Investigations With Mealworms: What Do They Prefer? Part 2: Light or Dark?

You have observed mealworms and recorded facts you noticed about them. We have also begun to think about what new questions we'd like to explore about them using investigation. Using your lab report forms, you and your partner will follow the procedures for a controlled experiment to find out if mealworms prefer a light or dark environment. For each trial, you should have a drawing that is labeled. You should also write your observations about what happened each time. We will use each team's data to compile class data.

Your conclusion and discussion should show what you learned from the data and tell if the results support or refute your hypothesis. Remember that all experiments with live animals should not harm the animals, so please be careful handling them.

Investigations With Mealworms: What Do They Prefer? Part 2: Light or Dark?

Suggested Grade Span

3–5

Task

You have observed mealworms and recorded facts you noticed about them. We have also begun to think about what new questions we'd like to explore about them using investigation. Using your lab report forms, you and your partner will follow the procedures for a controlled experiment to find out if mealworms prefer a light or dark environment. For each trial, you should have a drawing that is labeled. You should also write your observations about what happened each time. We will use each team's data to compile class data.

Your conclusion and discussion should show what you learned from the data and tell if the results support or refute your hypothesis. Remember that all experiments with live animals should not harm the animals, so please be careful handling them.

Big Ideas and Unifying Concepts

Cause and effect
Form and function
Interdependence
Systems

Life Science Concepts

Evolution, diversity and adaptations
Populations and ecosystems
Regulation and behavior
Reproduction and heredity
Structure and function

Mathematics Concepts

Data collection, organization and analysis
Graphs, tables and representations
Measurement
Probability

Time Required for the Task

One or two 45 minute class sessions (after introductory lessons).

Context

These investigations with mealworms are part of a unit of study on animal behavior for our fourth graders. We begin the unit with students identifying classroom objects that are either living or nonliving and then identifying the six characteristics of living things in order to classify them. Prior to conducting investigations, students are given time to observe mealworms. They watch to see how they move and how they interact. Additionally, they learn how to handle them respectfully and safely. Students have also been introduced to our lab report form and have discussed how to conduct a controlled experiment. We provide the procedures and materials list for our fourth graders when they are first learning how to conduct an investigation. These early investigations provide models for later ones that students may generate.

Prior to this investigation, students have conducted tests in wet and dry environments. (See "Mealworms, Part 1.") This investigation follows a similar model and allows teachers to observe how students are acquiring investigation and fair testing skills.

What the Task Accomplishes

Students use their science skills for observing mealworms in order to collect and record data. A model sentence (on the lab report) is given to help students use a prediction, based on prior knowledge, to generate their hypotheses. After compiling class data tables, they will analyze data to draw conclusions, communicate findings and make connections to what they have already learned.

The lab report form includes indicators (written along the left side of the page) to help students understand what the performance expectations are for each part of the lab. Using the same form in grades four through eight helps teachers to track students' growth over time, as well. The small box with each indicator allows the teacher to check if evidence is provided, making grading more efficient and giving direct feedback to students.

How the Student Will Investigate

Students work in pairs or trios to conduct their investigations. Each individual records his/her own data and observations. Procedures and materials are provided, but students must review the information together and set up their controlled experiment with minimal help from the teacher. Once all data are collected and recorded, the teacher compiles a table with class data (totals) before students write up their discussion, conclusions and reflections on what they learned. This sometimes generates discussions about why some data may be different from what most students found and possible sources of experimental error during the investigations. Students end with writing a new testable question to explore.

In this investigation, students cover half of the petri dish with dark paper. Two or three mealworms are placed in the middle of the dish and allowed to move for 30 seconds. Positions are recorded and the procedure is repeated for two more trials.

