Lesson Plan 4:
The History and Use of Sampling Methods

Grades
6-8, 9-12, College 100 level

Description
Students learn about sampling by tracing improvements in sampling procedures over the twentieth century. Scientific inquiries involving flawed sampling are illustrated and discussed using the Literary Digest poll in 1936 and the Gallup presidential poll of 1948. Scientific inquiries involving improved sampling methods are illustrated and discussed using Gallup's quota sample in 1936 and the random probability samples used today to illustrate the power of good sampling. Students will apply concepts through sampling exercises.

Learning Objectives
By fully participating in this lesson, students will be able to:

(1) define a population;
(2) draw a convenience sample from the population;
(3) draw a quota sample from the population;
(4) draw a random probability sample from the population;
(5) explain why a random probability sample usually gives more accurate results;
(6) explain a famous example of a convenience sample that failed; and
(7) explain a famous example of a quota sample that failed.

Time Required
This lesson is expected to require approximately 5 hours of class time.

Materials and Resources
NOTE: You will need to have Adobe Acrobat installed on your computer to access the Student Worksheets. You may download Adobe Acrobat free of charge at http://www.adobe.com/products/acrobat/readstep.html.

For this lesson you will need:
1. Computers connected to the internet for conducting research and to access “The First Measured Century” website.

2. Television, VCR, and videotape of the first hour of “The First Measured Century,” which can be purchased at [http://www.shop.pbs.org](http://www.shop.pbs.org), ordered by phone by calling 1-800-PLAY-PBS, or recorded during the broadcast:

   **The First Measured Century Premieres on PBS Wednesday December 20th, 2000 from 8:30 to 11:30 PM Check your local listings at:** [http://www.pbs.org/whatson/index.html](http://www.pbs.org/whatson/index.html)

Schools are permitted to tape The First Measured Century and use the program for educational purposes for one year following each PBS broadcast. Additional information about teacher taping rights can be found at PBSTeachersource: [http://www.pbs.org/teachersource/copyright/copyright_trights.shtm](http://www.pbs.org/teachersource/copyright/copyright_trights.shtm)

**Teaching Strategy**

**Class Session 1**

1. Prepare for this lesson by queuing “The First Measured Century” to the Gallup Poll segment of the program. This segment is the last segment of tape 1 and starts around 1 hour and 17 minutes into the tape where Ben is saying, "What did Americans of the 1930s think..."

2. Once the video is set to begin, prepare students for learning by discussing definitions and concepts as described below:

   - A population is a collection of things that you want to study, such as all immigrants or all high school students or all recently-married people.
   - A sample is a smaller group of things chosen from the population to represent the population. For example, all the students in your school constitute a population. All the students in your class are a sample of this population of students. What are some other samples of this population?
   - Ask the students to come up with samples of this population. [all the male students; all the female students; all the seniors; all the students with glasses; every tenth student as they walked in the door this morning; all the students who voted in the last school-wide election]
   - Discuss why would anyone want to sample a population? Usually because it is cheaper than measuring the entire population. Or because measuring the whole thing is impossible. [how would you do a blood test without sampling?]
   - But all these samples are not equally useful. One of the most important scientific discoveries of the 20th century is that some samples can be very powerful if they are chosen in certain ways. In the 20th century, scientists discovered that the size of a sample is much less important than how the sample is chosen. If the sample is chosen correctly, then a sample of just a hundred people can give accurate answers about the entire American population of 275 million people.

3. Distribute the student handout and go over each of the questions on it. The students are to take notes while viewing the program in preparation for answering the questions on the handout.
4. Show the Gallup segment of the First Measured Century video. Pay particular attention to the samples discussed in the video.

5. Provide any remaining class time for students to complete the worksheet questions. Offer to discuss questions students may have in order to enhance understanding. For more information, direct students to the website for the Gallup segment transcript and interviews with Gallup's sons about their father and also about different sampling methods.

