

Teacher's Outline for a Student-Based Inquiry

I Wonder... (One day)

Have the students write an "I wonder..." statement of some control method that would be effective for the invasive weed species they have selected.

Group the "I Wonder..." questions into similar themes based upon control methods (chemical, biological, mechanical, fire or other).

Create scientific teams based upon the various themes and provide each team with an experiment that addresses each theme (or alternatively, students may work individually).

Instruction on experimental design...

(One day)

Provide information on elements of experimentation, including:

- Independent and dependent variables
- Controls
- Hypothesis
- Data Collection

Have the scientific teams identify the above elements for the experiment that they have designed, using the Design An Experiment Form

Review of the Literature

(3-5 periods + homework)

From their experiment idea, have the students conduct a review of the literature to research what is known about their particular topic and prepare a report.

Students will include copies of the sources of their information (not a reference list, but the actual articles... this will assist you with assessing their reports to help them with the difference between plagiarism and paraphrasing).

Conduct the Experiment

(6-8 weeks, after a week or two it only takes 10-15/day to record data)

Students will assemble the materials and supplies for their experiment, provide a detail procedure for the experiment, conduct the experiment, and design a data collection process

Reporting

(Ongoing – research details, procedures refinements, etc. should be upgraded regularly)

Students will write a "scientific paper" to report the results of their experiment to the "scientific community" (the class) and give an oral presentation based upon the following criteria:

- A report of the research and review of the literature behind your experiment, including:
 1. A title page with the name of the project, your name, and date

2. paraphrasing the science you learned from the research
3. copies of the resources you used
- A description of the experiment you conducted, including:
 1. the independent and dependent variables
 2. the control
 3. problems with the experiment (sources of error)
 4. the hypothesis you were testing
- An interpretation of the data collected from your experiment, including:
 1. how you collected the data
 2. a display of the data (charts, transparencies, etc.)
 3. what the data tells you
 4. whether or not your hypothesis was supported
- Implications of the experiment (what new questions arise and how would you use the information gained from the experiment to learn more)
- Any photos or drawings that help illustrate what you did

Design an Experiment

Name: _____

Date: _____

Research Topic (describe in as much detail as possible):

1. Identify the *independent* (manipulated) variable. _____

2. Identify the *dependent* (responding) variable. _____

3. Come up with a *research question*. _____

4. State your *hypothesis*. _____

5. Describe the *materials* you will need to do the experiment. _____

6. On the back of this form, or a separate sheet of paper, write a *procedure* to test your hypothesis. Remember to include safety considerations and a detailed set-up.

7. Identify your *control*. _____

8. Describe the variables that you will hold *constant*. _____

9. On a separate sheet of paper, design a *data table* to collect and display your results.

10. What kind of *graph* or *chart* would you use to present your data? **line/bar/circle**

11. Be ready to graph your data on graph paper. Include a title, labels, and units for the vertical and horizontal axis.

12. Describe the results of your experiment. Did it answer your question? Did it support or disprove your hypothesis? Do you need to re-design the experiment and try again?

Student Experiment Notebook Check-off List

Name: _____ Area of Research _____

Below is a checklist of the different components that I would like you to assemble in a "My Experiment" notebook. Check off each item as you complete it!

_____ Your original "I Wonder" question.

_____ A report of the research and review of the literature behind your experiment, including:

- A title page with the name of the project, your name, and date
- paraphrasing the science you learned from the research
- copies of the resources you used
- and the following subjects should be addressed:
 - Botanical description
 - Life Cycle of the alien weed species
 - Classification
 - Adaptations
 - Known control methods

You may have already written an initial report about your alien plant. However, as you become involved with your experiment you will find you must learn new skills or details that will necessitate further research. *Those additional aspects should be added to the original research paper.*

_____ A description of the experiment you conduct, including:

- the independent and dependent variables
- the control
- problems with the experiment (sources of error)
- the hypothesis you were testing
- Detailed procedures
- Examples of the data collection sheet (preferably done in table form in either Word or Excel)

The procedures should be *very detailed* – a step-by-step outline of everything you have done or will be doing, including a materials list. This is another part of the project that will change and need to be *updated regularly* as you encounter problems or changes to your experiment/research.

