

INQUIRY PROJECT

For CIS Environmental Science Directions and Help

- TASK #1 -

WHAT TO DO: Identify a Topic and Question Pts Possible: 25

1. Your project topic should be something that **you** are interested in and want to learn more about! Since this is an Environmental Science Course your topic should be related to ECOLOGY, BIODIVERSITY, WATER QUALITY, or POLLUTION.
2. Your project topic should lend itself to **real** scientific investigation. You will need to be able to ask a question that has to do with your topic and design an experiment to find your answer.
3. Narrow your topic down to a specific question (or problem) that can be solved using scientific investigation. The problem should be one that **you** identify. To do this, you need to study and learn as much as you can about your topic.
4. You will be required to have your topic and question approved before you begin further research.

Begin: Immediately Due: _____

HINTS AND HELPS: Places to look for Project Topic and Question ideas

Science books or lab manuals

Science Magazines

Newspaper articles

Educational T.V. Programs

Environmental Science Related Websites

Visits to museums, hospitals, nature centers

Visiting with adults in the community, including:

+ *Professionals (doctors, veterinarians, foresters, engineers, college professors, etc.)*

+ *Community Groups (Lake associations, Civic Clubs, etc.)*

+ *Government Agencies (County Services, DNR, Federal Agencies, etc.)*

HINTS AND HELPS: Poor questions and how to make them better

Poor Question -- "Why is pollution bad?"

(Why is this a Poor Question ? It doesn't lend itself to real investigation.)

Better -- "What is the effect of road salt on White Pine trees?"

Poor Question -- "How much pollution is there?"

(Why is this a Poor Question ? It is too general, and not easily measured.)

Better -- "Does the water quality of Pelican Brook meet safe drinking water standards?"

Poor Question -- "How many different kinds of plants and animals live near us?"

(Why is this a Poor Question ? It needs to be limited in scope.)

Better -- "How many different fish species can be obtained using standard sampling techniques on Round Lake?"

HINTS AND HELPS: Outstanding Projects Are

1. **INNOVATIVE** - Something that has not been done before or not yet proven.
2. **USEFUL** - Solves a problem, advances knowledge.
3. **REPEATABLE** - Similar results can be produced in the future by repeating experimentation under the same conditions.
4. **MEASUREABLE** - You must be able to measure something in your experiment so it can be used to support or reject your hypothesis.
5. **CREATIVE** - All outstanding projects have one thing in common -- the result of creative thought.

HINTS AND HELPS: What is not a good project?

1. Simply building something or collecting something without drawing significant conclusions does not make a good science project.
2. "Cookbook" experiments that have been done over and over in textbooks do not make good projects unless you modify them with a question of your own.

- TASK #2 -

WHAT TO DO: Begin a Journal and Literature Search Points Possible: 50

1. From now on, all steps related to your project will be kept in your journal. Your journal must be a separate notebook or electronic file. Begin by making an introductory page with your topic and problem written across the middle. Your progress will be measured by the records and information you record in your journal. Each entry should have a date and description of what you did or found.
2. Search the internet and print material for any information related to your inquiry question. Note each of your findings in your journal. Write a summary of your research findings to be incorporated into your abstract later. Remember, research is only part of your project, not its entirety.

Begin: Immediately

Due: _____

- TASK #3 -

WHAT TO DO: Design an Experiment Pts Possible: 50

This is an outline that includes the following sections:

- A. *Purpose* - State the reason for doing the experiment
- B. *Hypothesis* - This is what you think will happen, based on what you know from research and experience.
- C. *Procedure* - Think through carefully how you can carry out your purpose in a scientific manner. Identify one variable that you are testing and try to eliminate all other variables between your control group and your experimental group. Describe each group. List the steps that you plan to follow.
- D. *Materials* - List all of the items that you need and the amounts. You should know where you are going to get most of the materials that you need. You may have to build some of the components of your experiment. Some things can be used from our lab, and some things can be ordered.
- E. *Visuals* - Draw a picture to show any of the equipment that you would need to build or put together for the project.