Interdisciplinary Links and Extensions

Science
Students could raise their own cultures of mealworms and study the four stages of their life cycles (egg, larvae, pupae, and adult grain beetle – TENEBRIO molitor). Mealworms can be purchased inexpensively from pet stores. Keep beetles and pupae in darkened containers with air holes. A layer of cornmeal, oatmeal or other crushed cereal can be used on the bottom. Add a piece of apple or potato for moisture. Cover with a paper towel, place a lid on the container and store in a dark, warm cupboard. Eggs are very tiny, white and hard to see. They hatch in about a week. Larvae grow for about four to six months and molt many times until they are about one inch long. The pupae stage lasts about 1–3 weeks before beetles emerge. (Note: Mealworms can detect odors, can sense light, and have an innate turning response that helps them find their shelters again. They are attracted to dampness but can die in even small amounts of water. All of these facts could provide testable questions for students to explore. (See also Mealworms, Part 1.)

Social Studies
Have students look for news media stories related to the ethical treatment of research animals and/or interview biologists at a local university about their research with live animals.

Teaching Tips and Guiding Questions

Providing time for observing mealworms before conducting investigations is important in teaching students to understand mealworms' “normal” behavior, so students can recognize when mealworms act differently. It is also essential to discuss the ethics of using live animals for science experiments.

Some possible questions to guide investigations might include:

- How will you control the experiment to find out what mealworms prefer? What variables will remain the same? What variable will you measure?
- Is this a fair test?
- What is the stimulus in this investigation?
- What responses are possible?
- Why should you start them in the middle of the dish each time?
- Why should you do more than one trial? Why use more than one mealworm? Why put all of the class data together? (allows us to generalize preferences)
- What other science vocabulary will you use to explain what you learned?
- How will you be sure to treat the mealworms safely and carefully so that no harm comes to them?
- What do you already know about mealworms from your observations?
- What questions will your investigation answer?

- What is your prediction?
- Have you given the mealworms a CLEAR choice in this investigation?
- Did you conduct at least three trials?
- Did you note at least three details in your recorded observations?
- Did anything surprise you during the investigation?
- How can you explain different results found in the class data?

Concepts to be Assessed

(Unifying concepts/big ideas and science concepts to be assessed using the Science Exemplars Rubric under the criterion: Science Concepts and Related Content)

Life Science – Structure and Function; Reproduction and Heredity: Students identify characteristics of organisms, and understand that all organisms are living systems, and that each distinct structure has a set function that serves the organism. Students observe that species acquire their unique characteristics through biological adaptations, and understand what to look for (size, shape, texture, structure, movement, etc.) when observing organisms. Students use prior knowledge, and classify and compare living organisms. Students observe that each organism has different structures that serve different functions in growth, survival and reproduction. Students understand the characteristics of mealworms by describing some of their needs, aspects of their immediate environments, some of their structures and effects of changes to their environment.

Scientific Method: Students need to be able to use the terms *stimulus*, *response*, *controlled experiment* and *variable* appropriately. Students need to be able to observe, explain and describe cause and effect relationships with some justification, using data and prior knowledge when variables are controlled (cause-effect).

Life Science – Regulation and Behavior: Students observe that all organisms have basic needs – air, water, food, and that all animals depend on plants, some eat plants and others eat animals that eat plants. Students observe that organisms can survive only in an environment in which their needs can be met. Different environments support different types of organisms.

Life Science – Evolution, Diversity and Adaptations: Students understand that species acquire many of their unique characteristics including structures, behaviors and physiology, through biological adaptation, that enhances survival and reproductive success.

Life Science – Populations and Ecosystems: Students identify some patterns of similarities and differences while recognizing mealworms' interdependence with other living things (systems and interdependence).

Mathematics: Students identify trends and patterns and use appropriate data representation and analysis. Students explore probability and use tables to show how values of one variable are related (increase, decrease, etc.) to values of another. Numerical data and precise measurements are used in describing events, answering questions, providing evidence for scientific explanations and challenging misconceptions.

Skills to be Developed

(Science process skills to be assessed using the Science Exemplars Rubric under the criteria: Scientific Procedures and Reasoning Strategies, and Scientific Communication Using Data)

Scientific Method: Observing, predicting/hypothesizing, collecting/recording, and analyzing data, drawing conclusions, communicating findings, challenging misconceptions and raising new questions.

