

Exemplary Responses and Examples of Common Errors Found on the Performance-Based Section of the Elementary-Level Science MAP Assessment

This document is designed to provide clarification of expectations for selected key elements of experimental design regularly assessed on the Science MAP assessment.

The performance-based event session of the MAP Assessment is focused on understandings of experimental design and inquiry. The elementary level assessment expects students to be able to design experiments, analyze and evaluate experimental design, and analyze the results and conclusions drawn from experiments involving a single independent variable. In order to improve student achievement on the MAP assessment, teachers are encouraged to:

- align instruction and assessment with the Science Grade-Level Expectations and supporting documents (e.g., Science Interpretations)
- involve students in learning experiences that incorporate inquiry methods
- use the Science Performance Event Template (which includes standardized prompts and scoring guides) to inform classroom instruction and assessment practices
- use assessment released items and corresponding anchor papers to become familiar with test item format and expectations

Each MAP performance event is developed as a module of questions focusing on a specific experimental scenario. A review of standardized prompts and scoring guides, with common errors, for selected performance event module items is provided. These are followed by samples of modules with examples of student responses. Teachers are encouraged to share and adopt these standards across classrooms and to expect mastery of inquiry skills by all students.

Students and Research, authored by Cothran, J. H., Giese, R. N., and Rezba, R. J. (2000, Dubuque, IA: Kendall/Hunt Publishing), is recommended as an excellent resource for use as teachers develop understandings of open-inquiry and experimental design.

Using Released Items with Colleagues and Students

#1 familiarize students/teachers with the format and expectations of the performance-event component of the MAP test

In Science and Communication Arts in particular, items are linked and students need to learn how to refer back to stimulus material or the initial prompt. A booklet of released items can be used as a “package” to show how items are linked. Teachers can use the performance-event template to write MAP like performance-events. The template can be found on DESE’s website. www.dese.mo.gov

#2 train students in self-evaluation and proofreading

Teachers should use the released items for the performance events and respective anchor papers to train students how to use the prompt and scoring guides to evaluate their own work. This is a very important step in improving student achievement. The following is a recommended process:

- a. Use post-it notes to cover the annotations and scores on the student anchor papers; then make transparencies of the problem (item prompt), the scoring guides, and the student anchor papers. Make paper copies of the problem and the scoring guide for student use.
- b. Distribute paper copies of the problem for students to work individually.
- c. Distribute copies of the scoring guide and review it with the class.
- d. Have students use the scoring guide to determine a score for their own paper (privately). If they think they have made a mistake, have them articulate the mistake on the paper or on a post-it note. The students’ own annotated papers should be set aside.
- e. Put up a transparency of one of the anchor papers. Be sure the score and annotations are not visible. Have students work in pairs to score the sample work. Remind them that they need to refer to the scoring guide and stay true to its expectations.
- f. As a class, discuss the scores assigned to the work by the students. Students must be able to defend the scores they gave based on the scoring guide.
- g. Repeat this process with the rest of the samples.
- h. Have students return to their own work and decide if the score they initially gave their paper needs to be revised.
- i. Students should be able to articulate what changes need to be made in their work to make an exemplary response.

#3 establishes standardized expectations for students across classrooms

In order to establish standardized expectations teachers need to experience the procedure described above using a packet of released items, scoring guides, and anchor papers. The following is a recommended process: After completion of steps a – g, teachers should use MAP-like scoring guides to blind-score sets of students’ work. After scoring the set of papers, compare assigned scores.

Discrepancies indicate the need to standardize expectations from one class to the next and/or to adopt MAP-like test formats, prompts and scoring guides for regular classroom use. Analysis of student scores may indicate the need to revise curriculum and assessments to better prepare students for mastery of expectations.