Begin: When topic is approved

Due: _____

HINTS AND HELPS: A Good Experiment Design

1. The longer you run an experiment, the more conclusive the results.
2. The more subjects you use, the more conclusive your results.
3. The fewer variables involved, the better your results.
4. The more you repeat an experiment, the better your results.
5. Identify what you will measure and how to accurately get those measurements. **Use metrics!**
6. Observation is a completely acceptable form of data collection, simply remember to be objective and record your observations.
7. Once your Experiment Design is approved, get started right away!

- TASK #4 -

WHAT TO DO: Collect Data

1. Follow the steps that you outlined for your *Experiment Design*. If you make any changes, **be sure to note them in your journal.**
2. **Record all data you collect from the experiment in your journal.** Each step needs to be recorded. Be sure to label all measurements you record! Remember, you must measure something to get good results.
3. It is helpful to use visuals. Set up charts, graphs or tables to record and organize your data. You may want to take photos as part of your data, especially if it can help you to better see changes during the experiment.

Begin: When Experiment Design is approved

Due: Checked periodically as part of your journal

- TASK #5 -

WHAT TO DO: Analyze Your Data and Make a Conclusion

1. In your journal, reorganize and summarize your data by finding averages and making charts or graphs to help you see patterns in the results. Using statistics can be very helpful. For example, you might want to find percentages.
2. Decide if the data supports your hypothesis or not and explain why in an entry **in your journal**.
3. Decide any problems and limitations of your experiment and how you could improve it. Be careful in drawing conclusions! If someone else repeated your experiment, would they get the same results?

Begin: When your experiment is finished.

Due: Checked as part of your journal

- TASK #6 -

WHAT TO DO: Write an Abstract Pts Possible: 75

1. Now you need to write a summary of all the work that you have done this far, from topic, through research, and experimenting, all the way through your conclusion!
2. This summary should be approx. 200 words long and no longer than 250. It should be typed and on one sheet of paper, including your name, core, the beginning date of the experiment, the end date, and title of the project.

Begin: When you have made a conclusion.

Due: _____

- TASK #7 -

WHAT TO DO: Create a Display Board

Points Possible: 25

1. Create a display board that summarizes your project in pictures and words.
2. You may use plywood, pegboard, cardboard, tagboard, or purchase a science fair board. Prepare a background using fabric, paint, markers, or construction paper.
3. Pick a catchy title that captures the problem you focused on. Cut out, stencil, or make word processor letters for your title and sub-titles for each step of the experiment. Neatly type each step of your experiment and place it under each subtitle.
4. Add photographs, charts and/or tables to your board.
5. Some restrictions will apply to what you can actually display. A more detailed sheet of regulations will be passed out when you get closer to the due date.

(Alternative option - Create a power point or Zohoshow presentation incorporating each of the above requirements rather than constructing a physical display board. You must still display any apparatus and collection tools used in your experiment)

Begin: When you have made a conclusion

Due: _____

- TASK #8-

WHAT TO DO: Deliver a Presentation

Points Possible: 25

1. Decide how you might best explain your experiment to someone who doesn't know anything about it, or perhaps even to someone who has never heard of the scientific method. Organize everything that you have done from selecting a title through creating your exhibit or display board.
3. Write a speech that explains to your class what you have done for your project. You may be speaking in front of a small group of students and one teacher, or you may be speaking in the auditorium, so prepare for either!
4. To aid your presentation you may use your display board, a video of your project, an overhead projector, and/or a computer.

