

Exercise 1—Introduction to the Scientific Method

Preparation Notes

1. **Supply lists are based on a class size of 24 students. In situations where class size varies, adjust supplies accordingly.**
2. **Asterisks (*) next to materials or supplies indicate a nonstandard or special order item. Specific details for obtaining these items can be found in the “Ordering Information” section for each exercise.**
3. **The times listed to complete activities are conservative estimates of the time required. In our community college classes (with three hours of lab per week), we’re usually able to complete all the activities in an exercise and still have time for short quizzes, introductory remarks, and summarizing important concepts at the end of the class period.**

Materials and Supplies

Equipment	Quantity
rulers, 6-inch, transparent	24
sampling cups	96
plastic jars or paper cups, approximate 6 oz volume	24
tray large enough to hold the 24 cups	1
Chemicals	
1 molar sodium carbonate (Na_2CO_3) solution	1.5 liters
dropper bottles, distilled water	12
dropper bottles, phenolphthalein indicator	12

Setup Instructions

1. **Activity 4:** The students shouldn’t know which of the 24 cups of liquid is “infected” with HIV. Therefore, you should fill the cups ahead of time and place them on a tray.

All the cups should be pre-filled **except** for the “infected” cup. A container that contains the sodium carbonate solution should be available in the classroom for the instructor to fill one cup at the last minute.

Note: If you want to know who patient “zero” is for your class discussion, pay attention to whom you give the “infected” cup.

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2. No special setup is needed for other equipment or supplies. Items should be placed in the classroom in convenient locations for easy access by students.

Ordering Information (*)

1. Sampling cups: clear plastic souffle cup, 2 ounce, Solo Cup Company Inc. Available from <http://acemart.com> or other Internet sources.

Suggestions for Specific Activities

This exercise is designed to introduce students to the scientific method, its steps, and its uses. Suggestions for various hypotheses are given to students in the exercise, and they're asked to think of others on their own. Even though they'll probably ask you for suggestions, try to let the students think for themselves, and they'll develop the skills to fulfill the objectives for this exercise.

Collaborative learning is an important focus of the laboratory experience and is carried throughout all the exercises in this manual. Ask your students to introduce themselves to one another so that they can begin to establish working relationships for the semester. Activity 4 provides an excellent opportunity for students to mix and interact on the first day.

The laboratory is a good place for students to make study group connections for cooperative assignments and test preparation. Beginning with the first week of laboratory, students are encouraged (and often required) to work cooperatively in small groups. In addition, students should be encouraged to walk around the room and see what other laboratory groups are doing. Many exercises in this manual require sharing of data with the entire class.

1. **Activity 4:** If the class has an uneven number of students, the instructor should participate in the exchange process. The infection pattern will follow exponential growth. After the first exchange, two students will be infected, then four, eight, and so on. By the end of the fifth exchange, the entire class should be infected.

Note: It's helpful to emphasize the instructions for the exchanges, especially that students should do only one exchange at a time and then wait for your instructions before exchanging again.

Approximate Time to Complete Activities

Because there are wide variations in the frequency and time allotted for laboratory periods in various schools, these time estimates are provided as a guide to help you schedule the activities included in these exercises.

Activity 1	15 minutes
Activities 2 and 3	30 minutes
Activities 4 and 5	70 minutes
Activity 6	25 minutes

Answer Key to Questions

Activity 1

Sample chemistry experiment hypotheses (**Table 1-1**)

- The roommate didn't copy the formula correctly.
- The chemicals were contaminated, out of date, mixed improperly.
- You didn't follow the directions properly.
- The instructor presented the formula incorrectly.

Activity 2

Comprehension Check

1. You need a control group to compare with your experimental group (to see if observed changes were caused by the one factor that differs between the two groups).
2. To control the variables that can exist within an experiment, and that can make it hard to interpret your results.
3. You would use larger groups to decrease the effect of individual variability on the experimental results. You might also wish to conduct your experiment for a longer period of time, for example, the entire growing season. You might experiment with different levels of fertilizer application to determine the optimal concentration. You might repeat the experiments with other species of plants.

Activity 3

Comprehension Check

1. Yes. The experimental group grew taller. Plants from the experimental group gained an average of 45 cm in height, while plants from the control group only gained, on average, 21 cm in height.
2. Yes. Fertilizer did make a significant difference in height compared to the group without fertilizer.
3. Individual plants differ in their growth patterns due to genetic variability. If we used only one plant from each group, we would have no way of knowing if we were comparing a "naturally tall" plant with one that was just "naturally shorter." Therefore, the larger the group we compare, the more confidence we'll have that our conclusions are accurate and supported by real evidence.

Activity 4

13. **Table 1-4:** Individual results will vary, but most students will be infected at some time before the end of the activity.

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14. **Table 1-5:** Survey results will vary, but in general, the number of infected students will increase with each fluid exchange.
15. The phenolphthalein indicator test was performed on the distilled water to ensure that no false positives would occur and that the indicator was reliable to use in the experiment.
16. The control.

Activity 5

Comprehension Check

1. Check for correct graphing procedures in **Figure 1-4**.
2. With each exchange, the number of infected students increased. By the end of the experiment, the entire class was probably infected.
3. Sexual exchanges are less frequent, people might not have as many partners, some people practice abstinence, many people practice safe sex and use condoms to prevent the spread of disease, diseases may have longer incubation periods.
4. Use of condoms during sexual activity, decrease number of partners, public education about sexually transmitted diseases, and safe sex practices.

Activity 6

1. The range of scores is 72 (97–25).
2. No. The median score was 83 and your score was only 80.
3. No. The mean was only 72, but the modal score was 87. In general, the larger the range, the less informative the mean will be.
4. You'll want the following statistical information:
 - How many women were evaluated?
 - What was the modal weight loss for the group?
 - What was the median weight loss?
 - What was the range?

You'll also want additional information not related directly to statistics but important for the validity of the experiment. For example:

- Was there a control group in this experiment?
- How were the women selected?
- What was the daily activity level?