1. Below are excerpts from an article “Happiness makes for a healthy heart” that appeared on line on February 18, 2010.  
www.reuters.com/article/2010/02/18/us-heart-disease-idUSTRE61H00K20100218

(Reuters) – People who are usually happy and enthusiastic are less likely to develop heart disease than those who tend to be glum, …, and boosting positive emotions could help cut heart health risks.

U.S. researchers said their observational study was the first to show an independent relationship between positive emotions and coronary heart disease, but stressed that more work was needed before any treatment recommendations could be made.

Over 10 years, Karina Davidson of Columbia University Medical Center and her team followed 1,739 men and women who were taking part in a large health survey in Canada. Trained nurses assessed the participants’ heart disease risk and measured negative emotions like depression, hostility and anxiety, as well as positive emotions like joy, happiness, excitement, enthusiasm and contentment – collectively known as a “positive affect.”

The researchers ranked the “positive affect” across five levels ranging from “none” to “extreme” and found that for each rank the risk of heart disease fell by 22 percent. “Participants with no positive affect were at a 22 percent higher risk of … heart attack or angina … than those with a little positive affect, who were themselves at 22 percent higher risk than those with moderate positive affect,” Davidson wrote.

(a) Why is this study an observational study and not an experiment? Explain briefly.

The study is an observational study because the 1,739 men and women were simply observed. The participants’ heart disease risk and emotions were evaluated by trained nurses but nothing was done to change the participants’ environment.

(b) Is this observational study a prospective or a retrospective study? Explain briefly.

This is a prospective study. Participants were enrolled in the study and followed over the next 10 years.

(c) What is the explanatory variable? Is this categorical or numerical?

The explanatory variable is the level of “positive affect.” This variable is categorical with five categories ranging from “none” to “extreme.”

(d) What is the response variable? Is this categorical or numerical?
The response variable is heart disease. This is a categorical variable, whether or not an individual participant has heart disease. The risk of heart disease is a numerical summary of several individual participants and is usually reported as the proportion of participants with heart disease.

e) Based on this study, will increasing a person’s “positive affect” cause a reduction in their risk of heart disease? Explain briefly.

No. Because this is an observational study, no cause and effect relationship can be inferred. There are many variables that contribute to heart disease or protection against heart disease.

2. An article in *JAMA Pediatrics* February 2010 reported findings on a study looking at the efficacy of an abstinence-only intervention on the sexual activity of young adolescents. The study involved 600 African American students in grades 6 and 7. One of five interventions was assigned, at random, to each of the students. The five interventions were:

- An 8-hour abstinence-only intervention targeted on reduced sexual intercourse.
- An 8-hour safer sex-only intervention targeted on increased condom use.
- An 8-hour comprehensive intervention targeted on reduced sexual intercourse and on increased condom use.
- A 12-hour comprehensive intervention targeted on reduced sexual intercourse and on increased condom use.
- An 8-hour health-promotion intervention targeted on health issues unrelated to sexual behavior.

Two years after getting the intervention, the students reported whether they had sexual intercourse or not. The estimated probability of having sexual intercourse by the 24-month follow-up was 33.5% in the abstinence-only intervention and 48.5% in the group that received the health-promotion intervention.

a) Why is this study an experiment and not an observational study?

This study is an experiment because there are treatments, the various interventions, and interventions are assigned to students.

b) Describe the experimental units in the experiment?

The experimental units in the experiment are the 600 African American students in grades 6 and 7.

c) What is the response variable? Is this variable categorical or numerical?

The response variable is whether or not the student had sexual intercourse during the two years following the intervention. This is a categorical variable.
d) What are the treatments? Be specific.

The treatments are the five different interventions: an 8 hour abstinence only, an 8 hour safer sex, an 8 hour combined abstinence and safer sex, a 12 hour combined abstinence and safer sex, and an 8 hour health promotion.

e) Is there a control/comparison group in the experiment? Explain briefly.

The 8 hour health promotion intervention targeted on health issues unrelated to sexual activity could be considered a control/comparison group because it contains no information about sexual activity, which is the focus of the other treatments.

f) Explain briefly how interventions can be randomly assigned to the students. Your explanation should be complete enough so that a person not knowledgeable in statistics could follow your explanation and actually assign the interventions to the students.

Get 600 chips that are all the same size and weight. On 120 put a, 120 put b, 120 put c, 120 put d and 120 but e. Let a represent the 8 hour abstinence only intervention, b represent the 8 hour safer sex intervention, c the 8 hour combined intervention, d represent the 12 hour combined intervention and e the 8 hour health promotion intervention. Mix the 600 chips thoroughly. Have each student draw one chip from the 600, without replacement. The letter on the chip indicates the intervention the student will receive.

3. A study is performed on the effect of temperature on the strength of plastic welds. Currently a temperature of 170 C is used for welding plastic parts. There are seven different temperatures (140, 150, 160, 170, 180, 190 and 200 C). At each temperature five specimens of the plastic material are welded. The welds are then subjected to a load until the weld breaks. The maximum load (in Newtons) before the weld breaks is the strength of the weld. The thirty five welds (5 specimens at each of 7 temperatures) are run in a random order. All welds are made with the same equipment by the same operator. All strengths are measured with the same equipment by the same operator.

a) Why is this study an experiment and not an observational study?

This is an experiment because temperature is manipulated to create treatments. The treatments (different temperatures) are assigned to the welds.

b) What is the response variable? Is this variable categorical or numerical?

The response variable is the strength of the weld as measured by the maximum load (in Newtons) before the weld breaks. This is a numerical variable.
c) What are the treatments? Be specific.

The treatments are the seven different temperatures (140, 150, 160, 170, 180, 190 and 200 C).

d) Identify an outside variable that is controlled in the study and indicate how that variable is controlled.

One variable that is controlled is the equipment used to make the weld. It is controlled by using the same equipment for all welds.

Another variable that is controlled is the equipment used to measure the strength of the weld. It is controlled by using the same equipment to measure all welds.

f) Is there a control/comparison group in the study? Explain briefly.

Because welds are currently made at 170 C, this is the standard temperature and welds made at this temperature could be used as a control/comparison group.

g) How is replication within this study accomplished?

Replication within this study is accomplished by welding 5 different pieces of plastic at each temperature.