictions about a population in general.

**Materials and Resources:**

- Bulletin board paper
- Construction paper
- Chart paper
- Markers
- Index cards
- Response boards
- Copies of worksheets
  - Show and Tell Preassessment
  - Rock On!
  - Friends Rock
  - Descriptor cards
  - Who's Who and What's What?
  - Picking People Proportionally
  - La Bella

- All for Algebra!
- Survey Placemat
- Survey Says...!

### **Development/Procedures:**

#### Day 1

- Pre-assessment  
Assess prior knowledge of solving proportions and surveying using the “Show and Tell Preassessment.” Solicit student volunteers to solve the proportions on the board. Additionally, discuss the vocabulary with the class.
  
- Exploration  
Divide the class into small groups of no more than 4. Project a transparency of “Rock On!”, and give each student a piece of chart paper. Have the students work together to design a method to sample one hundred students as described in the “Rock On!” exercise. Ask the students to write their methods onto the chart paper.
  
- Explanation  
Invite each group of students to display their chart papers and explain their survey methods. Have the students justify why their method produces a good sample of the population. Poll the class, using a thumbs up/thumbs down technique, as to whether or not each group has created a good way to survey the student body. Ask the students who show a ‘thumbs down’ to justify their thoughts. Retain the chart papers for an activity during day 3.  
  
Ask the students, “Who is the population in the ‘Rock On!’ survey? Who is the sample in the ‘Rock On!’ survey? What is the difference between a population and a sample?” Use these questions to introduce the vocabulary population and sample, but do not formally discuss what makes a good sample at this time.
  
- Application  
Come to a whole-class consensus about which sampling method they think is best. Adjust the other methods so that they no longer contain bias and/or poor sampling methods. Invite one representative from each group to make the changes to their chart papers.
  
- Differentiation
  - Reteach  
Provide examples of “good” vs. “not good” samples and discuss why. Visit the website [www.mdk12.org](http://www.mdk12.org) for MSA and HSA

released items. Select examples so that the students can work with identifying good sampling methods.

- Enrich  
Discuss the concept of voluntary vs. involuntary surveys. Present the idea, “Would a suggestion box placed in the cafeteria with one hundred blank voting sheet provide a good sample?”
- Assessment  
Assign the worksheet “Friends Rock”, and have the students respond to the prompt of why asking 100 of friends does not provide a good sample.

## Day 2

- Exploration  
Cut out the cards from “Descriptor Cards” prior to the start of class. Attach each card to an index card. Divide the class into student pairs, and give each pair one index-descriptor card. Explain to the students that they are to determine how many students in the classroom fit this descriptor, and from this data, determine how many students in the school would fit the descriptor. Project a transparency of “Who’s Who and What’s What?” for the students to reference. Make sure to change the number of total students in the exploration problem to fit the population of the school.
- Explanation:  
Group together pairs of students and have the students share their strategies for determining the number of students in the school with their given descriptor. Focus on the students who used proportions, and emphasize this solution method. In order to stress the correct set up of the proportion, ask students how they would change their proportions if there were 2000 students in the school? What if the number of students who fit the description changed? Before moving on, make sure students understand how to correctly set up the proportion and solve, stressing sample/population.
- Application  
Have the students work with surveys and proportions to find expected values using “Picking People Proportionally.” Consider distributing whiteboard response boards and dry erase markers so that the students can display their answers for quick assessment of understanding.
- Differentiation
  - Reteach:

Solve the first two problems from the “Picking People Proportionally” with the students to model and reinforce how to solve them using proportions.

- Enrich  
Have students create their own descriptor cards, trade with a partner, and use the cards to determine the number of students in the whole school that matches that descriptor. Have the students trade the cards back, and check each other’s work.
- Assessment
  - Students will complete an Exit Ticket (*see worksheet at end*).

### Day 3

- Exploration  
Distribute lollipops/candy to every third person (counting out loud) as students walk in the room. Do not answer any student who might ask you why they did/did not receive a lollipop/candy. Ask the students to hold onto the lollipops for a later activity, and do not eat them at this point.

