**Sampling**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_\_\_

**Part 1: Lunch with the Principal**

The school principal is selecting two students from each class to go to a special lunch with her to get input from students about what changes they would like to see happen at the school. (The principal is renting a limo for the lunch trip!)

1) List some ways in which your teacher could select two students from your class for lunch with the principal.

 2) Do you think that any of the methods that your classmates came up with how to select a student are biased? Why?

3) a) If the teacher picked the 10th and 23rd students to walk into class for the period, would this be a biased method?

b) If every teacher in the school used this same method to pick students to attend lunch with the principal, would the students selected accurately reflect the entire population of the school? Why or why not?

4) a) If the principal only took 6th graders to the lunch, would this group accurately reflect the school population? Explain.

b) What if only the government of the student body (ASB or president, vice-president, secretary and treasurer) were selected and surveyed, would these students accurately reflect the school population?

**Part 2: Types of Sampling**

When businesses or researchers want to find out some particular information about a population to make ***inferences*** (a conclusion based upon evidence) they often use ***sampling*** as a method to collect data. However, for a ***sample*** to be ***valid***, it must meet certain constraints.

Two types of sampling often used are ***random sampling*** and ***convenience sampling***.

Two different survey questions are below, describe if you think they are an example of ***random sampling*** or ***convenience sampling***.

A) You are on a website playing a video game and a pop-up comes up asking you to take a survey about a new video game coming out.

I think this is an example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sampling because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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B) You are out shopping with a friend and are approached by someone conducting a survey about what type of fast food restaurant you would like to see open in your neighborhood.

I think this is an example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sampling because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

***Random sampling*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Example: |

***Convenience sampling*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Example:  |

When ***sampling***, it is important that the sample be ***unbiased***. What do you think ***unbiased*** means?

\*Class definition of ***unbiased*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Unbiased Sampling**

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| Method | Examples |
| Each item or person in the population is likely to be chosen as any other. |  |
| Items or people are selected according to a time (interval), or random generator.  |  |

**Biased Sampling**

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| Method | Examples |
| A convenience sample; selecting people that are easily accessible.  |  |
| Voluntary response; people choose to participate in the survey.  |  |

**Part 3: Valid vs. Invalid**

When looking at data collected from ***sampling***, key questions that you need to ask yourself are:

* Who was surveyed?
* What were they asked?
* What kind of sampling method was used?
* Does this sampling produce unbiased results?
* Is the conclusion valid?

Using the 15 cards your teacher has provided, sort them by asking yourself, will the sample produce valid results. Next to each number, write if the sampling method is valid, or not valid. If it is NOT valid, explain why. If it is valid, explain what ***inference*** can be drawn. Number 2 has been done for you.

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| 1) |
| 2) Invalid; the survey population is not large enough and the math is wrong! |
| 3) |
| 4)  |
| 5) |
| 6) |
| 7) |
| 8) |
| 9) |
| 10) |
| 11) |
| 12)  |
| 13) |
| 14) |
| 15) |

**Teacher Directions: Sampling**

**Materials:**

* Copies of Sampling Worksheet (1 per student)
* Copies of Sample Sort: Valid or Invalid (1 set cut up per pair or group of students)

**Engaging Students in the Lesson**

To engage students with a fun look at sampling, start the lesson by watching the **first minute** of a game of Family Feud. This is a show in which contests must come up with the top responses to a survey question from 100 respondents. An appropriate episode can be found at: <http://www.youtube.com/watch?v=bT_DEZz99VQ>

**Part 1: Lunch with the Principal**

Pass out Sampling worksheet, and have a student volunteer read the scenario, Lunch with the Principal.

