Today's Agenda:
1. Introduction to Experiments
2. Activity 5-1 (with vocabulary)
3. Activity 5-2
4. Activity 5-3
5. Do Homework Activities 5-7, 5-17 & 5-23

Objectives:
• Students will be able to determine if a study is an experiment or not.
• Students will be able to randomly assign subjects to groups (control and treatment) in an experiment.
• Students will be able to state why random assignment is necessary in an experiment.
• Students will be able to sketch a flow chart of an experiment's design.

Well-Fed Rats

A researcher feeds one group of rats a normal diet and another group of rats a diet with 2500 parts per million of a toxic material. After 8 weeks, the rats that have been fed the normal diet have gained an average of 335 grams and the rats that have been fed the toxic diet gained an average of 289 grams.

Observational Units = rats

Variable #1 = diet (CB)

Variable #2 = weight (Q)

Did this data come from a survey, an observational study, or an experiment?
Exercise and heart attacks
A researcher assigns one group of men over 40 to a supervised regular exercise program and assigns another group of men over 40 to not exercise regularly. The researcher follows both groups of men for 5 years and records whether or not each man had a heart attack.

Observational Units = men over 40

Variable #1 = exercise or not (CB)

Variable #2 = heart attack or not (CB)

Did this data come from a survey, an observational study, or an experiment?
Observational Units = men over 40
Variable #1 = exercise program or not (CB)
Variable #2 = heart attack or not (CB)

Explanatory Variable = exercise
Response Variable = heart attack

Experimental Flow Chart =

**Violence and Video Games**

A researcher recruits a group of teenagers who play violent video games like Mortal Kombat and Grand Theft Auto: Vice City. They followed the teens around for three months to see if the students exhibited violent behaviors as a result of playing the games.

Observational Units =
Variable #1 = violent behavior

Did this data come from a survey, an observational study, or an experiment?
THE 3 PRINCIPLES of EXPERIMENTATION
(and why we use them)

1. CONTROL - reduces variability
2. REPLICATION- verifies accuracy of experiment results
3. RANDOMIZATION- reduces bias

The FIRST principle of experimentation:

CONTROL =
the overall effort to minimize variability in the way experimental groups are obtained and treated.

DO NOT CONFUSE
EXPERIMENTAL CONTROL and CONTROL GROUP

CONTROL GROUP =
receiving either the conventional (regular) treatment, or the placebo (sham) treatment.
The SECOND principle of experimentation:

REPLICATION =
the repetition used within your experiment; we replicate by having enough subjects so we reduce chance variation; we replicate by repeating the experiment multiple times on different subjects; we replicate by having others repeat our experiment to verify our results.

The THIRD principle of experimentation:

RANDOMIZATION =
the rule used to assign the experimental units to the treatments; we rely on chance for assigning subjects to treatments; we rely on chance to balance out any lurking variables we may not have thought about
Activity 5-1: Testing Strength Shoes

a. If your friend who wears strength shoes can jump much farther than another friend who wears ordinary shoes, would you consider that compelling evidence that strength shoes really do increase jumping ability?

No.  
Explain.  
There is no experiment involved so we cannot establish a cause and effect relationship between the shoes and jumping ability. At best, this is an observational study.

Topic 5: Designing Experiments  
Vocabulary

• anecdotal evidence (5-1) = recall of situations that easily come to mind; personal experiences; not a reliable way of collecting data
b. Suppose that you take a random sample of individuals, identify who does and does not wear strength shoes, then compare their jumping ability. Identify the following:

<table>
<thead>
<tr>
<th>Explanatory variable:</th>
<th>Type</th>
<th>Response variable:</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>wear strength shoes or not</td>
<td>CB</td>
<td>jumping ability (jumping height)</td>
<td>Q</td>
</tr>
</tbody>
</table>

c. Even if the strength shoe group tends to jump much farther than the other group, can you conclude legitimately that strength shoes cause longer jumps?

No. Explain. Again, this is an observational study... we are not controlling anything. We cannot establish cause and effect.

d/e. If you have 12 subjects and want to assign them to two groups in an effort to balance out potentially confounding variables, how might you do that?

**Random Number Table:** We could assign ID numbers 01 to 12 to each person and generate random numbers. The first 6 numbers are the people in the strength shoe group and the rest are in the non-strength shoe group.

**Coin:** We could flip a coin as we go through the list of names. Heads, the person is in the strength shoe group, tails they are not. We keep flipping until one of the groups is full. The rest of the people go in the other group.

**Dice:** We could roll a die as we go through the list of names. Evens, the person is in the strength shoe group, odds they are not. We keep rolling until one of the groups is full. The rest of the people go in the other group. (Or we could assign digits 1, 2 and 3 to one group and 4, 5 and 6 to the other.)

**Names in a Hat:** We could write each name on an index card (all cards are the same size) and put them in a "hat". Pull out names until one group is full. The rest of the people go in the other group.

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**Activity 5-2:**

**Testing Strength Shoes**

Use the list of 12 subjects on pg. 76 to complete this activity. Write all 12 subjects’ names on index cards.

a. Shuffle the cards and randomly draw 6 cards. These people will be in the strength shoe group. The remaining 6 will be in the ordinary shoe group. Draw a table like the one on pg 77 with the names, gender and height for all 12 people.

b. Calculate the proportion of men in the strength shoe group. Calculate the proportion of men in the ordinary shoe group. Subtract the two proportions: strength - ordinary

c. Calculate the average height in the strength shoe group. Calculate the average height in the ordinary shoe group. Subtract the two averages: strength - ordinary

d. Are the two groups identical?

Are the two groups similar?

e. Combine class results. (see following page for results)
Differences in Proportions of Men

The results should be centered around 0. This means that there tend to be 0 differences in the two groups.

Differences in Average Height

The results should be centered around 0. This means that there tend to be 0 differences in the two groups.
Activity 5-3:
Testing Strength Shoes

Growth of cataracts

Eye cataracts are responsible for over 40% of blindness around the world. Can regularly drinking tea slow the growth of cataracts? We can’t experiment on people, so we use rats as subjects. Researchers injected 18 young rats with a substance that causes cataracts. One group of the rats also received black tea extract, a second group received green tea extract, and a third group got a placebo (a substance with no effect on the body). Over the course of six weeks, the researchers checked the rats for growth of cataracts.

Observational Units =

Variable #1 =

Variable #2 =

Did this data come from a survey, an observational study, or an experiment?

Explanatory Variable =

Response Variable =

Experimental Flow Chart:
Growth of cataracts - ANSWERS

Observational Units = rats

Variable #1 = types of tea (C)

Variable #2 = cataracts or not (CB)

Did this data come from a survey, an observational study, or an experiment?

Explanatory Variable = types of tea

Response Variable = cataracts or not

Experimental Flow Chart:

- Random Assignment
- rats injected with substance that causes cataracts
- Treatment 1: black tea extract
- Treatment 2: green tea extract
- Treatment 3: placebo
- growth of cataracts?

Homework #1:

Activities 5-7, 5-17 (for part a, draw a flow chart instead of giving a description)

& 5-23 (for part b, draw a flow chart instead of giving a description)
Attachments

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