Project a transparency of “All for Algebra!” Have students determine the number of Algebra I students in the school applying the same strategy as yesterday, using their class as a sample size.

- Explanation  
Ask, “Why does it not make sense that all students should be in Algebra I?” Use this as a springboard to discuss the vocabulary sample, population, bias. Ask, “Is the class a ‘representative sample’ of the school population? How could we get a representative sample?” Lead the students to understanding that the sample Algebra I class is a biased sample, where not all students in the school were given an equal chance of being part of the sample. Connect this to the lollipops distributed at the beginning of the class. Ask students if the way in which the lollipops were distributed was fair. Emphasize the ‘independent’ part of the definition of simple random sample, where each object in a sample should be picked independently and uniquely from the other. Ask, “How could we make distribution of the lollipops better? How can we take a more representative sample of students to determine the number of students taking Algebra I at our school?” Allow time for think, pair share.

Point out to the students that a sample is only a simple random sample if everyone is equally likely to be picked and everyone is picked independently. Analyze an example of a simple random sample and a non-example as a class.

- Application

Divide the class into groups of four. Distribute the “Survey Placemats”, large chart paper, and a different student designed survey from Day 1 to each group. Ask students to copy the grid as shown on the “Survey Placemat” onto their large chart paper. Allow three minutes for the students to work independently, answering the questions in their section of the placemat. Have the students then discuss with their groups their thinking, and come to a group consensus to be placed in the center of the placemat. Instruct the groups to hang their chart paper around the room, and conduct a gallery walk of the completed placemats.

- Differentiation
  - Reteach  
Visit the website [www.mdk12.org](http://www.mdk12.org) for MSA and HSA released items. Select examples so that the students can work with sampling methods and expected value problems.
  - Enrich  
Have groups/class create the “ideal” sample for the original concert question from day 1. Discuss the idea that even though a method might be a simple random sample, how realistic is it to actually perform the survey method?

### **Summative Assessment:**

Students will complete a mini quiz, “Survey Says...!” of three multiple choice questions and one constructed response.

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**Show and Tell**  
**Pre-Assessment**

Name: \_\_\_\_\_

1. Solve for  $x$ :  $\frac{15}{x} = \frac{10}{12}$

2. Solve for  $y$ :  $\frac{3}{8} = \frac{y}{12}$

3. Read the sentences below.

I am **biased** towards Pennsylvania drivers because I was once in a car accident with a Pennsylvania driver. It was his fault!

- What does the underlined word, **biased**, mean?

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4. Read the sentences below.

Last evening I went to Baskin Robins, home of the 31 flavors of ice cream. I asked for a **sample** of mint-chocolate chip ice cream to make sure I liked it before I bought an ice cream cone.

- What does the underlined word, **sample**, mean?

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**Show and Tell**  
**Pre-Assessment**

Name: ANSWER KEY

1. Solve for  $x$ :  $\frac{15}{x} = \frac{10}{12}$

$x = 18$

2. Solve for  $y$ :  $\frac{3}{8} = \frac{y}{12}$

$y = 4.5$

3. Read the sentences below.

I am **biased** towards Pennsylvania drivers because I was once in a car accident with a Pennsylvania driver. It was his fault!

- What does the underlined word, **biased**, mean?

Answers may vary.

Sample phrases that are correct: unfair opinion, does not like based on characteristics.

4. Read the sentences below.

Last evening I went to Baskin Robins, home of the 31 flavors of ice cream. I asked for a **sample** of mint-chocolate chip ice cream to make sure I liked it before I bought an ice cream cone.

- What does the underlined word, **sample**, mean?

Answers may vary.

Sample answer: The sample represents what the “whole thing” (population) is like.

## Rock On!

Wow! Due to awesome behavior so far this year, students are being rewarded with a free concert!

The administration would like to survey the students to see which music group to invite.

Obviously, the administration does not have the time to poll every student in the school. They decide to survey a sample of one hundred students.



Design a method the administration can use to select the 100 students to survey in order to get a “good sample” of the student body. Explain why this method is a good method, resulting in a representative sample of the student population.





