Nano Silver

Silver nanoparticles are rapidly becoming a part of our daily life in the form of cosmetics, food packaging, wound dressings, detergents, and antimicrobial coatings. Ultimately, the nanoparticles in these products end up in the environment during waste disposal.

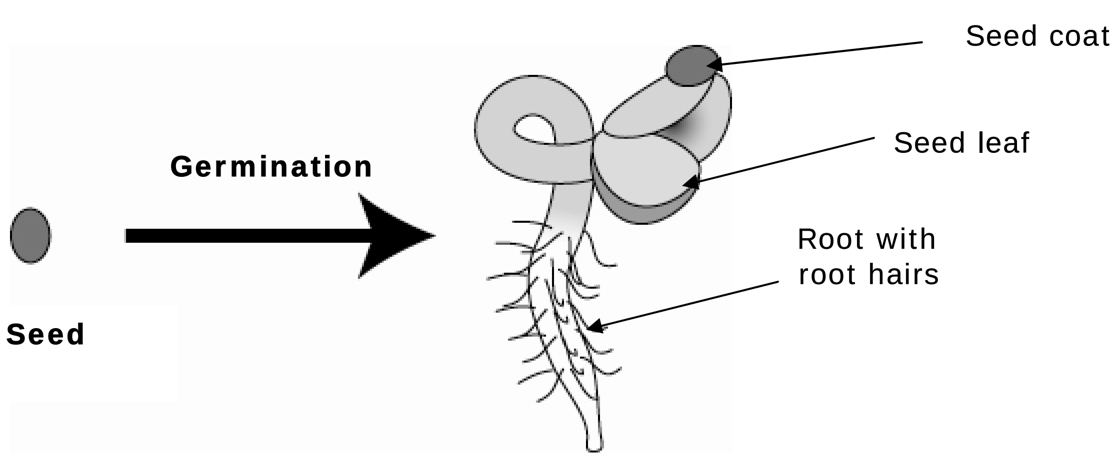
Little is known about the effects of silver nanoparticles on humans and the environment. Scientists have begun to express concerns about the safety of silver nanoparticles in consumer products.

Nanotoxicology is the study of the toxicity of nanomaterials. Nanotoxicologists do research to determine whether nanoparticles pose a threat to the environment or to humans.

To screen for possible hazards involved in exposure to nanoparticles, scientists may use simple plants or animals, rather than humans, as test subjects. This type of screening test enables scientists to identify nanoparticles that might result in environmental or human health problems.

In this activity you will conduct an experiment to study the effects of different concentrations of silver nanoparticles on the germination of seeds.

Germination is the process in which a plant begins to grow and emerge from a seed.



You will have the following materials to use in your experiment:

- 50 mL of silver nanoparticle solution. The concentration of this silver nanoparticle solution is 20 parts per million (ppm)
- 5 white plastic cups for mixing nanoparticle solutions
- Container with least 100 seeds
- 50 mL of tap water
- 5 clear plastic bags for growing seeds
- Magnifying glass
- 1 permanent marker
- 1 graduated cylinder (10 mL)
- 1 graduated measuring dropper (1 mL)
- 10 strips of masking tape
- Tweezers or forceps

ppm = parts per million

A unit of concentration often used when measuring very low levels of pollutants in air, water, body fluids, etc.

1 ppm is 1 part per million.

The unit of concentration, **milligrams/liter**, is the same thing as ppm.

Four drops of ink in a 55-gallon barrel of water would produce an "ink concentration" of 1 ppm.

Part 1: Procedure for setting up your experiment

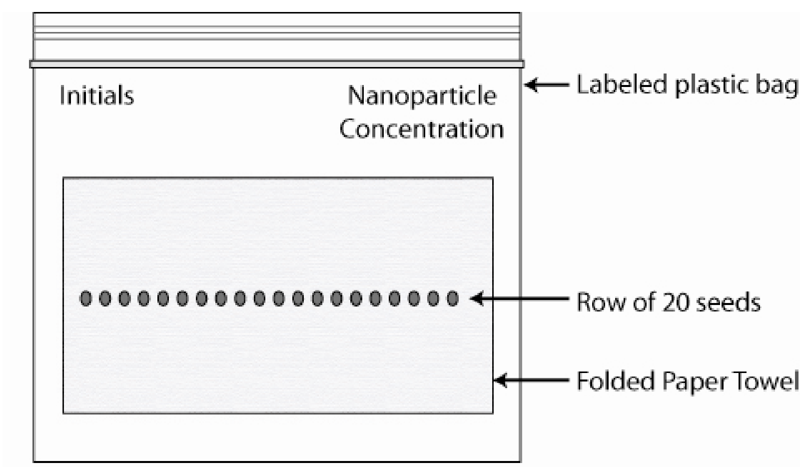
1. Use the information in the data table below to:

   - Label 5 white plastic cups with the concentrations of nanoparticles shown in **Column A** of data table below (0, 2,5,10, and 20 ppm).