Exemplary Responses and Examples of Common Errors Found on the Performance-Based Section of the Elementary Science MAP Assessment

Generic Scoring Guide for Testable Questions

Testable Question: (1 pt. possible for a correct testable question)

Any reasonable testable question about ____ that:

- identifies what will be tested or measured
- will generate quantifiable data
- has a control or comparison inherent in the question

(Scoring note: The independent variable (IV) and dependent variable (DV) must be identified in the question)

Common errors:

- response does not identify what is to be tested or measured (e.g., effect of independent variable on dependent variable)
- response does not identify what quantifiable data will be collected
- suggests vague change instead of a specific, measurable change in the dependent variable (e.g., “What will happen if the (IV) is changed?” does not identify a measurable dependent variable)
- response does not suggest a comparison between the control and experimental group(s)
- response does not suggest a problem (instead may be a prediction)
- problem is vague due to use of pronouns (it, they) instead of using specific nouns to identify the independent variable and dependent variable

Sample Prompt:

Monica was studying the diet of ants and how they obtained their food.
Write a **testable** question that Monica might use to learn more about ants.

Exemplary Responses:

1. Which type of food do ants prefer to eat, bread or cereal?
DV IV
2. Do red ants or black ants eat more food?
IV DV
3. Do larger or smaller ants eat more food?
IV DV

Generic Scoring Guide for Testable Hypotheses

Testable Hypothesis: (1 pt. possible for a correct answer)

Any reasonable hypothesis based on the testable question or statement of a problem that predicts an effect, or the lack of effect, of the independent variable (IV) on the dependent variable (DV).

Exemplary responses take these appropriate forms:

“If (independent variable, IV) (description of change in independent variable), then (dependent variable, DV) (description of effect)”

“As the (independent variable) (description of change), the (dependent variable) (description of change)”

“The (qualitative/quantitative change in independent variable) of (independent variable), the (quantitative change in dependent variable)”

Common errors:

- response does not provide a specific, directional prediction (e.g., prediction fails to identify how the dependent variable will be affected by the independent variable; prediction is vague as it does not specify how the change will differ from the expected results to be observed in the control group)
- response does not suggest a specific, quantifiable change in the dependent variable (e.g., predicts a “better/best” effect which does not suggest “how” the effect would be better; predicts that the independent variable will “affect/help/change the dependent variable more/most,” which does not specify what will be changed and/or how)
- prediction does not relate to problem or question asked (e.g., may predict a change in a dependent variable different from the change specified in the problem)
- provides a reason for change instead of a prediction of change
- prediction is vague due to use of pronouns (it, they) instead of using specific nouns to distinguish between the independent variable and dependent variable
- provides another question or statement of the problem instead of a hypothesis

Sample Prompt:

Write a hypothesis for the testable question you wrote about ants.

Exemplary Responses:

1. Ants will eat more bread than cereal. (Exemplary response: If the amount of bread decreases then ants prefer to eat bread over cereal.)
2. Red ants will eat more food than black ants.
3. Larger ants will eat more food than smaller ants.

Elementary Anchors:

A.

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

My testable question is what would happen if you dirt a little field for the ants and left them there for a week.

6. Write a reasonable hypothesis for your experiment.

The ants might eat each other because they will not have enough food.

A.

Question: 0 points- does not identify what is to be tested, no control or comparison is inherent in the question

Hypothesis: 0 points- does not relate to problem or question asked (question does not specify effect of food availability on ant behavior)

B.

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

What kind of ants eats more

6. Write a reasonable hypothesis for your experiment.

I think a red ant will eat more.

B.

Question: 1 Point- identifies what is to be tested (amount of food eaten by different kinds of ants), control or comparison is inherent in the question (comparing kinds of ants), will generate quantifiable data (measuring amounts of food eaten)

Hypothesis: 1 Point- prediction is vague (does not identify comparison group), however it does provide a prediction and suggests a comparison with other kinds of ants (as stated in question)

C.

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

Will the insect eat it?

6. Write a reasonable hypothesis for your experiment.

I think the insect will eat Bread instead of Cereal.

C.