**Friends Rock**

Name: ANSWER KEY

Tammy decides to survey one hundred of her closest friends who they think should play at the concert. Will Tammy's survey produce a good sample? Use mathematics to explain your answer. Use words, symbols, or both in your explanation.



Tammy's survey will not produce a good sample. Tammy's friends will produce a biased  
survey. Friends most likely enjoy the same type of music, or will vote for the type of  
music Tammy likes because she is their friend. Also, not everyone in the school is given  
a fair chance to be surveyed.

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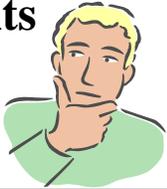
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Descriptor Cards

<b>Number of Students with Ponytails</b> 	<b>Number of Boys</b> 
<b>Number of Girls</b> 	<b>Number of Students Wearing Sneakers</b> 
<b>Number of Students with Earrings</b> 	<b>Number of Students Wearing Jeans</b> 
<b>Number of Students with Braces</b> 	<b>Number of Students with Glasses</b> 
<b>Number of Students wearing Sweatpants</b> 	<b>Number of Students with Blonde Hair</b> 
<b>Number of Students wearing Hoodies</b> 	<b>Number of Students with Ten Fingers</b> 
<b>Number of Students with Brown Hair</b> 	<b>Number of Students wearing a Watch</b> 
<b>Number of Students Wearing Skirts</b> 	<b>Number of Students using a Pencil</b> 

## Who's Who and What's What?



- Determine how many students in the classroom fit the description on the card.
- Use this information to predict how many people in the entire school will fit your descriptor.



- There are 1154 total students in our school.
- Write your prediction on the back of your index card. Show mathematics to support your answer.

*Hint: You may need to walk around the room in order to do this! It may also be helpful to determine how many students are in the class!*



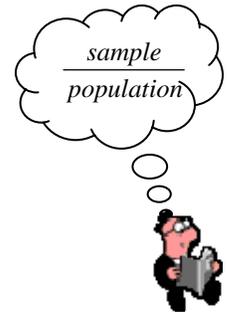
**Picking People Proportionally**

Name: \_\_\_\_\_

- Ms. Julian wants to order pencils for the school store. Pencils come in four styles: plain, star, "Happy Birthday", and scented. She randomly surveyed 50 students to determine which color notebook they would buy. The table below shows the results.

**Pencil Style Votes**

<b>Color</b>	Plain	Star	Happy Birthday	Scented
<b>Number of Votes</b>	16	22	5	7



Ms. Julian will order 800 pencils. How many star pencils should she order?

- The Orioles won 6 out of their 8 pre-season games. So far, they have won 39 games in the regular season. How many total regular season games have they played?
- One hundred randomly selected students from Parkville High School were surveyed to determine whether they would like lunch to last thirty more minutes. Of the students surveyed, 38 favored the change. Parkville High School has 1,600 students. According to the survey results, how many students would favor the change?
- In order to go through a toll, you must either use EZ Pass or pay in cash. A company conducted a random survey of 100 commuters to determine how they paid their toll fare. The survey results are shown in the table below.

**Toll Payment Survey**

<b>Number of People Who Use Cash</b>	<b>Number of People Who Use EZ Pass</b>
63	37

Mr. German, a tollbooth attendant for I-95, reported that 44 drivers through his booth one morning paid using a EZ Pass. Based on this survey, estimate how many drivers passed through his booth that morning. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

- There are 413 dolphins in an enclosed marine sanctuary. Scientists capture, tag, and release 30 dolphins. A month later, the scientists capture 100 dolphins. How many dolphins should the scientists expect to have tags? Round the answer to the nearest whole number.

6. Julia rolled a standard number cube 70 times and recorded her results in the table below.

**Results of 50 Rolls**

<b>Number</b>	<b>Frequency</b>
1	13
2	7
3	10
4	12
5	9
6	19

Based on the results in the table, how many times should Julia expect to roll a 4 or 5 if she rolls the number cube 600 times?

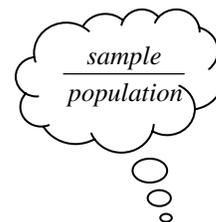
7. 75% of students surveyed went to the beach this summer. If there are 1150 students in your school, about how many would be expected to have gone to the beach?