   - Fill each of the cups with the appropriate concentration of nanoparticles using the information in **Column B** and **Column C**.

Column A	**Column B**	**Column C**
Nanoparticle Concentration (ppm)	Tap Water (mL)	20 ppm Nanoparticle Solution (mL)
0 (Control)	20 ml	0
2	18	2
5	15	5
10	10	10
20	0	20

Note: Instead of planting your seeds in soil, you will plant them in a plastic bag.



2. Write your initials and the concentration (0 (control), 2, 5, 10, and 20 ppm) of the nanoparticle solutions you are testing on 5 clear plastic bags. You will use a different bag for each nanoparticle solution.

3. Fold a paper towel and place it in the bag as shown in the diagram.

4. Pour the contents of the cups into the appropriately labeled bags. For example, pour the nanoparticle solution from the “0 control” cup into the bag labeled “0 control.”

5. Place 20 seeds in a horizontal row in the middle of the paper towel in each of the bags. Be certain to put the seeds on the outside of the paper towel so that you can see them. You may find it easier to use forceps (tweezers) to move the seeds onto the paper towel.

6. Seal the bags and use masking tape to attach the bags to a wall or a cabinet door in the area indicated by your teacher.

7. After three days, you will count and record the **number of seeds that germinated.**

Part 2: Analyzing the design of your experiment

Refer to the glossary when you answer the following questions.

1. What is the research question for your experiment?

2. What the hypothesis that you will be testing?
   State your hypothesis as and If……., then……. statement.

3. What is the independent variable in your experiment?

4. What is the dependent variable in your experiment?

5. What are the experimental groups for your experiment?

6. What is the control group for in your experiment?

7. Why is it important to include a control in the experiment?

8. What are four controlled factors (things that are kept the same in all of the bags) for your experiment?

9. Why is important to keep the controlled factors the same in each of the bags?

10. Why was it important to use more than one seed in each bag?

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11. Use the grid below to design a data table that you will use to collect data from your experiment.

    - The data table should have a title that includes the independent variable, the dependent variable, and the organism studied.
    - The independent variable (with units of measurement) is written in the left-hand column—arranged in increasing order from top to bottom.
    - The dependent variable (with units of measurement) is written in the right-hand column. You will collect data later to complete the right-hand column.
    - Be sure to include units of measurement for each variable.

Title: ____

Part 3: Analyzing the Results of Your Experiment

1. Observe the seeds in each of the bags and count the number of germinated seeds. Record the number of germinated seeds in the data table on the previous page.

2. Summarize the data you have collected in graph form.
   - The graph should have a title that includes the independent variable, the dependent variable, and the organisms studied.
   - Each axis should be clearly labeled with the variable and the units of measurement--put the independent variable on the horizontal axis and the dependent variable on the vertical axis.
   - Mark a scale (even intervals) on each axis.
   - Use the data from your data table to create a **line (<u>not</u> bar)** graph.

Title: ____

3. Look at the information represented in your graph. What conclusions can you draw from the data you collected? Describe any patterns or trends you see in the data. Are there any exceptions to these patterns or trends?

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4. Does your data support or refute (disprove) your hypothesis? Explain.

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5. Based on the results of your experiment, do you think the silver nanoparticles you were testing were harmful? At what concentrations? Explain your answer.

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6. A good experiment is one that gives approximately the same results if it is replicated (repeated) by others. List at least <u>two</u> ways you could improve your experiment to be certain that it could be replicated (repeated) by others to give the same results?

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7. During the next class period, you and your team members should be prepared to present your research findings to the class. You should prepare visuals (transparencies or PowerPoint slides) that show your:
   - Data table
   - Graph
   - Conclusions

   Be prepared to answer questions from your classmates and your teacher.