Other Science Standards and Concepts Addressed

Scientific Method: Students describe, predict, investigate and explain phenomena. Students control variables.

Scientific Theory: Students look for evidence that explains why things happen and modify explanations when new observations are made.

Life Science – Structure and Function; Reproduction and Heredity: Students describe and group animals by what they eat and where they live. Students understand that living things are found almost everywhere in the world and are interdependent. Each plant or animal has different structures that serve different functions in growth, survival and reproduction. Students understand the characteristics of organisms (needs, environments, structures and behaviors), see patterns of similarity and differences among living organisms, and recognize the interdependence of all systems that support life.

Life Science – Evolution, Diversity and Adaptations: Students understand that many characteristics of organisms are inherited from parents and that others are a result of interactions with the environment. Species acquire many of their unique characteristics through biological adaptation, which includes changes in structures, behaviors or physiology that enhance survival and reproductive success in a particular environment. Organisms can only survive in environments that meet their needs. Organisms have distinct structures that have developed to help them to function and survive.

Life Science – Regulation and Behavior: Students observe that an organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces and responds to danger are based on the species' evolutionary history.

Communication: Students use verbal and nonverbal skills to express themselves effectively.

Suggested Materials

Students are provided with scissors, dark paper (to be cut to fit over half of the dish), tape (to attach paper to dish), petri dishes, two to three mealworms, clock/timer with a second hand or stopwatches and lab report forms. Refer to the worksheets on pages 9–11.

Possible Solutions

Create a hypothesis showing a prediction about which side will be chosen and a possible reason to support your idea. Clearly state the variables to be kept constant and the variable to be measured. For each trial, there should be a drawing that is labeled (dark and light sides, 1st, 2nd, and 3rd trials, mealworms). Students might provide a key for labels as well. Observations about what happened each time should include at least three details.

The class data table should be accurate and used to write a conclusion and discussion, including whether the results support or refute the hypothesis. A new question to test should be stated as a question.

Task-Specific Assessment Notes

Novice

The student's solution is incomplete and lacks some details. There is an attempt to name variables, but the student does not include a way that results will be measured. The student's drawing is a side view, which does not show what actually happened. Only one trial is drawn, and no clear labels or key is provided. Data show that only one mealworm was used, which is evidence that procedures were not followed. Observations imply that the student did not move the mealworm back to the middle each time. ("He sleeps I think.") There is an accurate statement in the summary but no actual data referencing it. The big idea is rather vaguely stated, and while two choices are suggested for a further test, it is not in question form.

Apprentice

The student's solution is lacking in detail, although the task is completed. The student names the variable to be tested but does not specify what will be kept constant. It is not clear how the results will be measured. The drawing can be understood, but it is not labeled. Only one trial is drawn. The student attempts to use details in the observations, but explanations are somewhat confusing and wordy. The summary is accurate but does not include actual data. While two choices are suggested for a further test, the test is not stated in question form. The "unexpected result" of some staying in the middle is correctly recorded on the class data table.

Practitioner

The student's solution is complete. The student names the variable to be tested, identifies the constants and is clear about how the results will be measured. The drawings are accurate, sequenced and labeled using a key. Observations include each trial in sequence. Data for both tables are accurate and complete. The observation that some stayed in the middle is correctly recorded on the team and class data tables. The summary refers to actual data totals, and the reflections suggest a possible source of experimental error. A testable question is suggested for further investigation.

Expert

The student's solution is complete and detailed. Variables are correctly identified, and the student clearly states how results will be measured. The drawings are accurate, sequenced and labeled. A key is also provided. Data are accurate, and observations are stated in complete

sentences. Each trial is described in sequence and clear detail. Data for both tables are accurate and complete. The observation that some stayed in the middle is correctly recorded on the team and class data tables. The summary refers to actual data totals, and the reflections suggest a possible source of experimental error. The student answers the question based on findings. A suggestion for further investigation is included but not in question form.

