Analyze This!

Science
Module

Grades 9-12

By

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Analyze This!

Purpose: This module should be used after students have learned how to apply the step of the research method through hands-on experience. It will assess student's understanding of scientific inquiry and the skills related to it.

Learner Objective:
1. Apply the steps of the research method. (SC 7)
2. Analyze experiments and/or hypotheses to determine the components of a controlled experiment. (SC 7)
3. Organize data into useful forms for analysis. (1.8)

Subject: Science

Show-Me Standards Addressed:
    Knowledge: SC 7
    Performance: 1.6, 1.8, 1.10, 3.4, 3.5, 4.1

Grade Level: 9-12

Materials needed:
Student packet which contains prompts, response sheets, and scoring guides, and a pencil.

Time needed: One 50-minute class period

Instruction for Administration: Provide students with packet (includes prompt, response sheets, and scoring guides). Go over the instructions and scoring guides so students clearly understand what is expected.

Pre-Assessment Instructions:
The students must have an understanding of how to use the steps of the research method, formulate hypotheses, set up controlled experiments to test hypotheses, organizing data into charts, graphs, and tables, and analyzing the data. Prior to administering this module, students have applied the components mentioned above in a class activity.

Analyze This!
Student Prompt

You are interviewing for the position of researcher with the Mid-Missouri Science Research Corporation. The position demands that you are effective in scientific inquiry and the skills related to it. As a part of the interview process, they have given you the attached packet to complete.

Analyze This!
Student Response Sheet #1

1. In a controlled experiment, what are constants?

_____

_____

2. Tell the difference between the independent variable and dependent variable.

_____

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3. **Explain** how a control group is useful in scientific research.

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4. Describe the process you would go through to form a conclusion when using the research method.

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Analyze This!
Student Response Sheet #2

5. You have been asked to determine how different amounts of nutrients affect the growth of *E. coli* bacteria.

    A.   Form a valid hypothesis for this research.

_____

_____

    B.   Identify the independent variable.

_____

    C.   Identify the dependent variable.

_____

    D.   Name three constants.

_____

    E.   The control roup for this experiment should receive a normal amount of food, explain why.

_____

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6. Develop a question that you could use to initiate research about factors that affect plant growth, other than the amounts of nutrients.

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Performance Event

A group of biology students wanted to determine how temperature affected the growth of *Rhizopus*, which is common bread mold. They conducted the following research:

Hypothesis: If *Rhizopus* is exposed to varying temperatures, then the highest temperature will produce the most growth.

Experiment: The experiment had five test groups. Each test group consisted of three slices of bread with *Rhizopus* growing on each. Below you will find how each test group was treated.

Test Group #1: Placed in the school laboratory in front of a space heater that was set at $85\,^0$F for 20 days.

Test Group #2: Placed in the school laboratory on a lab table. The temperature of the lab is controlled by central heat/air and is set at $70\,^0$F for 24 days.

Test Group #3: Placed in a student's garage in front of air-conditioner that is set at 60^0 F for 25 days.

Test Group #4: Placed in the school's refrigerator set at 40^0 F for 18 days.

Test Group #5: Placed in the school's freezer set at $25\,^0$F for 15 days.

7. The group made several major errors in setting up their experiment. **Name** two errors and then **describe** what you would do to correct those two errors and make this experiment a correct controlled experiment.

Error #1_____
_____
_____

Error #2_____
_____
_____

The *Rhizopus* experiment was corrected by the students and resulted in the following:

   Observations: The group made the following observations. All growth statistics refer to the total growth of the fungus, not the growth from one observation to the next.

Test Group #1 (85^{0}F)

Day of Observation	Total Growth (cm) (Average of the test group)	Observation
5	8	Growing rapidly; appears healthy
10	17	Continuing to grow rapidly; several areas have brown, dry spots appearing
15	17	Growth has stopped; most of the fungus appears brown and dry
20	17	No growth: all of the fungus is brown and crusty

Test Group #2 (70^{0}F)

Day of Observation	Total Growth (cm) (Average of the test group)	Observation
5	6	Growing rapidly; appears healthy
10	12	Continuing to grow rapidly; appears healthy
15	19	Continuing to grow rapidly; appears healthy
20	24	Continuing to grow rapidly; fungus is full and appears healthy

Test Group #3 (60^{0}F)

Day of Observation	Total Growth (cm) (Average of the test group)	Observation
5	2	Growth is slow; fungus is a lighter color than test group #2
10	7	Growth is still relatively slow; fungus is sparse and does not appear to be healthy
15	8	Little growth; fungus is still sparse and unhealthy
20	8	No growth; fungus sparse and unhealthy

Test Group #4 (40^{0}F)

Day of Observation	Total Growth (cm) (Average of the test group)	Observation
5	0	No growth
10	1	Little growth; fungus appears healthy
15	3	Growth is slow; new growth is sparse
20	8	Growth remains slow; fungus is sparse and unhealthy

Test Group #5 (25 F)

Day of Observation	Total Growth (cm) (Average of the test group)	Observation
5	0	No growth
10	0	No growth
15	0	No growth
20	0	No growth

8. Analyze the data given. Describe the conclusion that you would form from this experiment and justify your answer using details from the data.

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9. Does the experiment prove the group's hypothesis to be true? _____ Explain your answer.

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10. Using Test Group #1, create a line graph that displays the growth of that test group throughout the experiment.

11. Explain one logical, scientific reason why the growth of test group #1 occurred the way that it did.

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Scoring Guide

Item 1: **Constructed Response**

  Content: SC 7   Process: 1.6

  1 point - correct description of what constants are

  0 points - other

Item 2: **Constructed Response**

  Content: SC 7   Process: 1.6

  2 points - correctly described the difference between the indepen-
   dent variable and the dependent variable

  1 point - correctly described either the independent variable or the
   dependent variable

  0 points - other

Item 3: **Constructed Response**

  Content: SC 7   Process: 1.6

  2 points - accurately described how control groups are useful

  1 point - defined what a control group is

  0 points - other

Item 4: **Constructed Response**

  Content: SC 7   Process: 1.10

  2 points - correctly describes the comparison of hypothesis and
   results OR the comparison of control group to other test
   groups

  1 point - answer lacks clarity in what is involved in forming a
   conclusion although the basic ideas are correct

  0 points - other

Item 5: **Constructed Response**

  Content: SC 7   Process: 1.6

 A. 1 point - formed a testable hypothesis

 B. 1 point - correctly identified the independent variable

 C. 1 point - correctly identified the dependent variable

 D. 2 points - correctly named three constants

   1 point - correctly named two constants

   0 points - other

 E. 1 point - correctly explained why the control group should receive
   a normal amount of food

Scoring Guide (Continued)

Item 6: **Constructed Response**

Content: SC 7   Process: 1.10

1 point - developed a usable question

Item 7: **Constructed Response**

Content: SC 7   Process: 3.4

3 points - correctly named the two errors <u>and</u> described how those two errors should be corrected

2 points - correctly named at least one error and described how that error should be corrected

1 point - correctly named two errors with no description of how the errors should be corrected

0 points - other

Item 8: **Constructed Response**

Content: SC 7   Process: 4.1

2 points - conclusion was accurate and justification was detailed

1 point - conclusion was accurate and justification was limited

0 points - other

Item 9: **Constructed Response**

Content: SC 7   Process: 3.5

1 point - correctly answer whether hypothesis was true or not

1 point - accurately explained how they determined if the hypothesis was true

Item 10: **Constructed Response**

Content: SC 7   Process: 1.8

1 point for accurately completing each of the following components within the graph

- title that shows the relationship between the variables
- axes labeled and include the units used
- intervals are even and attached to a line
- data is correctly plotted

Scoring Guide (Continued)

Item 11:   Constructed Response

Content: SC 7   Process: 3.5

1 point - explained one logical, scientific reason for the growth of
test group #1