

The drug company Pfizer wants to test whether the drug "Lipitor" causes a decrease in cholesterol for adults with high cholesterol. They recruit 894 adults with high cholesterol and require each of them to take one pill a day for six months. Half of them (447) are randomly selected to take Lipitor, while the other 447 are randomly selected to take an identical salt-water pill with no medicine in it. At the end of six months, they measure the change in cholesterol for all 894 adults. They find that the cholesterol level of the adults who took Lipitor decreased twice as much as the cholesterol level of the other adults.

Identify the:

Subjects: 894 adults with high cholesterol

Explanatory Variable: pill taken

Response Variable: change in cholesterol

Treatments: Lipitor, salt-water pill

Placebo: salt-water pill

Control Group: 447 subjects taking salt-water pill

Treatment Group: 447 subjects taking Lipitor

Does adding fertilizer affect the productivity of tomato plants? How about the amount of water given to the plants? To answer these questions, a gardener plants 24 similar tomato plants in identical pots in his greenhouse. He will add fertilizer to the soil in half of the pots. Also, he will water 8 of the plants with 0.5 gallons of water per day, 8 of the plants with 1 gallon of water per day and the remaining 8 plants with 1.5 gallons of water per day. At the end of three months he will record the total weight of tomatoes produced on each plant. Identify the explanatory and response variables, experimental units, and list all the treatments.

Explanatory Variable: amount of fertilizer, amount of water

Response Variable: productivity of tomato plants / total weight of tomatoes produced

Treatments: fertilizer + 0.5 gal water

no fert. + 0.5 gal water

fertilizer + 1 gal water

no fert. + 1 gal water

fertilizer + 1.5 gal water

no fert. + 1.5 gal water

Is diet or exercise effective in combating insomnia? Some believe that cutting out desserts can help alleviate the problem, while others recommend exercise. Forty volunteers suffering from insomnia agreed to participate in a month-long experiment. Half were randomly assigned to a special no-desserts diet; the others continued desserts as usual. Half of the people in each of these groups were randomly assigned to an exercise program, while the others did not exercise. Those who ate no desserts and engaged in exercise showed the most improvement.

Identify the:

Subjects: 40 volunteers with insomnia

(general) Explanatory Variable: diet, exercise

Response Variable: change in insomnia/sleep

(specific) Treatments: no desserts + no exercise  
no desserts + exercise  
desserts + no exercise  
desserts + exercise

Doctors identify "chronic tension-type headaches" as headaches that occur almost daily for at least six months. Can antidepressant medications or stress management training reduce the number and severity of these headaches? Are both together more effective than either alone? Investigators compared four treatments: antidepressant alone, placebo alone, antidepressant plus stress management, and placebo plus stress management. The headache sufferers named in the following table have agreed to participate in the study.

Acosta	Duncan	Han	Liang	Padilla	Valasco
Asihiro	Durr	Howard	Maldonado	Plochman	Vaughn
Bennett	Edwards	Hruska	Marsden	Rosen	Wei
Bikalis	Farouk	Imrani	Montoya	Solomon	Wilder
Chen	Fleming	James	O'Brian	Trujillo	Willis
Clemente	George	Kaplan	Ogle	Tulloch	Zhang

Identify the:

Subjects: headache sufferers listed

Explanatory Variable: antidepressant, stress man. training

Response Variable: change in amount<sup>\*severity</sup> of headaches

Treatments: antidepressant alone

placebo alone

antidepressant + stress management

placebo + stress management

Results should be statistically significant and important. But, the experiment (treatment, subjects, environment) must be **realistic**.

**Example 6.12 (pg. 280):** Studying frustration.

A psychologist wants to study the effects of failure and frustration on the relationships among members of a work team. She forms a team of students, brings them to the psychology lab, and had them play a game that requires teamwork. The game is rigged so that they lose regularly. The psychologist observes the students through a one-way window and notes the changes in their behavior.

Does the behavior of the students in the lab tell us much about the behavior of a team in a work environment? Why/Why not?