Worksheet

Mealworms in Light and Dark Experiment

Evaluation Criteria

☐ testable

☐ if, then construction

☐ shows cause/effect relationship

☐ Names variable to be tested (independent)

☐ Names variable to be measured (dependent)

☐ Identifies constants

Question: What I want to find out

Do mealworms prefer light or dark?

Hypothesis (Prediction): What I think will happen

If mealworms are given a choice of light or dark

then

Reason: Why I think it will happen

because

Variables: How I will make sure it is a fair test

Independent Variable: One I will change

Dependent variable: How I will measure results (units)

Variables I will keep the same (constants):

☐ Writes own procedure
☐ Procedure is fair test
☐ tells all steps
☐ steps are in order
☐ someone else could do the experiment exactly

when appropriate
☐ quantities stated
☐ number of trials stated
☐ times specified

Procedure: What I will do.

1. Put 2 or 3 mealworms in the middle of a petri dish.
2. Cover half of the dish with a piece of paper.
3. Time for 30 seconds.
4. Record the positions of the mealworms.
5. Repeat 2 more times.

Courtesy of Ann Arbor Public Schools, 2000

Worksheet (cont.)

☐ all materials listed
☐ metric units given
☐ quantities given when needed
☐ drawing has enough detail to be understood
☐ significant parts of drawing are labeled
☐ sequence noted, when needed

Materials:

What I will need

- 1 plastic petri dish
- 10 cm x 10 cm dark construction paper
- 2 or 3 live mealworms
- clock with second hand

Lab Set Up

	Data:	Trial	# of mealworms on wet	# of mealworms on dry
☐ units		1		
☐ accurate/ complete		2		
		3		
☐ totals or averages when needed		Totals		

☐ accurate
☐ at least 3 details
☐ complete sentences
☐ relevant
☐ reader can understand what is written

Observations:

Use words to describe what happened during the experiment. Give specific, relevant details. Avoid opinions, feelings, generalizations.

	Class Data:	Trial	Total # of mealworms on wet	Total # of mealworms on dry
☐ units		1		
☐ accurate/ complete		2		
		3		
☐ averages or totals when needed		Totals		

Courtesy of Ann Arbor Public Schools, 2000

Worksheet (cont.)

☐ accurate summary
☐ correct trend
☐ correct terms

Summary:

Use words to tell what the data says.
Then describe trends, patterns, etc.
Use scientific terms

(Using data) _____

☐ tells how evidence related to hypothesis
☐ answers question accurately

Conclusion

Tell if your hypothesis was or was not supported by the data.

Tell how your question was answered.

"My hypothesis was/was not supported by the data and showed that _____

☐ showed, stated what was learned
☐ refers to "Big Idea"
☐ science vocabulary accurate
☐ complete sentences

Big Idea:

What did you learn?

How is what you learned connected to the Big Idea you are studying in science ?
CLUE: _____

☐ complete sentences
☐ sources of error

Reflection:

Explain anything that happened in the experiment that you did not expect.

Discuss some likely sources of error.

☐ testable question

Next testable question:

Courtesy of Ann Arbor Public Schools, 2000

Novice

Mealworms in Light and Dark Experiment

Evaluation Criteria
- ☐ testable
- ☐ if, then construction
- ☐ shows cause/effect relationship
- ☐ Names variable to be tested (independent)
- ☐ Names variable to be measured (dependent)
- ☐ Identifies constants

Question: What I want to find out
Do mealworms prefer light or dark?

Hypothesis (Prediction): What I think will happen
If mealworms are given a choice of light or dark
then they would pick dark

Reason: Why I think it will happen
because
they hide in the darkne

Variables: How I will make sure it is a fair test

Independent Variable: One I will change
dark or light

Dependent variable: How I will measure results (units)
do they like dark or light

Variables I will keep the same (constants):
dish, time, and mealworms

- ☐ Writes own procedure
- ☐ Procedure is fair test
- ☐ tells all steps
- ☐ steps are in order
- ☐ someone else could do the experiment exactly

when appropriate
- ☐ quantities stated
- ☐ number of trials stated
- ☐ times specified

Procedure: What I will do.