## Picking People Proportionally

Name: \_\_\_ANSWER KEY\_\_\_

1. Ms. Julian wants to order pencils for the school store. Pencils come in four styles: plain, star, "Happy Birthday", and scented. She randomly surveyed 50 students to determine which color notebook they would buy. The table below shows the results.

Color	Plain	Star	Happy Birthday	Scented
Number of Votes	16	22	5	7



Ms. Julian will order 800 pencils. How many star pencils should she order?

352 star pencils

2. The Orioles won 6 out of their 8 pre-season games. So far, they have won 39 games in the regular season. How many total regular season games have they played?

52 regular season games

3. One hundred randomly selected students from Parkville High School were surveyed to determine whether they would like lunch to last thirty more minutes. Of the students surveyed, 38 favored the change. Parkville High School has 1,600 students. According to the survey results, how many students would favor the change?

608 students

4. In order to go through a toll, you must either use EZ Pass or pay in cash. A company conducted a random survey of 100 commuters to determine how they paid their toll fare. The survey results are shown in the table below.

Number of People Who Use Cash	Number of People Who Use EZ Pass
63	37

Mr. German, a tollbooth attendant for I-95, reported that 44 drivers through his booth one morning paid using a EZ Pass. Based on this survey, estimate how many drivers passed through his booth that morning. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

Approximately 119 drivers

5. There are 413 dolphins in an enclosed marine sanctuary. Scientists capture, tag, and release 30 dolphins. A month later, the scientists capture 100 dolphins. How many

dolphins should the scientists expect to have tags? Round the answer to the nearest whole number.

7 deer

6. Julia rolled a standard number cube 70 times and recorded her results in the table below.

**Results of 50 Rolls**

Number	Frequency
1	13
2	7
3	10
4	12
5	9
6	19

Based on the results in the table, how many times should Julia expect to roll a 4 or 5 if she rolls the number cube 600 times?

180 times

7. 75% of students surveyed went to the beach this summer. If there are 1150 students in your school, about how many would be expected to have gone to the beach?

Approximately 862-863 students

**La Bella  
Assessment**

Name: \_\_\_\_\_

1. At *La Bella* restaurant, the owner, Mr. Black, surveyed 25 random customers about their favorite appetizers. Ten people said their favorite appetizer was mozzarella sticks. If Mr. Black knows that there will be 200 customers eating in his restaurant, how many would be expected to order mozzarella sticks?



2. The next night at *La Bella*, Mr. Black conducted another survey using 40 random customers, and found that 15 of them ordered Mushroom Ravioli. At the end of the night, Mr. Black realized that 240 customers ordered Mushroom Ravioli. Based on the survey results, how many total people ate at *La Bella*?



**La Bella**  
**Assessment**

Name: ANSWER KEY

1. At *La Bella* restaurant, the owner, Mr. Black, surveyed 25 random customers about their favorite appetizers. Ten people said their favorite appetizer was mozzarella sticks. If Mr. Black knows that there will be 200 customers eating in his restaurant, how many would be expected to order mozzarella sticks?



$$\left( \frac{\text{sample}}{\text{population}} \right) \frac{10}{25} = \frac{x}{200} \quad \text{Let } x = \# \text{ people that ordered mozz. sticks.}$$

$$x = 80$$

80 people ordered mozzarella sticks.

2. The next night at *La Bella*, Mr. Black conducted another survey using 40 random customers, and found that 15 of them ordered Mushroom Ravioli. At the end of the night, Mr. Black realized that 240 customers ordered Mushroom Ravioli. Based on the survey results, how many total people ate at *La Bella*?



$$\left( \frac{\text{sample}}{\text{population}} \right) \frac{15}{40} = \frac{240}{p} \quad \text{Let } p = \# \text{ total people (population)}$$

$$p = 640$$

640 total people ate at *La Bella*.

# All for Algebra!

Descriptor Card

## Number of Students Taking Algebra I



- Using the class as your sample, determine the number of Algebra I students in the school. Remember, there are 1154 students in the school.