_____ An interpretation of the data collected from your experiment, including:

- how you collected the data
- a display of the data (charts, transparencies, etc.)
- what the data tells you
- whether or not your hypothesis was supported
- Implications of the experiment (what new questions arise and how would you use the information gained from the experiment to learn more)
- Any photos or drawings that help illustrate what you did

_____ A daily journal that details what you did each day, things you've learned, problems encountered, how you resolved those problems and/or altered the design and procedures, your feelings about the process (frustrations, confusing moments, feelings of success or breakthrough, Ah Ha! Moments, etc.) You should do daily 10-15 minute writings in class, but this should also be followed up at home and on weekends.

_____ All of these components will be bound and organized in a 3-ring notebook with a front cover of your own design, table of contents, etc. The final version will be typewritten but your preliminary rough drafts, hand-written notes, copies or printouts of resources will also be included.

_____ The original rubrics that were scored each time you turned in a draft copy.

_____ Include this check-off sheet with your notebook.

The next check of the Notebook will be _____. The score will be based on this updated check-off list, so everyone knows in advance what is needed!

Date of check-off: _____ Instructor initials here that it was done on time: _____

Science Experiment Assessment

| | | |
|--|--|--------------|
| Name: | Experiment Topic: | Date: |
| SKILLS | | |
| Basic Process - each skill below would score a "5" if all applicable criteria are observed in the student's project | | Score |
| Observation | Uses five senses to observe; observes using tools (lens, etc.); identifies properties of an object; uses numbers to describe observations; notes changes in objects; realizes that observation enhances understanding. | Rate 1-5 |
| Classification | Identifies similarities and differences in properties; identifies properties for sorting; classifies objects or attributes into groups; forms subgroups; has logical rationale for sorting; understands characteristics define sorting systems | Rate 1-5 |
| Communication | Describes accurately using appropriate vocabulary; asks relevant questions; verbalizes thinking; shares views with others; constructs other means to communicate (reports, media, graphs, etc.) | Rate 1-5 |
| Measurement | Uses non-standard ways as well as traditional ways to measure; selects appropriate measuring tools; uses tools with precision (i.e., to 10ths in metric); compares and orders objects by weight, length, volume and/or time | Rate 1-5 |
| Prediction | Performs simple predictions based on inferences; recognizes and extends patterns; shows reasoning in defending predictions; able to blend events, patterns, and data to form ideas of what may happen in the future | Rate 1-5 |
| Integrated Processes | | |
| Interpreting Data | Able to find meaning or patterns with accuracy between sets of information and use that meaning to construct inferences, predictions, and hypothesis; able to identify a single pattern among objects within an experiment | Rate 1-5 |
| Controlling Variables | Able to identify variables within an experiment that are to be held constant and those that are to be manipulated; understand the difference between single and multiple variable manipulation | Rate 1-5 |
| Designing Experiments | Able to visualize the procedures that may be necessary to answer question and plan the appropriate data collection operation; includes a plan to organize data; uses organized, sequential plans to test a hypothesis | Rate 1-5 |
| Inferring | Uses all appropriate information to form inferences and is able to distinguish non-essential information; develops inferences (ideas) based on observations; able to defend inferences reasonably and logically | Rate 1-5 |
| Defining Operationally | Able to explain relationships between observed actions to explain phenomena; uses events to describe how something works or doesn't work; is able to find alternative actions from evaluating what doesn't work | Rate 1-5 |
| Notes: | | |