1. Put 2 or 3 mealworms in the middle of a petri dish.
2. Cover half of the dish with a piece of paper.
3. Time for 30 seconds.
4. Record the positions of the mealworms.
5. Repeat 2 more times.

The student attempts to name variables, but does not include a way to measure results.

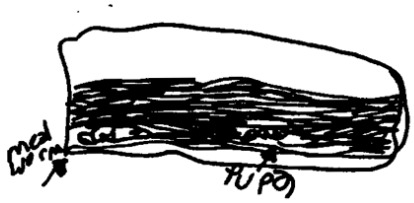
Novice

☐ all materials listed
☐ metric units given
☐ quantities given when needed
☐ drawing has enough detail to be understood
☐ significant parts of drawing are labeled
☐ sequence noted, when needed

Materials:
What I will need

- 1 plastic petri dish
- 10 cm x 10 cm dark construction paper
- 2 or 3 live mealworms
- clock with second hand

Lab Set Up



Side view does not show what happened or the number of trials.

	Data:	Trial	# of mealworms in dark	# of mealworms in light
☐ units		1		0
☐ accurate/ complete		2		0
		3		0
☐ totals or averages when needed		Totals		0

☐ accurate
☐ at least 3 details
☐ complete sentences
☐ relevant

☐ reader can understand what is written

Observations:
Use words to describe what happened during the experiment. Give specific, relevant details. Avoid opinions, feelings, generalizations.

He likes the dark.
He stayes in one place.
He sleeps I think.

	Class Data:	Trial	total # of mealworms in dark	total # of mealworms in light
☐ units		1	54	8
☐ accurate/ complete		2	39	20
		3	45	16
☐ averages or totals when needed		Totals	138	44

Data does not reflect procedures and is inaccurate.

There is no key nor clear labels in the drawing.

Novice

☐ accurate summary
☐ correct trend
☐ correct terms

Summary:
Use words to tell what the data says. Then describe trends, patterns, etc. Use scientific terms

(Using data) _____

Most Mealworms like the Dark

There is an accurate summary, but no data is included.

☐ tells how evidence related to hypothesis
☐ answers question accurately

Conclusion
Tell if your hypothesis was or was not supported by the data.

Tell how your question was answered.

"My hypothesis was/was not supported by the data and showed that

The data Soport My Perdicto

☐ showed, stated what was learned
☐ refers to "Big Idea"
☐ science vocabulary accurate
☐ complete sentences

Big Idea:
What did you learn?

How is what you learned connected to the Big Idea you are studying in science ? CLUE:

some creatures like Shade

☐ complete sentences
☐ sources of error

Reflection:
Explain anything that happened in the experiment that you did not expect.

Discuss some likely sources of error.

☐ testable question

Next testable question:

wet and dry.

The next testable question shows the student has 2 choices in mind, but it is not written as a question.

Apprentice

Mealworms in Light and Dark Experiment

Evaluation Criteria
- ☐ testable
- ☐ if, then construction
- ☐ shows cause/effect relationship
- ☐ Names variable to be tested (independent)
- ☐ Names variable to be measured (dependent)
- ☐ Identifies constants

Question: What I want to find out
Do mealworms prefer light or dark?

Hypothesis (Prediction): What I think will happen
If mealworms are given a choice of light or dark
then I think they will choose dark

Reason: Why I think it will happen
because
when they go into the meal they don't come out until it's gone.

Variables: How I will make sure it is a fair test

Independent Variable: One I will change
½ covered with a piece of paper.

Result does not state how test will be measured.

Dependent variable: How I will measure results (units) if meal worms like dark or light.

The student names variables to be tested, but does not specify constants.

Variables I will keep the same (constants):
everything on the procedure list expet #2.

- ☐ Writes own procedure
- ☐ Procedure is fair test
- ☐ tells all steps
- ☐ steps are in order
- ☐ someone else could do the experiment exactly

when appropriate
- ☐ quantities stated
- ☐ number of trials stated
- ☐ times specified

Procedure: What I will do.