### Survey Placemat

Student 1 Name: _____	<ul style="list-style-type: none"> <li>• Is the sample a simple random sample? Justify your answer.</li> </ul>	<ul style="list-style-type: none"> <li>• Is the sample a simple random sample? Justify your answer.</li> </ul>	Student 2 Name: _____
<ul style="list-style-type: none"> <li>• How can you improve the sampling method so that it is a simple random sample?</li> </ul>	<p>Group Space</p>		<ul style="list-style-type: none"> <li>• How can you improve the sampling method so that it is a simple random sample?</li> </ul>
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Student 4 Name: _____			Student 3 Name: _____

**Survey Says...!**  
**Summative Assessment:**

Name: \_\_\_\_\_

1. **(BCR)**

The Student Council Advisor will survey 50 students to determine which after school activities to run next year. The Student Council Advisor will use one of the methods below.

**Method A:** Survey the first 50 students who enter the cafeteria on a randomly selected day.

**Method B:** Have 25 teachers each randomly select 2 eleventh-grade students to be surveyed.

**Method C:** Assign each student a number. Use a random number generator to generate 50 numbers. Survey those students whose numbers are generated.

- Which method will provide the Student Council Advisor with a simple random sample of the student population? Use principles of simple random sampling to justify your answer.

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- Use principles of simple random sampling to justify why each of the other two methods does not provide a simple random sample.

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2. In a large city, 300 randomly sampled registered voters were asked to state who they would vote for in the next local election. The table below shows the results of the survey.

<b>Candidate A</b>	<b>Candidate B</b>	<b>Undecided</b>
150	106	44

There are 10,000 people expected to vote in the next election. Based on the data, how many people will vote for Candidate A in the next election?

- A. 1,467  
B. 3,533  
C. 5,000  
D. 50,000
3. Jennifer owns a jewelry store. She wants to survey her costumers in order to determine who has heard the new radio advertisement for her store.
- A. Survey customers who live near her store.  
B. Survey customers who shop at her store on weekends.  
C. Survey customers who shop at her store early in the morning.  
D. Survey customers who shop at her store at different times throughout the week.
4. The Eighth-grade Advisor is conducting a survey to determine music preferences for the graduation slideshow. The Advisor decides to survey the first 100 students that enter the school on Friday. Which of these best describes why this type of sampling may give biased results?
- A. The sample size is too small.  
B. Students are randomly selected.  
C. Not all students have the same chance to be surveyed.  
D. Every other student entering the school should be surveyed.

**Survey Says...!**  
**Summative Assessment:**

Name: ANSWER KEY

1. **(BCR)**

The Student Council Advisor will survey 50 students to determine which after school activities to run next year. The Student Council Advisor will use one of the methods below.

**Method A:** Survey the first 50 students who enter the cafeteria on a randomly selected day.

**Method B:** Have 25 teachers each randomly select 2 eleventh-grade students to be surveyed.

**Method C:** Assign each student a number. Use a random number generator to generate 50 numbers. Survey those students whose numbers are generated.

- Which method will provide the Student Council Advisor with a simple random sample of the student population? Use principles of simple random sampling to justify your answer.

Method C will provide the Student Council Advisor with a simple random sample.

Every student is equally likely to be chosen and students are chosen independently of each other.

- Use principles of simple random sampling to justify why each of the other two methods does not provide a simple random sample.

Method A is not a simple random sample because not everyone is equally likely to

be chosen. Students who are absent that day or do not get to the cafeteria early

cannot be picked. Method B is not a simple random sample because everyone is not

equally likely to be picked. Only eleventh graders will be surveyed. Other grades

will not be represented.

2. In a small town, 250 randomly sampled registered voters were asked to state whether they would vote “Yes” or “No” on Measure A in the next local election. The table below shows the results of the survey.

**Voter Survey Results**

Yes	No	Undecided
120	96	34

There are 5,500 people expected to vote in the next election. Based on the data, how many people will vote “No” on Measure A in the next election?

- A. 1,467  
B. 3,533  
C. 5,000  
D. 50,000
3. Jennifer owns a jewelry store. She wants to survey her costumers in order to determine who has heard the new radio advertisement for her store.
- A. Survey customers who live near her store.  
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