No → the difference in the environment can change results

Subjects: the team of students being studied

Treatment: rigged game

Environment: the psychology lab

**Example 6.13 (pg. 280):** Center brake lights

Cars sold in the U.S. since 1986 have been required to have a high center brake light in addition to the usual two brake lights at the rear of the vehicle. This safety requirement was justified by a randomized comparative experiment with fleets of rental and business cars. The experiments showed that the 3<sup>rd</sup> brake light reduced rear-end collisions by 50%. In 1997 the Insurance Institute did another experiment on 3<sup>rd</sup> brake lights and found that only 5% reduced rear-end collisions. What happened? Why did the percentage of reduced rear-end collision decrease so dramatically?

3<sup>rd</sup> brake lights became more common so they didn't catch the attention of drivers as much

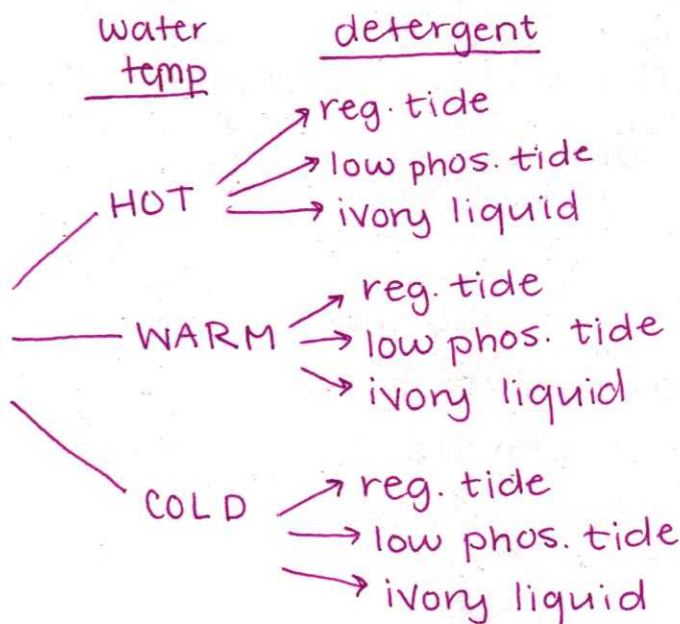
**Example 3:** Doctors are testing a new diet pill to help female patients lose weight. They selected 350 females of similar height and weight and split them into 3 groups. One group received the new diet pill, the second group received an already popular diet pill on the market, and the third group received the placebo. The study was conducted over a 6 month period. Females that took the new diet pill showed a 30% reduction in weight loss over the patients that took the on the market pill and a 50% reduction over the patients that took the placebo. Can we expect these same results if this diet pill was available for the general public to buy? Why or why not?

The results would likely be different (not as drastic) because other variables wouldn't be controlled like they could be in an experiment

Interaction – when an experiment can have combinations of explanatory variables that explain the response variable.