1. Put 2 or 3 mealworms in the middle of a petri dish.
2. Cover half of the dish with a piece of paper.
3. Time for 30 seconds.
4. Record the positions of the mealworms.
5. Repeat 2 more times.

Apprentice

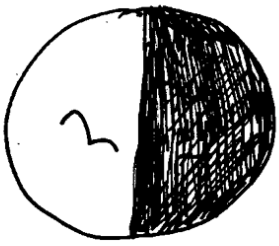
☐ all materials listed
☐ metric units given
☐ quantities given when needed

Materials:
What I will need

- 1 plastic petri dish
- 10 cm x 10 cm dark construction paper
- 2 or 3 live mealworms
- clock with second hand

☐ drawing has enough detail to be understood
☐ significant parts of drawing are labeled
☐ sequence noted, when needed

Lab Set Up



The student's drawing can be understood; however, labels would make it more clear.

	Data:	Trial	# of mealworms in dark	# of mealworms in light
☐ units		1	3	0
☐ accurate/ complete		2	2	1
		3	2	1
☐ totals or averages when needed		Totals	7	2

☐ accurate
☐ at least 3 details
☐ complete sentences
☐ relevant

☐ reader can understand what is written

Observations:
Use words to describe what happened during the experiment. Give specific, relevant details. Avoid opinions, feelings, generalizations.

The fatest one stayed in the light sometimes th fat one was half and hal the rest moved fastily into the dark and kept on moving in the dark so the result was 7 time in the dark and 2 times in the light in total was there were 3 of them and we tryed it 3 times

Student attempts to use details in observations, but they are confusing because of wordiness.

Class Data:	Trial	total # of mealworms in dark	total # of mealworms in light
☐ units	1	𝍸 𝍸 𝍸	𝍸
☐ accurate/ complete	2	𝍸 𝍸 𝍸	𝍸
	3	𝍸 𝍸 𝍸	
☐ averages or totals when needed	Totals	53 2	8

Apprentice

Summary is accurate, but no data given.

☐ accurate summary
☐ correct trend
☐ correct terms

Summary:
Use words to tell what the data says. Then describe trends, patterns, etc. Use scientific terms

(Using data) Our classrooms mealworms liked the dark.

☐ tells how evidence related to hypothesis
☐ answers question accurately

Conclusion
Tell if your hypothesis was or was not supported by the data.

Tell how your question was answered.

"My hypothesis was/was not supported by the data and showed that mealworms like dark maby cause they dark is wher they modtis are re

☐ showed, stated what was learned
☐ refers to "Big Idea"
☐ science vocabulary accurate
☐ complete sentences

Big Idea:
What did you learn?

How is what you learned connected to the Big Idea you are studying in science ? CLUE:

the thing I learnd was mealworms that they have segme nts.

The student is answering a "why" question, not the experimental question.

☐ complete sentences
☐ sources of error

Reflection:
Explain anything that happened in the experiment that you did not expect.

Discuss some likely sources of error.

the thing that I did not bxpect is that some stacle in the midel.

☐ testable question

Next testable question:

wet dry

Only a vague testable question is suggested as an extension.

Practitioner

Mealworms in Light and Dark Experiment

Evaluation Criteria

☐ testable

☐ if, then construction

☐ shows cause/effect relationship

☐ Names variable to be tested (independent)

☐ Names variable to be measured (dependent)

☐ Identifies constants

Question: What I want to find out — Do mealworms prefer light or dark?

Hypothesis (Prediction): What I think will happen — If mealworms are given a choice of light or dark then they will choose dark

Reason: Why I think it will happen — because they hide under things

Variables: How I will make sure it is a fair test

Independent Variable: One I will change — petri dish half covered with paper

Dependent variable: How I will measure results (units) — how many times mealworms go to dark or light

Variables I will keep the same (constants): time mealworm, starting point, petri dish,

Student names variable to be tested; identifies the constants; and names measurable variables.

☐ Writes own procedure
☐ Procedure is fair test
☐ tells all steps
☐ steps are in order
☐ someone else could do the experiment exactly

when appropriate
☐ quantities stated
☐ number of trials stated
☐ times specified

Procedure: What I will do.