* Have students answer question 1 alone for 1 minute, and then share with a partner for one minute. Select pairs to share ways in which you, the teacher, could choose two students from your class to have lunch with the principal. Record these on the board. Possible responses are:
	+ Pull our names using popsicle sticks.
	+ Randomly select a number from your grade book.
	+ Choose one boy and one girl.
	+ Chose the two students with the highest grades.
	+ Choose your two favorite students. (A pair might suggest that the favorite students are them!)
	+ Put our names in a hat.
* Once you have a nice list of possible ways at selecting students, have students answer question 2, and then have a class discussion about which of the methods you listed on the board would indicate bias, and which would not. You may need to define the word bias for the class first. A simple definition is:
	+ In [statistics](http://en.wikipedia.org/wiki/Statistics), **sampling bias** is a [bias](http://en.wikipedia.org/wiki/Bias) in which a sample is collected in such a way that some members of the intended [population](http://en.wikipedia.org/wiki/Statistical_population) are less likely to be included than others.
* Have students answer questions 3 and 4 alone, and then work with a partner to compare answers. Have students share their responses and clarify their understanding about bias and sampling.

 **Part 2: Types of Sampling**

Ask for a student volunteer to read the paragraph at the top of page 2. Have students fill in the definitions for *random sampling* and *convenience sampling*. Note: These definitions are simplified for 7th grade content. There are many other types of sampling, and more sophisticated definitions.

Have students read the two examples and ask them to determine if the sample is a random or convenience sample. Ask for volunteers to explain which they believe is the random and/or convenience sample and why.

**Random Sampling***:* a method of data collect that ensures each portion of the population undergoing the study has a chance to be selected at random.

**Convenience Sampling**: the sample is drawn from the population close at hand.

* After students fill in the definitions, have a class discussion, asking students what they think are examples of *random sampling* and *convenience sampling*.
* Read the sentence about samples needing to be unbiased. Have students write their own definition. Come together as a class and have students share out their definitions, while you record them. Come to a consensus regarding a definition. It should be something similar to:
	+ A sample is ***unbiased*** if every individual in the population has an equal chance of being selected.
* Quiz students on their understanding of bias. Read the following taken from iCoachMath.com. Once students have had a chance to think of an answer, ask student volunteers to explain what they think is the correct answer. Poll the class using thumbs up/down as to whether they agree that the example is appropriate
	+ **Question**: Kathy wants to know how many students in her city use the internet for learning purposes. She used an email poll. Based on the replies to her poll, she found that 83% of those surveyed used the internet. Is Kathy’s sample biased or not?
	+ **Answer**: Kathy’s sample is biased as she surveyed only the students those who use the internet. She should have randomly selected a few schools and colleges in the city to conduct the survey.
	+ **Question:** Which one of the following sampling methods would give unbiased results, if you need to find the number of people in your town liking vanilla or chocolate ice creams?
1. ask my neighbors
2. randomly select a few ice cream shops in tow, and question people coming there
3. ask my friends
4. ask my classmates
* **Answer**: B; among the choices listed, randomly selecting a few ice cream shops in town and questioning people coming there would be a good sampling method as people of different age groups have a chance of being surveyed. It could be representative of the entire population of the town.
* Have students work with a partner for 4-5 minutes, filling in the tables, providing examples of each situation. Once students have had a chance to fill in the tables, ask student volunteers to read their examples and then poll the class using thumbs up/down as to whether they agree that the example is appropriate. Continue until you have a good sampling ☺ that the class understands!

**Part 3: Invalid v. Valid**

* Pass out the Valid or Invalid situation cards. You can choose to have students work in pairs, or in groups. If working in groups, assign group roles, such as:
	+ Manager: Passes out cards equally to each member of the group, and makes sure that students take turns reading their cards.
	+ Timekeeper: Makes sure that the group spends no more than 1 minute per card.
	+ Recorder: Records answers for their group to share out with the class.
	+ Motivator: Keeps the group moving along, and conversations to the task at hand.
* Have students read the top of the worksheet and then quiz them about what they are looking for that would make a sample valid or invalid. Refer back to the examples about biased sampling.
* Give students 15-20 minutes to sort cards and to fill out the table provided. Walk around to monitor student understanding, asking students to justify why they believe a certain sampling might be invalid. (Note: If 15 cards seems to be too much for the class, have them randomly select 7 situations to determine if the sampling is valid or not.)
* Once students are finished with their sort, and can justify why certain samples are invalid, randomly select pairs or groups to share out their reasons.
* Note: The objective of this section is not to be right or wrong, but to have a class discussion about why a sample is valid or invalid.