**Example 6.15:** Durability of fabric after repeated washings.

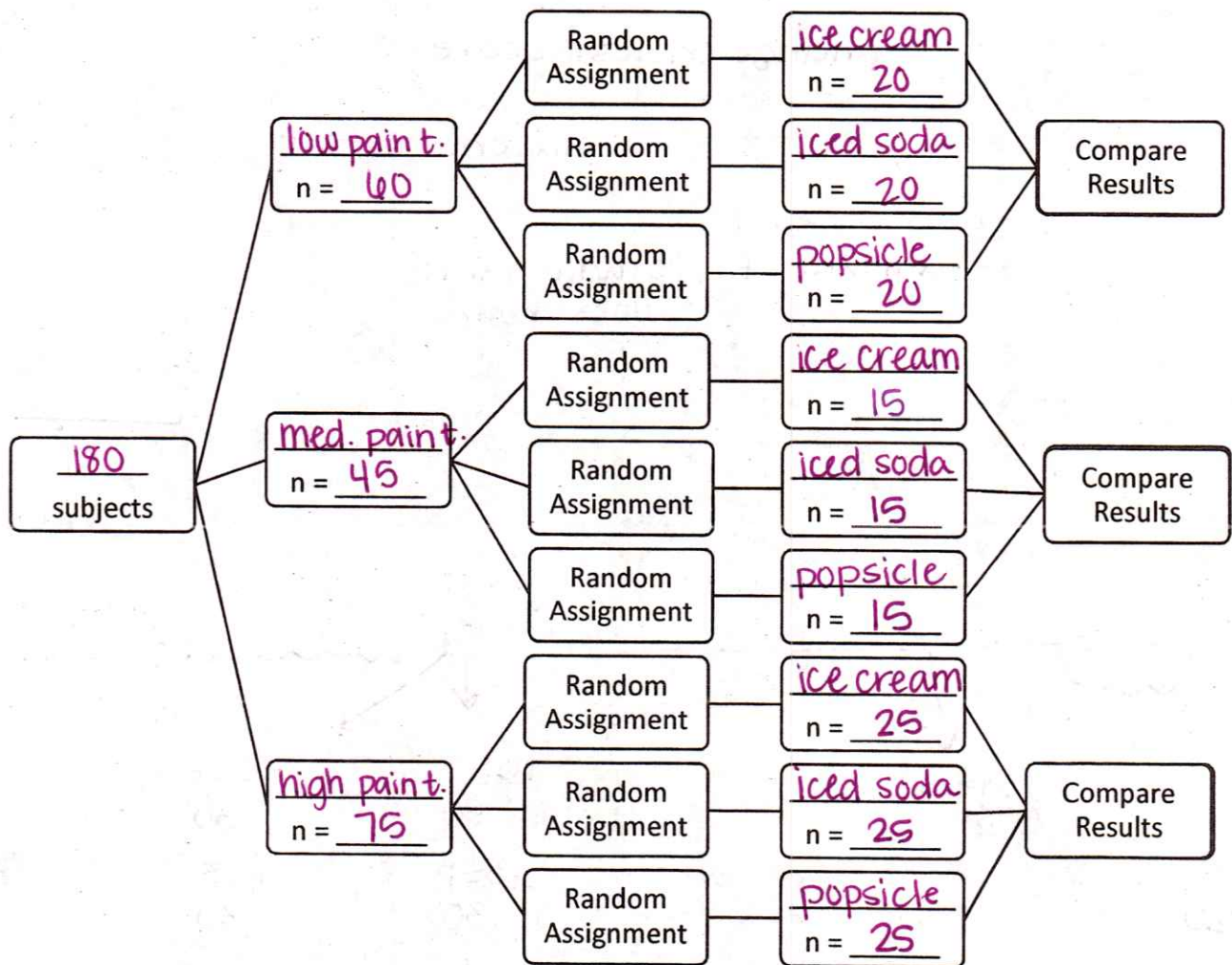
Many things can affect the durability of a fabric. A researcher decides to test the effects of water temperature and type of detergent. Variable A has 3 water temperatures: HOT (145), WARM (100), COLD (50). Variable B is the type of detergent: Regular Tide, Low-phosphate Tide, Ivory Liquid. A treatments consists of washing a piece of fabric 50 times in a regular home washer with a specific combination of water temp and detergent. After 50 washes, the fabric is put through a machine that forces a steel ball through the fabric and records the fabrics resistance to breaking. Create a diagram to describe all the treatments that can take place.



	detergents		
	reg. tide	low phos. tide	liquid ivory
hot			
warm			
cold			

1. A Brain Freeze is a sudden headache stimulated by a cold stimulus. A study will be conducted to determine if ice cream, iced soda, or a popsicle will cause a worse headache. 180 Subjects will be randomly assigned one of the treatments and rate their level of headache pain from 1 through 10. A possible confounding variable are the subject's prior pain tolerance (low – 60 subjects, medium – 45 subjects, and high – 75 subjects). Design an experiment that accounts for three levels of pain tolerance.

**Blocks:** Pain tolerance (low, medium, and high), **Treatments:** ice cream, iced soda, popsicle



2. In a study to assess whether sleeping improves test scores, 60 North Cobb students were randomly assigned to be a part of the sleep study. 30 received a low dosage (30 mg) sleep drug, while the remaining 30 received a placebo every day for a week. Of those in the sleep drug group 12 showed a statistically significant test score growth, compared to only 3 of those in the placebo group.

