1. **Alcohol and heart attacks.** Many studies have found that people who drink alcohol in moderation have lower risk of heart attacks than either nondrinkers or heavy drinkers. Does alcohol consumption also improve survival after a heart attack? One study followed 1913 people who were hospitalized after severe heart attacks. In the year before their heart attacks, 47% of these people did not drink, 36% drank moderately, and 17% drank heavily. After four years, fewer of the moderate drinkers had died.15

(a) Is this an observational study or an experiment? Why? What are the explanatory and response variables?

(b) Suggest some lurking variables that may be confounded with the drinking habits of the subjects. The possible confounding makes it difficult to conclude that drinking habits explain death rates.

2. **Reducing nonresponse.** How can we reduce the rate of refusals in telephone surveys? Most people who answer at all listen to the interviewer's introductory remarks and then decide whether to continue. One study made telephone calls to randomly selected households to ask opinions about the next election. In some calls, the interviewer gave her name, in others she identified the university she was representing, and in still others she identified both herself and the university. The study recorded what percent of each group of interviews was completed. Is this an observational study or an experiment? Why? What are the explanatory and response variables?

3. **Observation versus experiment.** Observational studies have suggested that vitamin E reduces the risk of heart disease. Careful experiments, however, showed that vitamin E has no effect. According to a commentary in the Journal of the American Medical Association: Thus, vitamin E enters the category of therapies that were promising in epidemiologic and observational studies but failed to deliver in adequately powered randomized controlled trials. As in other studies, the "healthy user" bias must be considered; i.e., the healthy lifestyle behaviors that characterize individuals who care enough about their health to take various supplements are actually responsible for the better health, but this is minimized with the rigorous trial design. A friend who knows no statistics asks you to explain this.

(a) What is the difference between observational studies and experiments?

(b) What is a "randomized controlled trial"? (We'll discuss "adequately powered" in Chapter 16.)

(c) How does "healthy user bias" explain how people who take vitamin E supplements have better health in observational studies but not in controlled experiments?

4. **Getting teachers to come to school.** Elementary schools in rural India are usually small, with a single teacher. The teachers often fail to show up for work. Here is an idea for improving attendance: give the teacher a digital camera with a tamper-proof time and date stamp and ask a student to take a photo of the teacher and class at the beginning and end of the day. Offer the teacher better pay for good attendance—verified by the photos. Will this work? A randomized comparative experiment started with 120 rural schools in Rajasthan and assigned 60 to this treatment and 60 to a control group. Random checks for teacher attendance showed that 21% of teachers in the treatment group were absent, as opposed to 42% in the control group.18

(a) Outline the design of this experiment.

(b) Label the schools and choose the first 10 schools for the treatment group. Use Table B starting at line 108.

5. **The benefits of red wine.** Some people think that red wine protects moderate drinkers from heart disease better than other alcoholic beverages. This calls for a randomized comparative experiment. The subjects were healthy men aged 35 to 65. They were randomly assigned to drink red wine (9 subjects), drink white wine (9 subjects), drink white wine and also take polyphenols from red wine (6 subjects), take polyphenols alone (9 subjects), or drink vodka and lemonade (6 subjects).20 Outline the design of the experiment and randomly assign the 39 subjects to the 5 groups. Use Table B and start at line 107.

6. **Treating sinus infections.** Sinus infections are common, and doctors commonly treat them with antibiotics. Another treatment is to spray a steroid solution into the nose. A well-designed clinical trial found that these treatments, alone or in combination, do not reduce the severity or the length of sinus infections. Experimental design: The clinical trial was a com- pletely randomized experiment that assigned 240 patients at random among four treatments as follows:

	Antibiotic Pill	**Placebo Pill**
Steroid Spray	53	64
Placebo Spray	60	63

(a) Outline the design of the experiment.

(b) How will you label the 240 subjects?

(c) Explain briefly how you would do the random assignment of patients to treatments. Assign the first 5 patients who will receive the first treatment.

7. **Growing trees faster.** The concentration of carbon dioxide (CO_2) in the atmosphere is increasing rapidly due to our use of fossil fuels. Because green plants use CO_2 to fuel photosynthesis, more CO_2 may cause trees to grow faster. An elaborate apparatus allows researchers to pipe extra CO_2 to a 30-meter circle of forest. We want to compare the growth in base area of trees in treated and untreated areas to see if extra CO_2 does in fact increase growth. We can afford to treat three circular areas.23

(a) Describe the design of a completely randomized experiment using six well-separated 30-meter circular areas in a pine forest. Sketch the circles and carry out the randomization your design calls for.

(b) Areas within the forest may differ in soil fertility. Describe a matched pairs design using three pairs of circles that will reduce the extra variation due to different fertility. Sketch the circles and carry out the randomization your design calls for.

8. **Protecting ultramarathon runners.** An ultramarathon, as you might guess, is a footrace longer than the 26.2 miles of a marathon. Runners commonly develop respiratory infections after an ultramarathon. Will taking 600 milligrams of vitamin C daily reduce these infections? Researchers randomly assigned ultramarathon runners to receive either vitamin C or a placebo. Separately, they also randomly assigned these treatments to a group of nonrunners the same age as the runners. All subjects were watched for 14 days after the big race to see if infections developed.24

(a) What is the name for this experimental design?

(b) Use a diagram to outline the design.