Class Session 2

1. Conduct the following discussion as a review of the concepts and definitions presented in the previous class.
   - What kinds of samples are shown in the video? [Literary Digest: convenience sample; Gallup in 1936 and 1948: quota sample]
   - What are the pros and cons of the different kinds of samples?
   - What is the standard kind of sample today? [random probability sample]
   - What is a random probability sample? [sample composed of elements chosen at random; meaning each individual in the population had an equal chance of getting into the sample]
   - How can you contact a random probability sample of telephone-equipped Americans?

Activity 1:

- Have the students practice drawing convenience samples.
- Have the students think of the class as a population.
- Have a student draw a convenience sample of the population.
- Get several more convenience samples.
- Can the students think of a way that these samples are unrepresentative of the class?
- Would the sample answer any question the same way the class would? [For example, suppose the convenience sample is all the girls who have long hair. Suppose we want to know what percentage of the class gets their hair cut at the barber shop. If we ask our sample, we will probably get an answer of 0%, which is probably wrong for the class as a whole, because our convenience sample is unrepresentative of the class.]

Activity 2:

- Have students come up with a quota sample of the class. [One male athlete, one female athlete; one student who drives to school; one student who walks, etc. This sample is probably better, but still not the best.]
- Draw some more quota samples.

Activity 3:

- Have the students come up with a random probability sample of the class by following these steps:
  
  Step 1: Assign each student a number from 1 to however many students are in the class. How you assign the numbers make no difference at all. You can have the students count off. Have the students write down their number on two slips of paper.
Step 2: Collect one slip from each student into a box or bag or envelope.

Step 3: Without being able to tell the slips apart, draw a slip from the bag and read the number. The student whose number is chosen goes to the front of the room. Do not replace the slip in the bag until the entire sample is drawn. Draw five more numbers, sending five more students to the front of the room. You have now drawn a random probability sample of six students from the population of the class.

Step 4: Put all the slips back in the bag. Repeat step 8.3 to draw another random sample of six students. Step 5: Repeat steps 1 through 5 several times. Notice that the sample is usually different people. [The odds of drawing the same 6 people twice in row from a class of 25 students are 117,100 to 1.]

Class Session 3, 4 and 5

Activity 4:

- For a partial scientific inquiry, divide the class into groups and have each group add a research question to be investigated with each of the sampling techniques as a comparison.
- Have each group demonstrate by conducting and presenting their sampling techniques and results to the class. For example, if you want to know the average height of students in the class. Take a convenience sample, a quota sample and a random sample and compare the average height in the samples to the average height in the class as a whole.

Assessment Recommendations

- Examine the students’ worksheets. The worksheet should be correctly completed.
- Each student should participate in the drawing of samples.
- Each student should draw different kinds of samples, and be part of samples that are drawn from the class.

Related Links

The Gallup Organization:
http://www.gallup.com/

Extensions

Conduct a full scientific inquiry as a class project, developing questions, conducting a survey, analyzing the results, creating the report and presenting the data.

Adaptations

For younger students limit the activities to conducting some of the shorter sampling exercises where students participate. Have students take turn keeping track of results on the board.
Lesson Plan 4

Relevant Standards

Standards for School Mathematics
From the National Council of Teachers of Mathematics (http://www.nctm.org)

Data Analysis and Probability

Instructional programs from prekindergarten through grade 12 should enable all students to—

- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
- select and use appropriate statistical methods to analyze data;
- develop and evaluate inferences and predictions that are based on data;
- understand and apply basic concepts of probability.

Communication

Instructional programs from prekindergarten through grade 12 should enable all students to—

- organize and consolidate their mathematical thinking through communication;
- communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- analyze and evaluate the mathematical thinking and strategies of others;
- use the language of mathematics to express mathematical ideas precisely.

Connections

Instructional programs from prekindergarten through grade 12 should enable all students to—

- recognize and use connections among mathematical ideas;
- understand how mathematical ideas interconnect and build on one another to produce a coherent whole;
- recognize and apply mathematics in contexts outside of mathematics.

Representation

Instructional programs from prekindergarten through grade 12 should enable all students to—

- create and use representations to organize, record, and communicate mathematical ideas;
- select, apply, and translate among mathematical representations to solve problems;
- use representations to model and interpret physical, social, and mathematical phenomena.
Science as Inquiry

CONTENT STANDARD A: As a result of activities in grades 5-8 and 9-12, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry