

Worms!!!!

I've Got Worms!!! The Effect of Hands-on Activities in the Science Classroom on the
Achievement Levels of Middle School Life Science Students

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Abstract

This action research proposal will present the findings of the effect hands-on activities have in the science classroom on the achievement levels of middle school life science students. The study will include a unit on the nature of science/scientific method using a laboratory exercise with *C.elegans*. The unit will take place during the first nine weeks of the 2015-2016 school year and involve 2 regular, 7th grade life science students. One class will be given the pre-test and post-test only and be considered the control group. The other class will be given the pre-test, the worm lab as an intervention and then the post test to determine if the intervention increased student knowledge on the nature of science benchmark. Specifically, if hands-on, inquiry based labs are increased, then student knowledge would also increase. Results will determine pedagogical strategies for the remainder of the school year as shown on the single lesson plan template, through student work samples, and reflection logs.

Keywords: C.elegans, hands-on, nature of science, scientific method, middle school

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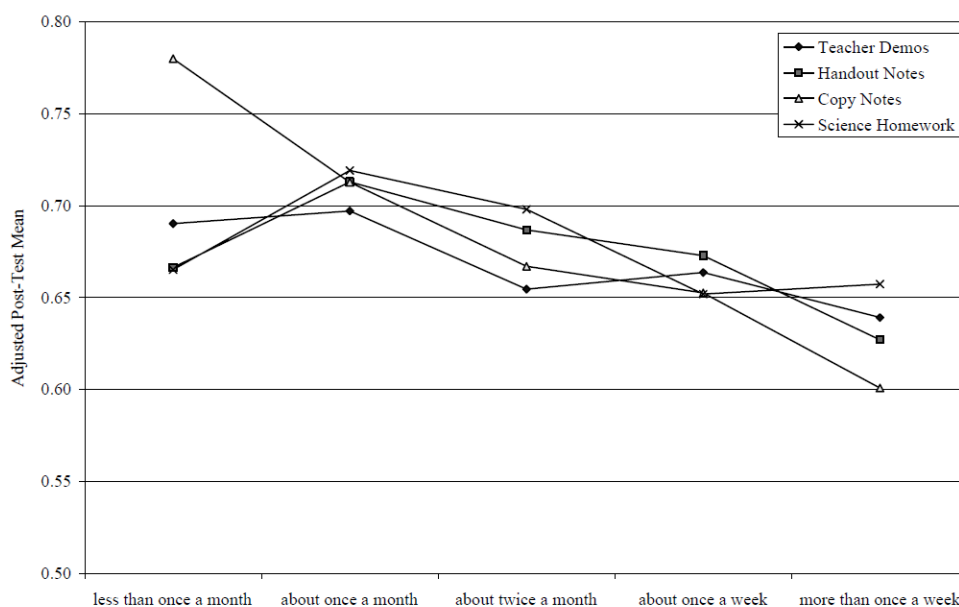
I've Got Worms!!! The Effect of Hands-on Activities in the Science Classroom on the Achievement Levels of Middle School Life Science Students

Rationale

The topic of using hands-on instructional practices versus traditional teaching methods, such as lectures and the use of Power Point slides continues to be a debate within schools and counties, and the scientific community, as a whole. The purpose of this study is to explore the relationship among specific instructional practices on middle school students' achievement in science. "The National Research Council, (NRC, 1995) recommended teachers engage students in active inquiry, which included modeling and guiding scientific attitudes that facilitate learning"(Odom, Stoddard, LaNasa, 2007). "In particular, classroom practices should support active inquiry with space and resources, where communities of science learners can practice the intellectual rigor and social values conducive to learning science"(Odom, Stoddard, LaNasa, 2007). "Traditional teaching practices such as copying notes from lecture or learning scientific terms without context provide poor learning opportunities and are inconsistent with NRC(1995)recommendations"(Odom, Stoddard, LaNasa, 2007). Furthermore, Ausubel (1998) asserts that rote learning, promoted by memorization, may explain the negative association with science homework. "According to Simplico (2005), many parents believe their students spend too much time completing tedious, repetitious, and boring homework assignments that have little or no impact on their ability to learn"(Odom, Stoddard, LaNasa, 2007). "Tien, Roth, and Kampmeier (2002) found that student-centered learning with peer-led teams improved performance, retention, and attitudes about science"(Odom, Stoddard, LaNasa, 2007).

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Accordingly, “Freedman (1997) reported a strong positive association between laboratory instruction and scores on an objective science knowledge test and student attitudes toward science”(Odom, Stoddard, LaNasa, 2007). He also noted, “science laboratory experiences were effective with students of diverse backgrounds who live in large urban areas”(Odom, Stoddard, LaNasa, 2007).



t 06:20 25 June 2015

-Odom, Stoddard, LaNasa, 2007

Action Research Intervention

I will attempt to answer the following question while conducting my research:

- How do instructional practices affect science achievement as measured by post-test science scores after controlling for pre-test scores?

I will be targeting both of my gifted classes to collect data from. Although I am recording data from two classes, the interventions I mention for my target classes will also be used for all of my classes. An important aspect to my action research proposal is to note areas of concerns for my students and implement more hands-on activities throughout the year. The single lesson plan template will serve as a record of strategies I try and those that are implemented

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throughout the course of the year. The specific labs and hands-on activities should include but not be limited to: I've Got Worms!!! C.elegans unit.

Connections to Bench to Bedside

The hands-on unit was provided by or adapted from Dr. Keith Choe. The materials for the labs will be provided from the Bench to Bedside program. This will include the dissection microscopes. Additionally, the C.elegans kit will be purchased from the Carolina Biologics Company.

Data Collection and Analysis

I will be using a pre-test and post-test to assess student knowledge about the concept of the scientific method/experimentation. Since my students are middle school students, it can be assumed that most of them have had little to no laboratory experiences prior to this stage in their academic career. The pre-test should give us a relatively accurate reflection of what they remember about the concept with little to no hands-on experience. After completing the C.elegans unit, the post test will be given to see if scores increase after the collaborative, hands-on approach. Statistical analysis will be used to calculate the mean scores within each class and then a comparison will be conducted across the classes. Two, regular level classes of 7th grade life science students will be used. The first group will be given the pre and post-tests with the regular curriculum which includes no hands-on activities for this benchmark and the second group will be given the same pre and post-tests however they will use the addition of the worm curriculum after the pre-test and before the post-test.

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References

BrainPOP (1999-2015). FWD Media, Inc. All Rights Reserved.

Choe, K.P. (2015). Introduction to *C. elegans* life cycle, anatomy, and behavior.

Developed by the Choe Lab at the University of Florida.

Chin, G. & Dunn, M. (2011). Module 1: Meet the Worms! Developed by

Bay Area Biotechnology Education Consortium and Capuchinno High School.

Odom, A.L., Stoddard, E.R., & LaNasa, S.M. (2007). Teacher practices and middle-school science achievements. *International Journal of Science Education*, 29(3), 1329-1346.

Budget and Budget Justification

C.elegans Laboratory Exercise:

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Dissection Microscopes-UF Foot Locker-FREE☺

C.elegans Kit-Carolina Biologics -\$75.65 +S&H

Culturing and Observing *C. elegans* Kit Item # 211390

This simple kit makes it easy to introduce students to the model organism *C. elegans*, a microscopic nematode worm used in Nobel Prize-winning studies on development, programmed cell death (apoptosis), and RNA interference. *C. elegans* is also widely used in studies to gain insight into the function of many human genes.

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SINGLE LESSON PLAN

| | | | |
|--|--|---|----------------------|
| Teacher: Gerhard-Sterner | | Content Area/Grade: Life Science-7 | Date: 6/24/15 |
| Unit Name: | I've Got Worms!!! Laboratory Exercise | | |
| Unit Goal What unit goal does this daily lesson address? | Standard(s)/Benchmark(s) What standard(s)/benchmark(s) does this daily lesson address? | | |
| Student s will use hands-on activities and collaboration exercises to gain further understanding of the nature of science and the scientific method. | SC.7.N.1.1-Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables and graphics, analyze information, make predictions, and defend conclusions. | | |
| Students will understand that... What should the students understand by the end of today's lesson? | Essential Questions What essential question(s) does this lesson address? | | |
| <ul style="list-style-type: none"> Define a problem and carry out an investigation Identify the test (independent variable) and the outcome (dependent variable) Write to explain the importance of scientific debate and confirmation within the science community, giving examples Identify some of the benefits and limitations of the use of scientific models | <ul style="list-style-type: none"> What defines a "testable" question? Can you identify the variables? Can you interpret data charts, tables, and graphs? What are the benefits and limitations of the use of scientific models? | | |
| Connecting Concepts How will you review yesterday's content and connect today's lesson to it? | Organizing Students for Learning How will students be organized today for the lessons activities? | | |
| Review steps of the scientific method from previous years taught and actually apply those steps in a hands-on laboratory exercise. | Students will be grouped in collaborative pairs based on data (FCAT reading scores) to perform today's activities. | | |

LEARNING EXPERIENCES, INSTRUCTION AND RESOURCES

What activities or experiences (from your Unit Plan) will students engage in today?

| | | |
|-----------------------------------|---|---|
| Lesson Sequence | | |
| Activating Prior Knowledge | Students will silently read the introduction to the lab. They will then construct the purpose and hypothesis individually. Once they complete those activities they will partner up (according to teacher pairing) and discuss their hypothesis and purpose making corrections as they work. The pair will then take turns reading the procedures placing a box around all the verbs and underlining all the nouns. | <input type="checkbox"/> ABC Brainstorming <input type="checkbox"/> KWL <input type="checkbox"/> Anticipation Guide <input type="checkbox"/> Card Sort <input checked="" type="checkbox"/> Think-Pair-Share |
| Explicit Instruction | C.elegans video clip: https://www.youtube.com/watch?v=zjqLwPgLnV0 The teacher will go over the procedures and demonstrate the lab to highlight certain skills (like reviewing the correct use of the scopes, handling of plates, and filling out data tables) and also surveying the class to correct any misconceptions and answer questions. | <input type="checkbox"/> Motivational Hook <input checked="" type="checkbox"/> Lecture <input checked="" type="checkbox"/> Demonstration <input type="checkbox"/> Note-taking Guide |

| Lesson Sequence | | | Resources and Materials |
|--|---|---|--|
| Group Processing of New Information | Laboratory exercise I've Got Worms!!! Adapted from Dr. Choe's C.elegans experiment #1 | <input type="checkbox"/> Jigsaw <input type="checkbox"/> Reciprocal Teaching <input type="checkbox"/> Concept Attainment <input type="checkbox"/> Think-Pair-Share | <input checked="" type="checkbox"/> Lab / Inquiry Activity <input checked="" type="checkbox"/> Computer <input checked="" type="checkbox"/> LCD Projector <input type="checkbox"/> Paper <input checked="" type="checkbox"/> Pencils <input type="checkbox"/> Whiteboards <input type="checkbox"/> Markers <input type="checkbox"/> Butcher Paper <input type="checkbox"/> Response Cards <input type="checkbox"/> Post-it Notes <input type="checkbox"/> Video Clip(s): <input checked="" type="checkbox"/> Website(s): https://www.youtube.com/watch?v=zjgLwPgLnV0 https://www.brainpop.com/science/scientificinquiry/scientificmethod/ <input checked="" type="checkbox"/> Lab Materials: C.elegans Carolina Biologics kit #211390 UF Foot Locker: Dissecting Microscopes |
| Elaborative Questioning | Students will complete the graph and post lab questions | <input checked="" type="checkbox"/> Inferential Questions <input checked="" type="checkbox"/> Analytic Questions <input type="checkbox"/> Philosophical Chairs | |
| Demonstrating Understanding | Students will complete a concept map on the scientific method | <input type="checkbox"/> Graphic Organizers <input checked="" type="checkbox"/> Picture Notes <input type="checkbox"/> Flow Charts <input checked="" type="checkbox"/> Concept Maps <input type="checkbox"/> Mnemonics <input type="checkbox"/> Graffiti | |
| Reflection | Brain Pop Quiz | <input type="checkbox"/> Reflective Journals <input type="checkbox"/> Think Logs <input checked="" type="checkbox"/> Exit Ticket (Student Learning) | |
| Daily Progress Monitoring Assessment | Brain Pop Quiz | <input checked="" type="checkbox"/> Quiz <input type="checkbox"/> Journal <input type="checkbox"/> Exit Ticket (for Content) <input type="checkbox"/> Response Cards | |
| Based in the results from your Daily Progress Monitoring Assessment, what concepts need to be revisited in the next lesson? <ul style="list-style-type: none"> • Independent vs. Dependent variables • Quantitative vs. Qualitative data | | | Homework Graph if not completed in class Conclusion questions if not completed in class |

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C. Elegans

The elegance
Of Caenorhabditis elegans
Cannot be hidden or disguised
This tiny nematode (worm)
can be seen to squirm
under the microscope
of those who wish to poke
into the life and love
of this bit of biology
that resembles man
(Yes it can.)

In many ways
It spends its days
Just as we all do
Feeding and excreting, to name a few.
While most elegans are true hermaphrodites
Some few are disposed to have a single X chromosome
Which permits evolutionary courses
To play the game of selection
So that the species while remaining
Much as before,
Can still juggle the genes
To test what may be in store.

-Excerpt from Sidi J. Mahtrow <http://www.poemhunter.com/poem/c-elegans/>

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Jigsaw-C. elegans

"Model" model

| |
|--|
| A. C. elegans is a free-living, soil roundworm (nematode). It is an important model organism that is used to study topics like genetics, aging, neuroscience, programmed cell death (apoptosis), immunity, and even drug response. |
| B. It is small, easy to breed and grow, and inexpensive. It is the first multicellular organism to have its genome sequenced. |
| C. Since its genome is very similar to humans, this makes it the perfect model to study human diseases. |
| D. C. elegans body consists of a clear, outer tube, called the cuticle which allows for easy visualization of the internal organs. |
| E. The cuticle also serves as an external skeleton which helps C.elegans maintain its body shape and protects the worm from its environment. |

"On the Move"

| |
|---|
| A. A ventral nerve cord runs the length of the body, as does a smaller dorsal nerve cord. Four bands of muscles also run the length of the body. The alternating flexing and relaxing of these muscles causes the worm to move in an "elegant" curved motion. |
| B. Chemical cues prompt moving toward a stimulus (chemotaxis), avoidance (moving away from a stimulus), entry into or exit from the dauer larval stage, and changes in motility. |
| C. The worm moves toward a stimulus in a somewhat inefficient way. It starts by making long movements toward an attractant with occasional reversals in the wrong direction. These reversals are known as "pirouettes." |
| D. Over time, the worm makes more long movements toward its goal than shorter pirouettes away from it, thus eventually reaching its goal. However, mutations can occur that make a worm unable to detect chemicals in their environment. In this case, a worm will not move toward a stimulus that would normally attract it. |
| E. Worms respond to touch in several ways. A gentle tapping of the plate will cause worms to move backwards, whereas when poked on the nose, worms generally recoil. There are also strains that do not respond to touch. |

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"Wild Ride of Food"

| |
|--|
| A. In the wild, <i>C.elegans</i> live in soil and compost, eating bacteria that grow on decaying plant matter. In the laboratory, the worms are fed a strain of <i>E.coli</i> , which is harmless to humans. |
| B. Bacteria are ingested through the pharynx at one end of the worm. The bacterium goes through the intestine and is digested in the midgut. |
| C. The waste is released from the opposite end of the pharynx through a hole called the anus. The waste is released every 45-60 seconds. |
| D. Feces appear as a cloud of white material around the tail. Worms will not defecate (poop) if disturbed. |
| E. When feeding, worms spend about 80% of their time "dwelling." During this dwelling phase, worms will congregate in close areas with other worms. |

"Live, Laugh..."

| |
|---|
| A. The entire life cycle for <i>C.elegans</i> takes approximately 3 days under ideal conditions, with a single worm able to live up to 3 weeks. The worms cycle from an egg stage through 4 developmental stages before becoming mature adults. |
| B. Each larval stage (L1-L4) is followed a molt and the production of a new external skeleton. |
| C. At the end of the L2 stage, if conditions are favorable due to "overcrowding," insufficient food, or heat stress, worms may enter a Dauer stage, a form of arrested development. A dauer worm is thinner, does not eat, and moves more slowly than a regular worm. |
| D. When conditions become favorable, dauer worms will continue to develop and eventually mature into adult worms. Worms become full of ripe eggs approximately 40 hours after reaching the late L4 stage of development. |
| E. The L4 larvae stage can be distinguished by a black spot located in a white crescent located in the middle of the worm. |

"...Love"

| |
|---|
| A. <i>C.elegans</i> has 2 sexes defined as XX, which results in a self-fertilizing hermaphrodite (has both male and female reproductive organs), and XO, or male. |
| B. Males are uncommon, however, they may occur at higher rates due to stress, such as heat or food scarcity. |
| C. A hermaphrodite's tail has a more tapered, pointed tail whereas a male's tail tends to be more blunt or spade-shaped. |
| D. Self-fertilized worms lay approximately 300 eggs, whereas worms inseminated by males can lay as many as 1000 eggs. |
| E. Hermaphrodites can also be induced to produce a higher rate of male progeny (offspring) by increasing the temperature during self-fertilization. |

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Guiding Questions for "Jigsaw"

Guiding Questions Directions: Use the guiding questions 1-5 below as you share information about *C. elegans* in your home group. Answer as thoroughly as possible. Include illustrations as needed.

1. Why *C. elegans* is considered a "perfect" model to use in the laboratory?
2. What causes *C. elegans* to move? Hint: there may be more than one correct answer!
3. How do bacteria enter and exit *C. elegans*?
4. What are the 2 sexes associated with *C. elegans*?
5. Summarize the life cycle of *C. elegans*. Be sure to include the term eggs, L1, L2, L3, L4, molt and dauer.

Instructor note: The teacher should go over the life cycle of *C. elegans* and what each of the larval stages should look like with students using the power point slides. Students should be instructed to draw a picture representation of each stage as well as a picture of the life cycle complete with labels. For lower level students, the instructor may want to print these pages and include with the laboratory report.

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Web quest: Virtual Microscopy

A. Middle School Version

Use the following website to familiarize yourself with a compound light microscope. Be sure to answer the questions as you work.

<http://www.pbslearningmedia.org/resource/f4f6097a-807f-4488-b874-0bae0d8446c8/microscope-activity/en/>

1. What is the purpose of this lab?
2. "Light microscopes show cells at different _____?"
3. How many times does the **eyepiece** magnify an object?
4. How many objectives are on the compound light microscope?
5. List the objectives below and indicate their magnification.
 1. _____
 2. _____
 3. _____
6. How do you figure the total magnification for an object you are viewing?
7. If our eyepiece has a magnification of 10 and our objective has a magnification of 10 what is the total power of our magnification?

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8. What is the total magnification when looking under low power?
9. What is the total magnification when using the medium power and high power objectives?
10. Which power should you always START with when viewing a specimen?
11. Which focus knob should you use FIRST?
12. Which focus knob should you use second?
13. What does the course focus knob do?
14. What does the fine focus knob do?
15. Draw all of the different cells you see. Be sure to label each drawing with the correct magnification.

| | Cell 1 | Cell 2 | Cell 3 |
|------------------------|--------|--------|--------|
| Name and Magnification | | | |
| Picture | | | |

16. Think about it...Which magnification gave you the clearest picture of all the objects you viewed? Explain your position with evidence from the activity.

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Web quest: Virtual Microscopy

B. High School Version

Use the following website to familiarize yourself with a compound light microscope. Be sure to answer the questions as you work. **HINT:** If you click the "cc" button you will get written instructions as you proceed through each activity. Also, if you click the back arrow it will take you to the very beginning of the lab. If you need something repeated click the back arrow and then simply click the topic you were working on.

<https://www.udel.edu/biology/ketcham/microscope/scope.html>

1. What type of microscope is this and when do you think you would use this in the laboratory?
2. When controlling the lighting, what 3 steps should you follow?
 1. _____
 2. _____
 3. _____
3. Click on the letter "e" slide. What is the lowest power you can view this slide on?
4. Explain how the letter "e" looks when looking through the microscope view?
5. Now try moving the slide using the two adjustment knobs closest to the slide. What happens to the letter "e" when you click the right arrow on the knob? The left arrow? Briefly explain why you think this occurs.

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6. What are the names of the two focus knobs?

7. What is the difference between the two focus knobs? Please do not tell me one is BIG and the other is small...

8. Which focus knob should you use FIRST when using the low power objective?

9. True/False...you use the course focus knob when using the medium and high powered objectives.

10. Draw the letter "e" as seen when looking through the microscope.

11. Calculate the total magnification for your letter "e". REMEMBER: the eyepiece already has a magnification of 10!!!!

12. Review your checklist on the left hand side of your screen. Are there any steps you did not complete? If so explain how you perform those steps (in words) below.

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Qualitative VS. Quantitative Data-Part I

Define the following terms below.

Scientists collect two different types of data: qualitative data and quantitative data.

Qualitative Data:

Quantitative Data:

Example

Suppose a marine biologist observes the behavior and activities of dolphins. She identifies different dolphins within the group and observes them every day for a month. She records detailed observations about their behaviors. Some of her observations are qualitative data and some are quantitative data.

Qualitative data examples

- Dolphin colors range from gray to white.
- Dolphins in a pod engage in play behavior.
- Dolphins have smooth skin.

Quantitative data examples

- There are nine dolphins in this pod.
- Dolphins eat the equivalent of 4-5% of their body mass each day.
- The sonar frequency most often used by the dolphins is around 100 kHz.

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Qualitative VS. Quantitative Data-Part II

With your partner, share your definition for qualitative vs. quantitative data. Once you have both agreed on a definition complete the following activities below.



Identify Data Types

Suppose that you are a biologist studying elephants in their natural habitat in Africa. You observe their behaviors and interaction, and take photographs of their interactions to study later. Examine the photograph of the elephants shown above.

1. **Analyze** Give two examples of qualitative data that could be obtained from the photograph of the elephants.

2. **Analyze** Give two examples of quantitative data that could be obtained from the photograph of the elephants.

-adapted from the Centennial School District, www.centennialsd.org

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I've Got Worms!!! Laboratory Exercise

Introduction: You have already learned about *C.elegans*: their behavior and their physical features. You have also learned the difference between qualitative and quantitative data and the steps to the scientific method. In this exercise you will use the steps of the scientific method to determine the difference (if there is any!) between a petri plate containing “normal” *C.elegans* and a petri plate containing “mutant” strains of *C.elegans*.

Purpose:

Hypothesis: Remember-Using the background knowledge you already have about *C. elegans* predict what you think you will observe in the lab regarding the normal vs. mutant strain of *C.elegans* (If/Then format)...

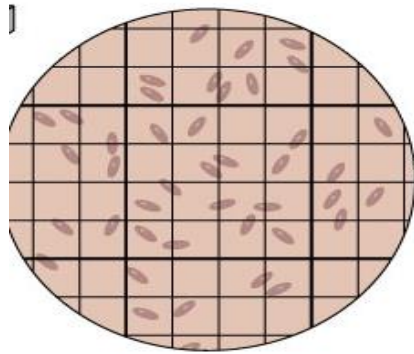
Procedure:

1. Place a plate of N2 (normal) worms on the stage of the dissecting scope.
2. Start at low magnification and observe the shape and movement of the worms. You may need to switch to a higher magnification to make some of the following observations, but always start at low magnification FIRST!
3. Identify eggs and record the number in your data table. Remember they will appear as small, clear or dark, oval spots on the plate. NOTE: The petri plates should be kept closed whenever the plate is not being examined. If there is condensation on the lid, remove the lid and wipe with a Kim wipe. You may also try to view the plate upside down, through the agar and see if you note any differences.
4. Identify the four larval stages (L1-L4). Remember that they cover a broad range of sizes with the L1 worms being the smallest and the L4 worms being the largest. Count the number of worms you see of each type and record the number for each type in your data table. Then record the behaviors of each type. NOTE: behaviors may include things like: movement (locomotion), egg-laying, eating, and defecation (pooping)!!!
5. Identify the number of hermaphrodites and male worms you observe. Remember that most of the plate will consist of hermaphrodites with tapered tails. In contrast, males have a thin, spade-shaped tail. Record the number of each type in your data table. Then record the behavior of each type.
6. Clean up your area:
 - All plates should be returned to your teacher
 - Clean your work area with a Lysol/Clorox cleaning wipe provided by your teacher
 - Turn off your microscope
 - Wash your hands

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Data Collection/Plate Counts:

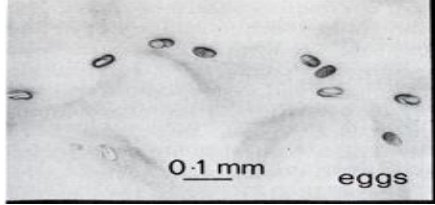
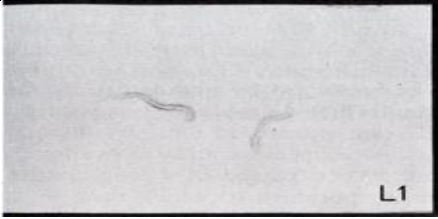



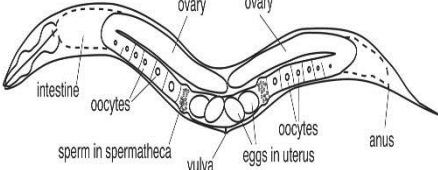
Scientists sometimes use agar plates with a grid on the bottom in order to count organisms and bacterial colonies growing on the petri dish. Try to count each stage of *C.elegans* when you see it in each grid. It may be necessary to mark the bottom of the petri dish with marker to outline the larger grids so you can visualize them under the microscope. You would want to use a thin sharpie for this and lightly mark the plate so the worms are still visible. If a worm is more than half way inside of a large gridded area, then it counts for that section. Once you have counted each stage in one large grid, move the plate to a new grid. Try to move the plate randomly without looking through the microscope. The more times you move the grid randomly and count, the more accurate your data will be.



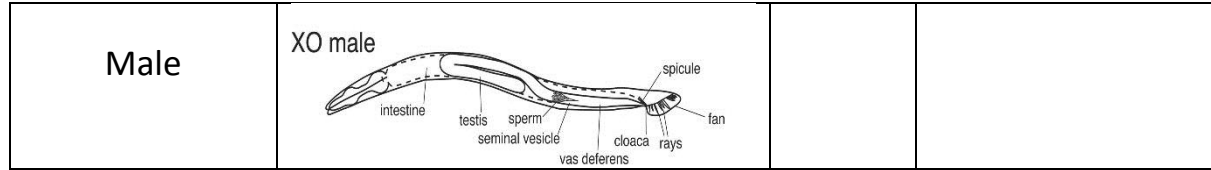
Extension: You could also make a chart to keep track of the gridded areas and how many of each type of worm you find in each. Then you could average those numbers together and ask students why they think there were more worms in some areas and less in others etc.

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Data Table: Normal plate

| Type/Stage of Worms | Pictures | Plate Count | Behavior |
|---------------------|---|-------------|----------|
| Eggs |  | | |
| L1 |  | | |
| L2 |  | | |
| L3 |  | | |
| L4 |  | | |
| Hermaphrodite | <p>XX hermaphrodite</p>  | | |

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Data Analysis: Construct a graph with the information from your data table. You may construct your graph by hand or by using the computer.

Conclusion Questions:

1. List the following variables/groups for this lab:

Independent Variable: _____

Dependent Variable: _____

Experimental Group: _____

Control Group: _____

2. Was your hypothesis correct? _____ If not, what should you do next?

3. How many developmental stages were you able to observe? _____ Is this qualitative or quantitative data? Provide evidence to support your answer.

4. List two examples (not including the one from above) of qualitative data and two examples of quantitative data.

Pictures were taken from openwetware.org and wormbook.org

Extension Activities: You could not tell students which plate was the normal *C.elegans* and which ones were the mutant strains. The students could use the information they obtained earlier to help determine which are which. Also, the high school version of this lab could be an additional extension.

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Bioethics

All animals are equal, but some animals are more equal than others.

– George Orwell, *Animal Farm*

Explain what you think is meant by the quote above. After you completed all of the components of this unit and after all you have learned about *C.elegans*, do you think of this worm as an animal. Use evidence from this unit to support your position.

If you believe *C.elegans* is an animal, do you think it is acceptable that we use it as a model in the laboratory setting? Make sure you back up your position with facts and not opinions.

If you do not think of *C.elegans* as an animal, then what do you believe it is? Make sure you back up your position with facts and not opinions.

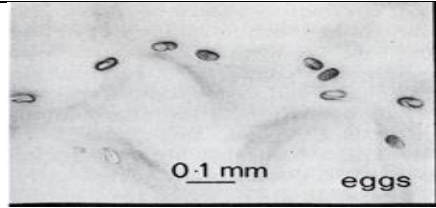




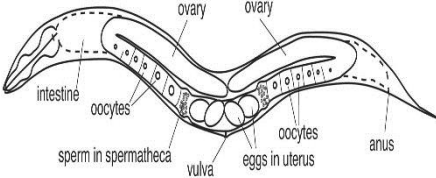
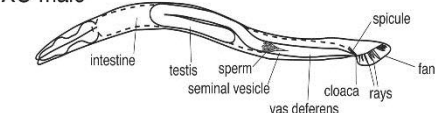
I've Got Worms!!!

Extension: The idea for this lesson came from a journal article found in ILAR Journal, Volume 52(2). High school students should read the entire article and annotate as they read. An in class debate can be conducted using the philosophical chairs model from the AVID organization found at the link below.

<https://www.youtube.com/watch?v=U0XTkCSb6a8>

I've Got Worms!!!

Data Table: Mutant plate

| Type/Stage of Worms | Pictures | Plate Count | Behavior |
|---------------------|---|-------------|----------|
| Eggs |  | | |
| L1 |  | | |
| L2 |  | | |
| L3 |  | | |
| L4 |  | | |
| Hermaphrodite | <p>XX hermaphrodite</p>  | | |
| Male | <p>XO male</p>  | | |

I've Got Worms!!!

Date: _____

Name: _____

Class: _____

1 What's the difference between a hypothesis and a theory?

- A "Theory" is another word for "fact;" "hypothesis" is another word for "guess"
- B Hypotheses can't be proven; theories can
- C Theories have been confirmed through tests; hypotheses haven't
- D Theories contain many hypotheses; a hypothesis only contains one theory

2 Place the following steps in sequence: A) Recognizing a problem; B) Testing a hypothesis; C) Drawing inferences

- A A, C, B
- B A, B, C
- C B, C, A
- D C, B, A

3 In the phrase, "The scientific method is an analytic process for determining why things happen," what's the best synonym for "analytic?"

- A Probable
- B Amazing
- C Incoherent
- D Logical

4 What must you do before you make a hypothesis?

- A Run an experiment
- B Make observations
- C Form a theory
- D Draw conclusions

5 If you were running an experiment to determine the temperature at which beans sprout the fastest, what would be the variable?

- A The number of beans you plant
- B The height of the sprouts you grow
- C The amount of water you give the beans
- D The temperature at which each bean is kept

6 You should run an experiment several times to make sure your results are consistent. In the preceding phrase, what does "consistent" mean?

- A Obvious
- B Perfect
- C Unchanging
- D Testable

7 What might cause a theory to change over time?

- A New laws passed by the government
- B New but untestable ideas
- C Changes in public opinion
- D The discovery of new evidence

8 Evolution is one example of a theory. From what you know about the scientific method, what can you conclude about this biological theory?

- A It's been tested many times
- B Scientists don't need to test it anymore
- C No one is allowed to test whether it's true or not
- D There is very little evidence to support it

9 Which of the following is a testable hypothesis?

- A Roses are more beautiful than violets
- B A plant needs at least five hours of sunlight per day to grow
- C Ice cream is delicious
- D Humans will someday land on Mars

10 What happens if you test a hypothesis multiple times and the data doesn't support your prediction?

- A Change the data to support your prediction
- B Run the experiment again until you get the results you're looking for
- C Conclude that your hypothesis cannot be proven
- D Re-think your hypothesis

UNIT PLAN

Unit Title: I've Got Worms!!!

Content Area/Grade: Life Science-7th Grade

Teacher: Gerhard-Sterner

Implementation Time Frame: 3-4 BLOCK (90min) classes

STAGE 1: THE DESIRED RESULTS

What are my learning goals?

Unit Goal

Students will understand that...

Standard(s)/Benchmark(s)

What standard(s)/benchmark(s) does this daily lesson address?

- Define a problem and carry out an investigation
- Identify the test (independent variable) and the outcome (dependent variable)
- Write to explain the importance of scientific debate and confirmation within the science community,

SC.7.N.1.1
SC.7.N.1.3
SC.7.N.1.4
SC.7.N.1.7
SC.7.N.3.2

Related Misconceptions

What misconceptions are predictable?

Students will know...

Vocabulary, terminology, definitions

- Construction of a hypothesis
- The difference between qualitative and quantitative data
- The difference between variables and what comprises an experiment
- How a model is used...not always made/nonliving
- Defending a position with fact NOT opinion
- Worms are GROSS
- Graphing...X vs. Y axis

Vocabulary:

Essential to benchmark: hypothesis, independent variable, dependent variable, quantitative data, qualitative data, experimental group, control group, bioethics, model

Secondary Vocabulary: Caenorhabditis elegans(C. elegans), nematodes, apoptosis, stimulus, , pirouettes, E.coli, bacterium, hermaphrodite, self-fertilization, petri plate, agar, mutant, compound light microscope

Essential Questions

What questions will foster inquiry, understanding and transfer of learning?

- What defines a "testable" question?
- Can you identify the variables?
- Can you interpret data charts, tables, and graphs?
- What are the benefits and limitations of the use of scientific models?

Students will know...

key facts, formulas, critical details, important events, important people, timelines

Other Essential Knowledge: Understand the life cycle of C.elegans and be able to identify the different larval stages, be able to use a microscope, be able to perform an accurate plate count and distinguish between the different behaviors of C.elegans at different stages, use data to construct a graph, write to defend my position of the use of scientific models

Students will be able to...

Specific skills students will acquire as a result of this unit

- Identify and apply the steps of the scientific method
- Conduct a plate count
- Construct a line graph
- Analyze qualitative and quantitative data
- Use a microscope properly

STAGE 2: ASSESSMENT EVIDENCE

What evidence will show that my students have achieved the learning goals?

Performance tasks:

Through what specific "real-world" performance task(s) will students demonstrate their understanding of the learning goals?

Students will learn how to properly use a microscope. Once this skill is learned they will be able to use this skill set to observe *C.elegans* directly and perform a proper plate count in order to obtain "real world" data sets. While conducting this experiment students will apply the steps of the scientific method to their lab activity. Students will also use their data sets to construct a line graph and analyze their results. Students will also analyze the benefits and limitations to using *C.elegans* as a model.

Rubric

By what criteria will "performance of understanding" be judged?

| | | |
|--|---|-------------|
| Variables <i>40 points</i> | The independent variable is drawn on the X axis. The dependent variable is drawn on the Y axis. | 20 20 |
| Layout <i>25 points</i> | The scale is such that the graph covers most of the page. Rectangular graph paper is turned so that the variable with the widest range is drawn along the widest side of the paper. | 20 5 |
| Axis Identification <i>10 points</i> | Grid lines on each axis are clearly and neatly numbered. Each axis is clearly and neatly labeled, including the units in which each variable is measured. | 5 5 |
| Graph Data <i>15 points</i> | Each data point is indicated by an obvious, but not overly large dot. The value of the data for the dependent variable is neatly written by each data point. <i>(These numbers must be done without cluttering the graph.)</i> The line plotted for the graph is neatly done and appropriate. <i>(Most graphs should be drawn as "best-fit" lines or curves.)</i> | 5 5 5 |
| Title & Key <i>10 points</i> | A descriptive title is neatly printed in the largest area inside the graph area. <i>(Graph titles are not printed in the margin of the paper.)</i> If more than one line is drawn on a single graph, a "key" is provided near the title to identify the lines. <i>(This is only done if there is more than one line on the graph.)</i> | 10 |
| Score | Total Points | 100 |

Other Evidence:

What other evidence needs to be collected in order to monitor student progress on these concepts and skills along the way?

A guided reading will be used during the jigsaw on *C.elegans* and a discussion of results will follow. The web quest will serve as a learning module and the skill will be observed and assessed in class by the instructor. The plate count and data will be checked by the instructor for errors and accuracy as will the prelab and post lab questions. The bioethics portion will be either debated in class for content or will be analyzed by the instructor with descriptive feedback given to each student individual in written format. A quiz will be given at the end of class to check for errors in identifying the steps of the scientific method.

Self-Assessment/Reflection

How will students reflect and self-assess their learning?

Students will be given a pre and post- test before and after the module to assess their learning with relation to each objective within the benchmark. Students will also have an opportunity to reflect and share their opinions of the lesson and topics they need further help with.

STAGE 3: LEARNING EXPERIENCES, INSTRUCTION, AND RESOURCES

What activities will help my students achieve the learning goals?

| | |
|--|---|
| <p>What here</p> | <p>What is expected? How will you ensure that students are aware of the learning goals? Where are your students? How will you establish your students' prior knowledge?</p> <p>Students are expected to be able to identify and apply the steps of the scientific method and conduct a viable experiment. Students will be given a pre-test before the module to assess their prior knowledge with the benchmark objectives and then given the same test after the unit to assess their learning and knowledge of new skills.</p> |
| <p>Hook old</p> | <p>How will you hook students at the beginning of the unit? How will you hold their attention throughout the units?</p> <p>Using a poem at the beginning of the unit to grab their attention on C. elegans and then incorporating a video clip and hands-on activities and technology throughout to keep them interested in the topic. Using live specimens and conducting a "real" experiment should also add to their enjoyment of the topic.</p> |
| <p>Experience Explore quip</p> | <p>What critical input experience will help students explore the key ideas and essential questions? How will you equip your students with needed skills and knowledge?</p> <p>The critical input experience is the laboratory exercise however all of the activities are designed in such a way as to build on prior knowledge or foster a new learning experience. Through discussion, demonstrations, and technology new skills will be explored and learned.</p> |
| <p>Reflect ethink ehearsing evising efining</p> | <p>How will you encourage students to reflect and rethink? How will you guide students in the process of rehearsing, revising, and refining their work?</p> <p>Students will have ample opportunities to reflect and think through collaborative activities like the jigsaw and think-pair-shares. Students will also have a lab partner to collaborate with during the hands on activities however the end products such as the graph, bioethics portion, and quiz will be individually produced.</p> |
| <p>Exhibit valuate</p> | <p>How will you help students to exhibit and self-evaluate their developing skills, knowledge and understanding throughout the unit?</p> <p>By circulating during all of the activities and guiding them through active questioning and participation.</p> |
| <p>Tailor</p> | <p>How will you tailor your instruction to meet the different needs, interests and abilities of all learners in your classroom?</p> <p>Giving students extended time to complete tasks as needed, using guided note-taking/questioning sheets, the use of technology with closed captioning as needed, proximity to the teacher as needed, grouping/partnering according to the data, directions with pictures or demonstrations, hands-on activities and manipulatives, repetition of important information, use of checklists, use of graphics/pictures as needed, use of computer for graphing as needed, modified bioethics assignment as needed, quiz presented orally, word wall to be used as word bank as needed</p> |
| <p>Organize</p> | <p>How will you organize and sequence the learning activities to maximize the engagement and achievement of all students?</p> <p>I have organized the activities into learning stages to support the laboratory skills needed and higher level thinking. There is a natural progression to the learning with important, new information being given first and then scaffolding the instruction to incorporate new skills and then the higher level thinking questions at the end.</p> |

| | | |
|--|---|---|
| Big Idea: Nature of Science/Scientific Thinking | | Standard(s)/Benchmark(s): |
| Unit: I've Got Worms!!!! | | Sample Activities |
| Grade: Life Science-7th grade | | |
| Score 4.0 | In addition to Score 3.0, in-depth inferences and applications that go beyond what was taught. | Given a scientific investigation, analyze the methods used to identify the strengths and weaknesses of the method and write to defend your analysis. |
| Score 3.0 | The student can: describe a "testable" question, explain the difference between systematic observations and experiments, define each type of variable, describe ways to collect and organize data, explain how to read and interpret data, explain how to analyze information from scientific articles and lab reports and draw conclusions, explain how to defend scientific claims. | Write scientific procedures that are clear and replicable, conduct and record measurements at appropriate levels of precision, properly use equipment and instruments including set up, technique and storage, use appropriate evidence and reasoning to justify explanations to other, communicate results of scientific investigations, and evaluate the merits of the explanations produced by others. |
| Score 2.0 | <p>There are no major errors or omissions regarding the simpler details and processes as the student:</p> <p>Recognizes or recalls specific terminology: : hypothesis, independent variable, dependent variable, quantitative data, qualitative data, experimental group, control group, bioethics, model</p> <ul style="list-style-type: none"> • Performs basic processes, such as: Identifying a problem, carrying out an experiment, collecting and recording data, and reporting results <p>However, the student exhibits major errors or omissions regarding the more complex ideas and processes</p> | Identify a "testable" question, research the topic to develop a hypothesis, determine materials needed to conduct a simple experiment, carry out the investigation, collect and record data, and report results. |
| Score 1.0 | With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes. | |
| Score 0.0 | Even with help, no understanding or skills demonstrated. | |