Answer Key:

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| 1) Valid; each student has an equal chance of holding the white beads |
| 2) Invalid; sample population is not large enough and math is not correct! |
| 3) Invalid; the reporter interviewed people in the summer, injuries would be different during other times of the year; is the hospital near the beach? Summer destination? |
| 4) Invalid; do Alaskan’s use air conditioning? Randomly select families from all 50 states.  |
| 5) Valid, although only 3 papers might not be a large enough sample. Students understood the homework from the night before.  |
| 6) Valid; by going to a sporting goods store and randomly sampling people you could argue he would have a greater probability of finding someone who plays golf, say over than the grocery store |
| 7) Invalid; the art teacher is only asking art students, which would skew the sample |
| 8) Invalid; the real estate agent should have polled people equally from all types of dwellings |
| 9) Valid; using random intervals a valid inference can be made the corn is the favorite vegetable |
| 10) Valid; all phones have an equal chance of being sampled for quality control |
| 11) Invalid; survey is voluntary and not representative of the population |
| 12) Invalid; Elvio’s inference is invalid as all seat sections had an equal chance of being chosen from the entire population of sections |
| 13) Invalid; an inference cannot be made and the response is voluntary |
| 14) Invalid; voluntary, which will not be representative of the entire population |
| 15) Answers will vary! |

**Sample Sort: Valid or Invalid**

Cut up 1-set for each pair or group of students.

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| 1) One bead for every member of the school orchestra is placed in a bag. All but 2 of the beads are white. Each member draws a bead from the bag, and the members who pick the non-white beads will represent the orchestra. It is predicted that two different instrument players will choose the non-white beads. | 2) To evaluate the defect rate of its memory chips, an integrated circuit manufacturer tests every 100th chip off the production line. Out of 10 chips tested, one chip is found to be defective. The manufacturer concludes that 3 chips out of 3,000 will be defective. | 3) To determine the most common injury cared for in an emergency room, a reporter goes to the same hospital every afternoon for one month during the summer and observes people entering the emergency room. She concludes that second-degree sunburn is the most common injury. |
| 4) To find out how much money the average American family spends to cool their home, 100 Alaskan families were surveyed at random. | 5) To determine if the class understood the homework assignment, the math teacher checks the top 3 papers in the pile of collected homework. The teacher finds that all students understood the homework assignment. | 6) Zach is trying to decide which of three golf courses in the area is the best, so he randomly surveyed people at a sports store. |
| 7) To determine whether students at your school will attend the local art festival, the art teacher surveys students in the art club. | 8) A real estate agent surveys people about their housing preferences at an open house for a luxury townhouse. He finds that most people prefer townhomes. | 9) A member of the cafeteria staff asks every fifth student leaving the cafeteria to rank 5 vegetables from most favorite to least favorite. She finds that corn is one of the favorite vegetables. |
| 10) To evaluate the quality of their product, a manufacturer of cell phones checks every 50th phone.  | 11) To determine the most popular children’s programs, a television station asks parents to call in and complete a phone survey. The television station finds that the children’s programs that are animated are the most popular. | 12) To award prizes at a hockey game, four tickets with individual seat numbers printed on them are picked from a barrel. Since Elvio’s section was not selected for any of the four prizes, he assumes thatthey forgot to include the entire section in the drawing. |
| 13) A magazine asks its readers to complete and return a questionnaire about popular television actors.  | 14) Your mom entered the freeway behind a Prius, who was driving very slowly. Your conclusion is that all Prius drivers drive slowly.  | 15) Make your own ***valid*** scenario. |