1. Put 2 or 3 mealworms in the middle of a petri dish.
2. Cover half of the dish with a piece of paper.
3. Time for 30 seconds.
4. Record the positions of the mealworms.
5. Repeat 2 more times.

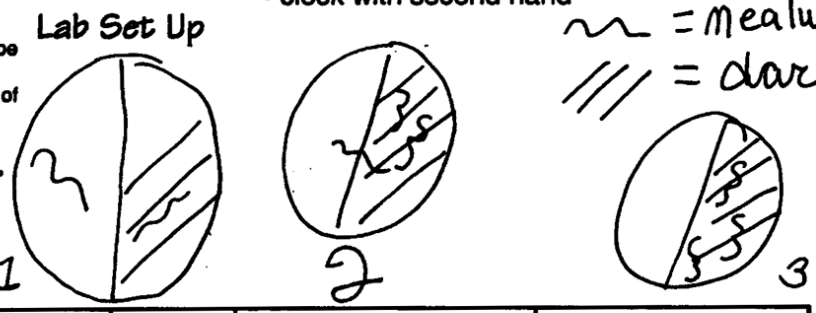
Practitioner

☐ all materials listed
☐ metric units given
☐ quantities given when needed
☐ drawing has enough detail to be understood
☐ significant parts of drawing are labeled
☐ sequence noted, when needed

Materials:
What I will need

- 1 plastic petri dish
- 10 cm x 10 cm dark construction paper
- 2 or 3 live mealworms
- clock with second hand

Lab Set Up



Drawing is accurate and sequenced. Key shows correct labels.

	Data:	Trial	# of mealworms in dark	# of mealworms in light
☐ units		1	2	1
☐ accurate/ complete		2	2 1	0
		3	3	0
☐ totals or averages when needed		Totals	7 1	1

Observations are accurate. All 3 trials are described and sentences are complete.

☐ accurate
☐ at least 3 details
☐ complete sentences
☐ relevant

☐ reader can understand what is written

Observations:
Use words to describe what happened during the experiment. Give specific, relevant details. Avoid opinions, feelings, generalizations.

I saw that the first time there was more in dark the second time more in dark the third time there was more in dark

	Class Data:	Trial	total # of mealworms in dark	total # of mealworms in light
☐ units		1	𝍸 𝍸 𝍸 ||	||||
☐ accurate/ complete		2	𝍸 𝍸 𝍸	|||
		3	𝍸 𝍸 𝍸 ||||	1
☐ averages or totals when needed		Totals	53	12 18

Data in both tables are accurate and totaled.

Practitioner

☐ accurate summary
☐ correct trend
☐ correct terms

Summary:
Use words to tell what the data says.
Then describe trends, patterns, etc.
Use scientific terms

(Using data)
I think they like dark because 53/61 of the mealworms liked the dark.

☐ tells how evidence related to hypothesis
☐ answers question accurately

Conclusion
Tell if your hypothesis was or was not supported by the data.

Tell how your question was answered.

"My hypothesis was/was not supported by the data and showed that
My hypothesis was right because we proved that 53 of the Mealworms liked dark!

☐ showed, stated what was learned
☐ refers to "Big Idea"
☐ science vocabulary accurate
☐ complete sentences

Big Idea:
What did you learn?

How is what you learned connected to the Big Idea you are studying in science ?
CLUE:

I learned Mealwormwould rather be in the dark.

☐ complete sentences
☐ sources of error

Reflection:
Explain anything that happened in the experiment that you did not expect.

Discuss some likely sources of error.

I don't think our mealworms were exactly in the middle of the dish.

☐ testable question

Next testable question:

My question is Do mealworms like to be with other mealworms or alone

Summary tells that 53 mealworms out of 61 liked the dark, evidence that the student used data to state conclusions.

A testable question is stated for further study.

Expert

Mealworms in Light and Dark Experiment

Evaluation Criteria

☐ testable

Question: What I want to find out

Do mealworms prefer light or dark?

☐ if, then construction

Hypothesis (Prediction): What I think will happen

If mealworms are given a choice of light or dark

then *it will choice dark*

☐ shows cause/effect relationship

Reason: Why I think it will happen

because *it digs in the food and there no light*

☐ Names variable to be tested (independent)

Variables: How I will make sure it is a fair test

Independent Variable: One I will change

½ covered with paper

☐ Names variable to be measured (dependent)

Dependent variable: How I will measure results (units)

How many times it goes to light or dark

☐ Identifies constants

Variables I will keep the same (constants):

petrie dish, time for 30 sec, record pation, repeat 2 more times, 10 cm x 10 dark paper, 2-3 lisa mealworms, clock with sec hand

☐ Writes own procedure

☐ Procedure is fair test

☐ tells all steps

☐ steps are in order

☐ someone else could do the experiment exactly

when appropriate

☐ quantities stated

☐ number of trials stated

☐ times specified

Procedure: What I will do.

1. Put 2 or 3 mealworms in the middle of a petri dish.
2. Cover half of the dish with a piece of paper.
3. Time for 30 seconds.
4. Record the positions of the mealworms.
5. Repeat 2 more times.

Student has correctly identified the variables that change and variables that are held constant.

Student states measurable results.

Expert

☐ all materials listed
☐ metric units given
☐ quantities given when needed
☐ drawing has enough detail to be understood
☐ significant parts of drawing are labeled
☐ sequence noted, when needed

Materials:
What I will need

- 1 plastic petri dish
- 10 cm x 10 cm dark construction paper
- 2 or 3 live mealworms
- clock with second hand

Lab Set Up

	Data:	Trial	# of mealworms in dark	# of mealworms in light
☐ units		1	2	1
☐ accurate/ complete		2	2 1	0
		3	3	0
☐ totals or averages when needed		Totals	7 1	1

Results: Drawing has a key. Labels clearly show results of 3 trials. Light and dark are labeled.

☐ accurate
☐ at least 3 details
☐ complete sentences
☐ relevant
☐ reader can understand what is written

Observations:
Use words to describe what happened during the experiment. Give specific, relevant details. Avoid opinions, feelings, generalizations.

I observed the first time we tested one mealwormswas in the light. and 2 were in the dark. The second time we tested 2 were in the dark and one was in the middle. the 3rd time all 3 were in the dark.

	Class Data:	Trial	total # of mealworms in dark	total # of mealworms in light
☐ units		1	𝍸 𝍸 𝍸 ||	||||
☐ accurate/ complete		2	𝍸 𝍸 𝍸 || ×	|||
		3	𝍸 𝍸 𝍸 ||| ×	|
☐ averages or totals when needed		Totals	53 2	8

Data is accurate. The position of the numbers tells what happened (i.e. one mealworm was in the middle).

Observations are in sentences; 3 details are written, and are accurate with the data. It is clearly written and understandable.

Expert

☐ accurate summary
☐ correct trend
☐ correct terms

Summary:
Use words to tell what the data says.
Then describe trends, patterns, etc.
Use scientific terms

(Using data) Because I did 3 experiments and 53/63 picked dark

☐ tells how evidence related to hypothesis
☐ answers question accurately

Conclusion
Tell if your hypothesis was or was not supported by the data.

Tell how your question was answered.

"My hypothesis was/was not supported by the data and showed that Mealworms like to be in the dark

☐ showed, stated what was learned
☐ refers to "Big Idea"
☐ science vocabulary accurate
☐ complete sentences

Big Idea:
What did you learn?

How is what you learned connected to the Big Idea you are studying in science ?
CLUE:

I learned that meal worms like dark more than light but that is not always a characteristic of a meal worm.

Reflection includes a possible experimental error.

☐ complete sentences
☐ sources of error

Reflection:
Explain anything that happened in the experiment that you did not expect.

Discuss some likely sources of error.

I think we messed up by covering more than half of the dish.

☐ testable question

Next testable question:

We could test if the meal worms like fruit or veggies best

A testable question, with clearly stated variables is suggested for further study.