| RESEARCH | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Score |
|---|---|--|--|--|--|---|--|--------------|
| Evaluate research paper on the following criteria and provide a single score | No work Completed | Incomplete, poor organization, many misspellings, poor punctuation and plagiarism. Some references | Many details organized, few spelling or punctuation errors, attempts paraphrasing 1-3 references | Good writing skills and use of own interpretation 3 or more references | Progressing - expressing an understanding of concepts with good writing style. References, and some are attached | Proficient - solid expression of concepts, a broad range of information written very well References attached | Exemplary - thorough understanding and expression of concepts, information complete, incorporates prior knowledge, and written creatively and technically. Fully cited as appropriate for scientific papers. | |
| Sub-total Score | | | | | | | | |
| JOURNAL | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Score |
| Journal is scored according to ONE of the six categories | No journal | Little response and/or the writing is inaccurate or unrelated | The writing shows partial knowledge; lacks detail | The writing is mostly accurate | Shows detail, use of vocab., and a positive attitude | Shows great detail and reflects personal feelings | A coherent whole, personal feelings motivate creative solutions and extensions | |
| ATTITUDE | (scored as -1 to -5) | 1 to 5 | 1 to 5 | 1 to 5 | 1 to 5 | 1 to 5 | | Score |
| Score EACH a value of 0-5 and total | Poor Attitude | Curious | Cooperates | Persists | Open-Minded | Handling Equip.Works Safely | | (max. 25) |
| GENERAL | Poor (0) | Inadequate (1) | Fair (2) | Good (3) | Outstanding (4) | | | Score |
| Score general completion in ONE of the five areas | The student did not do the task, did not complete the assignment, or did not show comprehension | The experiment does not accomplish what was asked, contains errors, and/or is of poor quality | The experiment meets most of the criteria and does not contain gross errors or significant omissions | The experiment completely meets the expectations described by the criteria | the experiment meets all criteria, exceeds expectations and shows additional effort | Notes: Criteria for this assessment were provided to the students via the: Science Experiment Check-off List | | |
| Score to Grade Conversion: A maximum score of 100 points is possible (including bonus points for early turn-in, exemplary presentation of material, or at the discretion of the instructor) A = 90-100 B = 80-89 C = 70 - 79 Scores below 70 - Project returned, parents contacted. Project to be re-done by: | | | | | | | Total This Page | |
| | | | | | | | Total Previous Page | |
| | | | | | | | Bonus (max. 9) | |
| | | | | | | | TOTAL SCORE | |

Science Experiment Assessment Detail

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|--|--|--------------|
| Name: | Experiment Topic: | Date: |
| SKILLS | | |
| Basic Process - Describe specifically how your experiment allows you to use each skill in the spaces below | | Score |
| Observation | Uses five senses to observe; observes using tools (lens, etc.); identifies properties of an object; uses numbers to describe observations; notes changes in objects; realizes that observation enhances understanding. | Rate 1-5 |
| | | |
| Classification | Identifies similarities and differences in properties; identifies properties for sorting; classifies objects or attributes into groups; forms subgroups; has logical rationale for sorting; understands characteristics define sorting systems | Rate 1-5 |
| | | |
| Communication | Describes accurately using appropriate vocabulary; asks relevant questions; verbalizes thinking; shares views with others; constructs other means to communicate (reports, media, graphs, etc.) | Rate 1-5 |
| | | |
| Measurement | Uses non-standard ways as well as traditional ways to measure; selects appropriate measuring tools; uses tools with precision (i.e., to 10ths in metric); compares and orders objects by weight, length, volume and/or time | Rate 1-5 |
| | | |
| Prediction | Performs simple predictions based on inferences; recognizes and extends patterns; shows reasoning in defending predictions; able to blend events, patterns, and data to form ideas of what may happen in the future | Rate 1-5 |
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|-----------------------------|--|-------------|--|
| Other Notes | | | |
| Integrated Processes | | | |
| Interpreting Data | Able to find meaning or patterns with accuracy between sets of information and use that meaning to construct inferences, predictions, and hypothesis; able to identify a single pattern among objects within an experiment | Rate 1-5 | |
| | | | |
| Controlling Variables | Able to identify variables within an experiment that are to be held constant and those that are to be manipulated; understand the difference between single and multiple variable manipulation | Rate 1-5 | |
| | | | |
| Designing Experiments | Able to visualize the procedures that may be necessary to answer question and plan the appropriate data collection operation; includes a plan to organize data; uses organized, sequential plans to test a hypothesis | Rate 1-5 | |
| | | | |
| Inferring | Uses all appropriate information to form inferences and is able to distinguish non-essential information; develops inferences (ideas) based on observations; able to defend inferences reasonably and logically | Rate 1-5 | |
| | | | |
| Defining Operationally | Able to explain relationships between observed actions to explain phenomena; uses events to describe how something works or doesn't work; is able to find alternative actions from evaluating what doesn't work | Rate 1-5 | |
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