

Math 3

Name _____

Experiment Design

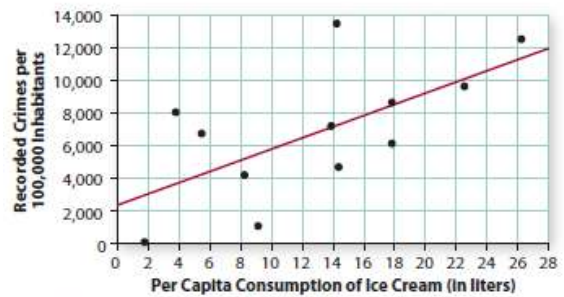
Date _____

1. To find out if students do better on exams where the easier problems come first, a teacher wrote two versions of an exam. One had the more difficult problems first, and a second contained the same problems only with the easier ones first. He gave the first version to his first-period class and the second to his second-period class. He will compare the scores on the first version with the scores on the second version.
 - a. What are the treatments? What is the response variable?
 - b. Does this study have the three characteristics of a well-designed experiment? Explain.
 - c. Is the study subject blind? Is it evaluator blind? Double blind?
 - d. Name at least one lurking variable for this study.
 - e. Describe how the teacher could improve the design of his study.

2. Suppose that the manufacturer of a cough medicine wants to conduct a randomized, double-blind experiment to determine if adding a new ingredient results in a reduction in the mean number of coughs per hour. Fifty adult volunteers with persistent coughs are available. Describe how the manufacturer should conduct this experiment.

3. The 12 countries listed below have the highest per person ice cream consumption of any countries in the world. As shown in the following table and scatterplot, there is an association between the number of recorded crimes and ice cream consumption.

Country	Ice Cream Consumption per Person (in liters) per Year	Recorded Crimes per 100,000 Inhabitants per Year
New Zealand	26.3	12,591
United States	22.5	9,622
Canada	17.8	8,705
Australia	17.8	6,161
Switzerland	14.4	4,769
Sweden	14.2	13,516
Finland	13.9	7,273
Denmark	9.2	1,051
Italy	8.2	4,243
France	5.4	6,765
Germany	3.8	8,025
China	1.8	131



Source: United Nations Office on Drugs and Crime www.unodc.org/unodc/crime_cicp_surveys.html and www.foodsci.uoguelph.ca/dairyedu/icdata.html. Their source: *The Latest Scoop*, 2000 Edition, Int. Dairy Foods Assn.

a. For the data above, the regression line is $y = 34.4x + 2,500$, and the correlation is 0.637. Do these data imply that if a country wants to decrease the crime rate, it should ask people to eat less ice cream? Explain your reasoning.

b. What are some possible lurking variables that might explain this association between crime rate and ice cream consumption?

4. The British Doctors Study was one of the earliest studies to establish a link between smoking and lung cancer. In 1951, all male doctors in the United Kingdom were contacted. About two-thirds, or 34,439 doctors, agreed to participate. Eventually, researchers found that the doctors who smoked were more likely to get lung cancer than doctors who did not smoke. The difference was statistically significant.

- a. What type of study was this?
- b. Can you conclude from this study that smoking causes lung cancer? Explain your thinking?
- c. Can you generalize the results of this study to some larger population? Explain your thinking?
- d. Describe exactly what you can conclude from this study.

5. Psychotropic bacteria cause meat spoil. Six beef steaks were randomly assigned to be packaged. The following table gives the logarithm (log) of the number of psychotropic bacteria per square centimeter on the meat after nine days of storage at controlled temperature.

Commercial Plastic Wrap log (count/cm ²)	Vacuum Packaged log (count/cm ²)
7.66	5.26
6.98	5.44
7.80	5.80

Source: Robert O. Kuehl, *Statistical Principles of Research Design and Analysis*, Duxbury Press, Belmont, CA, 1994, p. 31. Original source: B. Nichols, *Comparison of Grain-Fed and Grass-Fed Beef for Quality Changes When Packaged in Various Gas Atmospheres and Vacuum*, M.S. thesis, Department of Animal Science, University of Arizona, 1980.

- a. What are the treatments? What is the response variable?

- b. Does this study have the three characteristics of a well-designed experiment? What else would you like to know about how it was conducted?

6. Forty-nine volunteer college students were randomly assigned to two treatments. Twenty-five students were told that they would view a video of a teacher who other students thought was “charismatic”: lively, stimulating, and encouraging. The remaining twenty-four students were told that the instructor they would view was thought to be “punitive”: not helpful, not interested in students, and a hard grader. Then all students watched the same twenty-five-minute lecture given by the same instructor. The students’ summary ratings are given below. Higher ratings are better.

- a. What are the treatments? What is the Response variable?

- b. Does it have the three characteristics of a well-designed experiment?

7. You conduct a test to see if an inexperienced person gets a bigger geyser if he or she drops Mentos candy into a liter bottle of cola by hand or by using a paper funnel. You find ten friends who have never done this demonstration and we are willing to participate. You write “by hand” on five slips of paper and “funnel” on five slips of paper. Each person draws a slip and is shown how to use that method. Then, each person drops Mentos into his or her bottle of cola using the method assigned. The maximum height of each geyser is measured.

You find that difference between the mean heights of the geysers produced by your friends who used their hand and your friends who used a paper of funnel is not statistically significant.

- a. What type of study is this?

- b. What are the treatments? What are the subjects?

c. Can you generalize the results of this study to some larger population? Explain your thinking.

d. Describe exactly what you can conclude from this study.

8. Researchers wanted to determine whether social class is related to smoking behavior. They conducted telephone interviews with 1,308 Massachusetts adolescents aged 12 to 17, selected by dialing at random. They found statistically significant association between whether the adolescent smoked or not and the household income. Adolescents from households with less income were more likely to smoke, and this was true across all ages, for both sexes, for all races, and for all amounts of disposable income the adolescent had.

(Source: Elpidoforos S. Soteriades and Joseph R. DiFranza.
"Parent's Socioeconomic Status, Adolescents' Disposable Income,
and Adolescents' Smoking Status in Massachusetts,"
Journal of Public Health, Vol. 93, July 2003, pp. 1155-1160,
www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1447926)

a. What type of study is this?

b. Can you conclude from this study that smoking is caused by an adolescent's social class? Can you think of a lurking variable that might be responsible for both?

c. Can you generalize the results of this study to some larger population? Explain your thinking.

d. Describe exactly what you can conclude from this study.