Begin: When you have made a conclusion

Due: _____

Display Regulations

Biological Organisms/Parts/Waste

You may not display:

- 1) Living vertebrate or invertebrate animals
- 2) Plants over 50 cm high
- 3) Microbes not in a sealed container
- 4) Taxidermied or preserved or unpreserved vertebrate (including human) or invertebrate animals
- 5) Taxidermied or preserved or unpreserved vertebrate (including human) animal parts (Exceptions: Teeth, hair, nails, dried animal bones, histological dry mount sections, and wet mount tissue slides)
- 6) Taxidermied or preserved or unpreserved vertebrate (including human) embryos.
- 7) Vertebrate (including human) animal waste samples ("Scat")
- 8) Photographs or other visual presentations depicting vertebrate animals in other than normal positions (including dissections, surgery, or butchering)

Liquids/Chemicals/Flammables

You may not display:

- 9) More than 1 liter of water
- 10) Caustic or hazardous chemicals
- 11) Poisons, controlled substances, or hazardous substances
- 12) Dry ice or other sublimating solids
- 13) Combustable liquids
- 14) Empty tanks or containers that previously contained combustable liquids or gasses.
- 15) Any flame over 2 cm high
- 16) Unshielded flames of any height
- 17) Dry or wet cell batteries with open top cells.

Objects/Devices

You may not display:

- 18) Sharp objects (including knives, razors, fishhooks, or syringes with needles)
- 19) Hazardous devices (Including devices with unshielded belts, pulleys, chains, and moving parts with tension or pinch points)
- 20) Firearms or amunition or reloading devices
- 21) Weapons with tension devices (unless it is a model that is displayed without tension and unloaded)
- 22) Pressurized tanks
- 23) Any apparatus producing temperatures that will cause physical burns (unless it is adequately insulated and shielded)

Electrical

You may not OPERATE:

- 23) Any electrical device requiring 100 volts AC away from designated areas (ie. the wall)
- 24) Any device requireing over 110 volts AC
- 25) Lasers (Exceptions: Lasers in electronic devices, ie. CD-ROM drives, audio CD players, shielded lasers with a protective housing preventing access to beam.)
- 26) Unshielded large vacuum tubes or ray-generating devices
- 27) Circuits with bare wires or exposed knife switches of 12 volts or more. (Standard insulated switches are required for over 12 volts .)

Examples of Good Environmental Science Inquiry Questions

* **Is bottled water more pure than tap water?** According to some studies, the results may surprise you!

* **How do different factors affect seed germination?** Factors that you could test include the intensity, duration, or type of light, the temperature, the amount of water, the presence/absence of certain chemicals, or the presence/absence of soil. You can look at the percentage of seeds that germinate or the rate at which seeds germinate.

* **How are different soils affected by erosion?** You can make your own wind or water and evaluate the effects on soil. If you have access to a very cold freezer, you can look at the effects of freeze and thaw cycles.

* **How does the pH of soil relate to the pH of the water around the soil?** You can make your own pH paper, test the pH of the soil, add water, then test the pH of the water. Are the two values the same? If not, is there a relationship between them?

* **How close does a plant have to be to a pesticide for it to work?** What factors influence the effectiveness of a pesticide (rain? light? wind?)? How much can you dilute a pesticide while retaining its effectiveness? How effective are natural pest deterrents?

* **What is the effect of a chemical on a plant?** Factors that you can measure include rate of plant growth, leaf size, life/death of the plant, color of plant, and ability to flower/bear fruit.

* **What is the effect of automobile exhaust on Hydra?** Study the structure and habitat of the hydra and determine if morphological and/or behavioral changes occur within the animal upon exposure to automobile exhaust.

* **Does the level of air pollution vary during the week?** To determine relationships between amount of pollution and time of day or week.

* **What are the health effects of ozone on patients with asthma?** People with asthma have been identified to be the most acutely responsive to tropospheric ozone exposure.

* **Which polypedon (type of soil) is most absorbent of liquid pollutants?** Different soil types may absorb different types of pollutants and at different rates. The information gained from this experiment may benefit farmers, gardeners and botanists who have soil pollution problems.

* **Does Organic Material Affect The Absorbency Of Water In Soil?** The purpose of this experiment is to determine how organic material affects the water absorbency of soil. The information gained from this experiment will aid gardeners by determining which organic material will benefit their plants the most.

* **What environmental problems do diapers cause in landfills?** The volume of and the materials used in disposable diapers have been cited as major issues in solid waste management.

Reminder: Be sure you get your topic and question approved...even if you choose to do one very similar to one on this list!