(a) Is this study an experimental or an observational study? Explain.

experiment → treatments are being imposed on the students

(b) Identify the treatment in this study.

low dosage sleep drug  
placebo

(c) Identify the variable of interest (response variable) in this study.

change in test score

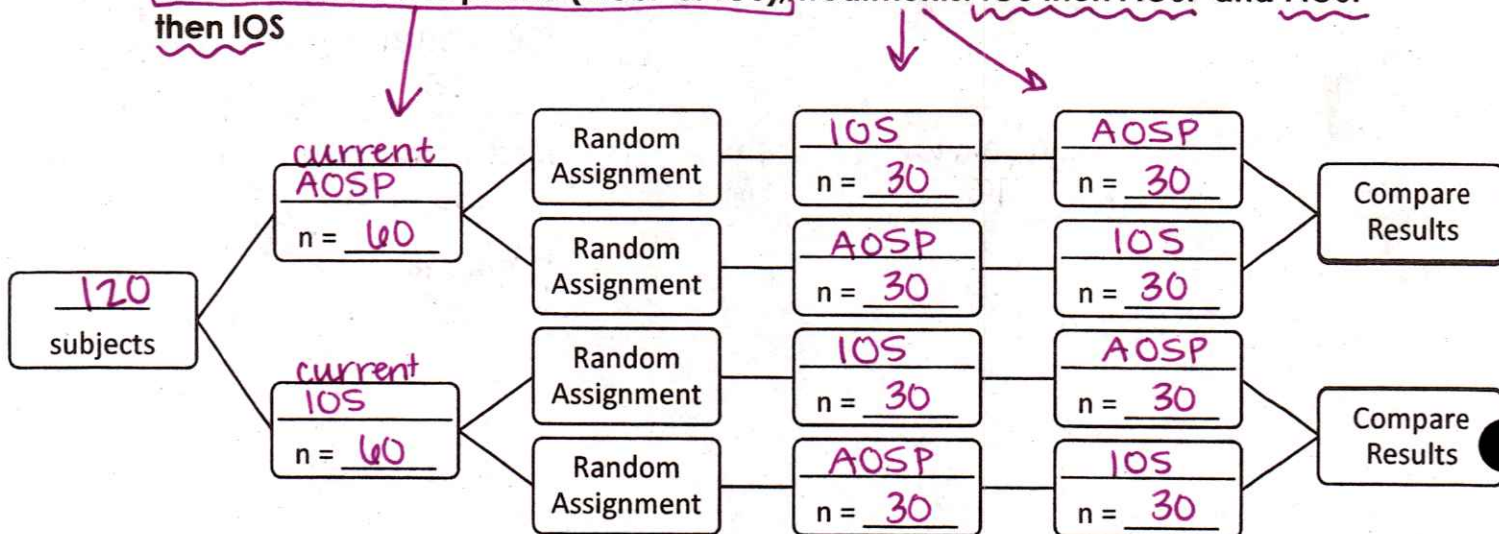
(d) If some students showed test growth, but they weren't in the treatment group, they experienced a placebo effect.

(e) List any confounding variables.

study habits  
work hours

3. Android (AOSP) and Apple (IOS) are fierce competitors in the smart phone market. Researchers are curious which operating system is most user friendly. 120 subjects will be separated into 2 groups according to which operating system they currently use and then randomly assigned timed simple tasks to complete on each operating system. A possible confounding variable is the order in which the subjects attempt the time tasks. Design a matched pairs experiment that randomly assigns subjects to attempt IOS then AOSP, and AOSP then IOS.

Blocks: Current cell phone (AOSP or IOS), Treatments: IOS then AOSP and AOSP then IOS



4. A school principal wants to form a student committee to review the lunch menu in the school cafeteria. There are 1500 students in the entire school, but he would like to select a random sample of 120 students just from just one of the lunch periods. The principal randomly chose the A lunch period and surveyed everyone in the cafeteria. Only 23 students returned the survey. 47% of the students gave the lunch menu a positive score (4 - good or 5 - great). Below is the survey the students received.

"How much do you like this year's menu options? (Circle one)

1	2	3	4	5
Very poor	Poorish	Satisfactory	Gooderish	Great

(a) What is the population?

1500 students in the school

(b) What is the sample?

120 students from one lunch period

(c) What is the statistic?

47% gave a positive score

(d) Was this study observational or experimental?

observational study

(e) What type of sampling method was used?

convenience sample

(f) What is the variable of interest (response variable)?

Score given on survey

(g) Is there a treatment? If yes, then what? If no, then why?

NO, they want to see how students feel

(h) Identify the forms of bias if there is any. about the menu options - they aren't trying to change

opinions

- nonresponse (only 23 of 120 returned their survey)
- undercoverage (only went to 1 lunch block)
- sampling error (conducted a convenience sample)