subjects in both treatment groups appear to be treated exactly the same way.
In an **evaluator-blind** experiment, the person who evaluates how well the treatment works does not know which treatment the subject received. If an experiment is both subject blind and evaluator blind, it is called a **double blind**.

a. The Salk experiment was double blind. One reason this was nessesary was because the diagnosis of polio is not clear-cut. Cases that cause paralysis are obvious, but they are the exception. Sometimes polio looks like a bad cold and so professional judgement is needed. How might a doctor's knowledge of whether or not a child had been immunized affects his or her diagnosis? How might this lead to the wrong conclusion about how well the vaccine works?

b. Could you make the penny-stacking experiment subject blind? Evaluator Blind? Double Blind? Expalin

6. A lurking variable helps to explain the association between the treatments and the response but is not the explanation that the study was designed to test. Treatments are assigned randomly to Subjects ~~sbjuects~~ to equalize the effects of possible lurking varialbes amoung the treatment groups as much as possible. Analyze each of the following reports of studies with particular attention to possible lurking variables.

a. Researchers from the Minnesota Antibiotic Resistance Collaborative reported an attempt to deal with the problem that bacteria are becoming resistant to antibiotics. One reason for increasing resistance is that some people want antibiotics when

they have a cold, even though cold viruses do not respond to antibiotics.
Five medical clinics distributed colorful kits containing Tylenol decongestant, cough syrup, lozenges, powdered chicken soup, and a tea bag to patients with cold symptoms. At five other medical clinics, patients with similar symptoms were not given these kits. Patients with colds who visited clinics that made the kits available were less likely to fill prescriptions of antibiotics than patients with colds who visited clinics where the kits were not available.

i. What are the treatments in the study? What is the response variable?

ii. Why is this not a well-designed experiment? How could you improve it?

iii. What lurking variable might account for the difference in responses?

b. Researchers supplied 238 New York City households with hand-washing soaps, laundry detergents, and kitchen cleansers. Half of the households, selected at random, were given antibacterial products, and the other half received products that were identically packaged but without the antibacterial ingredient.
The participants were asked weekly about any disease in the household. The researchers found no differences in frequency of infectious disease symptoms over one year.

i. Does this study have the three characteristics of a well-designed experiment?

ii. Suppose that instead of assigning the treatments at random to the households, the researchers simply compare the frequency of infectious disease symptoms one a year in households that use the antibacterial products and those that do not. Describe lurking variables that might invalidate the conclusion of the study.

c. A December 2004 article on Washingtonpost.com entitled "In AP-vs-IB Debate, A Win for Students" reports on a study by the National Center for Education Accountability that show that "even students who fail AP examinations in high school are twice as likely to graduate from college in five years as students who never try AP." This study followed 78,079 students in Texas.

i. What are the treatments? What is the response variable?

ii. Do you think that the conclusion came from a well-designed experiment?

iii. What lurking variables could account for the differences in response for the two groups?

iv. Can you design an experiment to establish that taking AP courses, even if you fail the exam, means you are more likely to graduate from college in five years?

What you will learn about:
Statistical Studies

The three main types of statistical studies are described below.

- ***sample survey or poll***: You observe a random sample in order to estimate a characteristic of the larger population from which the sample was taken. Getting a **random sample of size *n*** is equivalent to writing the name of every member of the population on a card, mixing the cards well, and drawing n cards.
- ***experiment***: You randomly assign two (or more) treatments to the available subjects in order to see which treatment is the most effective.
- ***observational study***: The conditions you want to compare come already built into the subjects that are observed. Typically, no randomization is involved.

1. Suppose you want to investigate the effects of exercise on the blood pressure of students in your school. You have thought about three different study designs. Classify each design as a sample survey, an experiment, or an observational study.

Study 1: You ask for volunteers from the students in your school and get 30 students willing to participate in your study. You randomly divide them into two groups of 15 students. You ask one group not to exercise at all for the next week, and you ask the other group to do at least 30 minutes of exercise each day. At the end of the week, you find that everyone complied with your instructions. You then take each student's blood pressure. You find that the mean blood pressure of the students who exercised is lower than the mean blood pressure of the students who did not exercise.

Study 2: You get a list of all students in your school and use a random digit table to select 30 of them for your study. You take these students' blood pressure and then have them fill out a questionnaire about how much exercise they get. You divide them into those who exercise a lot and those who exercise less. You find that the mean blood pressure of the students who exercise more is lower than the mean blood pressure of the students who exercise less.

Study 3: You discover that the nurse in the health office at your school has taken the blood pressure of 157 students who have visited the health office over the past year for a variety of reasons. In some cases, they felt sick; and in other cases, they had to turn in routine paperwork. You get the names of these students and have them fill out a questionnaire about how much exercise they get. You find that the mean blood pressure of the students who exercise more is lower than the mean blood pressure of the students who exercise less.

2. In each study in problem 1, there was an association between amount of exercise and blood pressure. Assume that in each case the difference in mean blood pressure was statistically significant. Answer the following questions for each study in Problem 1.

a. Is it reasonable to conclude that it was exercise that caused the lower blood pressure? Explain your thinking.

Study 1

Study 2

	Study 3 b. Can you generalize the results of this study to all of the students in your school? Explain you thinking? Study 1 Study 2 Study 3 c. Exactly what can you conclude from this study? Study 1 Study 2 Study 3

3. Refer to the Problem 6 Part c on page 6 about students who take AP examinations in high school.

a. What type of study is this?

b. State the conclusion that can be drawn.

4. Every four year, the Gallup organization tries to predict the winner of the U.S. presidential election. They do this by first creating a list of all possible household phone numbers in the United States. They then phone several thousand households using random digit dialing, calling back if no one answers. An adult is selected at random from each household and interviewed about whether he or she intends to vote and for whom.

a. What type of study is this?

b. Explain why households cannot be selected by phone books.

c. Are all adults in the United State equally likely to be in the sample? Explain.