Question: 0 points- does not identify what is to be tested (what insects, eat what), no control or comparison is inherent in the question

Hypothesis: 1 point- (suggests a comparison of groups (bread vs. cereal), is directional (insects eat bread and not cereal))

D.

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

A race with ants. Which one would win? The fire ant, or the black ant.

6. Write a reasonable hypothesis for your experiment.

I think the fire ant would win because it is smaller.

D.

Question: 0 points- does not identify what will be tested (color of ant /size of ant) or measured (speed)

Hypothesis: 1 point- predicts an effect of size and is directional (fire ant will win, not black ant)

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

How do insects live?

6. Write a reasonable hypothesis for your experiment.

find insects and find out how
the insects live in their
environment!!

E.

E.

Question: 0 points- does not identify what is to be tested, no control or comparison is inherent in the question, does not identify quantifiable data to be collected related to the independent variable

Hypothesis: 0 points- no prediction of the result of an experiment

F.

5. Think of a different experiment you could do that uses insects. Write a good, testable question for the experiment.

How does weather affect bugs?

6. Write a reasonable hypothesis for your experiment.

The bugs will die in the cold and the bugs
will live in the warm and they will hide
in the rain.

F.

Question: 0 points- no control or comparison is inherent in the question (does not identify specific weather conditions to be compared), does not identify quantifiable data to be collected related to the independent variable

Hypothesis: 0 points- no prediction of the result of an experiment

Generic Scoring Guide for Bar or Single Line Graphs, Grade 5

Sample prompt:

Complete the bar graph below using the information from the data table on page ____.
Be sure to do the following:

- finish labeling the axes with categories or a number scale
- draw bars to represent the data, but do not color or shade inside the bars

-Or-

Construct a single line graph below, using the information from the data table. Be sure to finish labeling each axis with a number scale.

Generic Scoring Guide for Bar or Single Line Graphs, Grade 5

(10 x 10 grid provided with title given, axes labeled with general description of independent and dependent variables, with units if appropriate, spaces/lines provided for category labels)

Four Total Points:

1. First key element:

Bar graph: all categories to be graphed correctly, labeled within bar spaces along horizontal graph
OR

Single-line graph: an appropriate number scale labeled along horizontal axis:

- numbers written on grid lines
- numbers allow for plotting of all data
- consistently scaled

2. Second key element:

All graphs: an appropriate number scale along vertical axis:

- numbers written on grid lines
- numbers that allow all data to be plotted
- consistently scaled

3. Third key element:

Bar graph: at least four bars correctly drawn (top line of each bar is well-defined)

Single-line graph: at least four points correctly plotted on lines and correctly connected by line

4. Fourth key element:

Bar graph: all five bars are correctly drawn (top line of each bar is well-defined)

Single-line graph: all five points correctly plotted on lines and correctly connected by line

Common errors on Bar Graphs:

- no bars or only some bars are plotted correctly
- bars are not plotted above correct category labels
- bar does not extend to correct number value (e.g., top of the bar cannot be distinguished, bar stops short of or extends beyond data value)
- points are plotted instead of bars
- numbering of y-axis is not consistently scaled
- numbering scale does not allow for plotting of data
- number values along y-axis are not aligned with grid lines (e.g., written between lines so the value of the line cannot be distinguished)
- categories of the independent variable:
 - are not labeled along x-axis
 - do not match those provided by the data

Common errors on Line Graphs:

- no points or only some of the points are plotted correctly
- points are not connected by a line
- bars are plotted instead of points connected by a line
- numbering of axes:
 - not consistently scaled
 - not equally spaced
 - values do not allow for plotting of data
 - not aligned with grid lines (e.g., written between the lines so the value of the line cannot be distinguished)

- The fifth grade class wanted to learn more about insects so they decided to study Monarch Caterpillars. Only five students hunted for Monarch eggs. Shelley found two eggs, Debi found six eggs, Darrell found ten eggs, Michael found four eggs, and Sheila found three eggs.

The Number of Monarch Eggs Found by Each Student

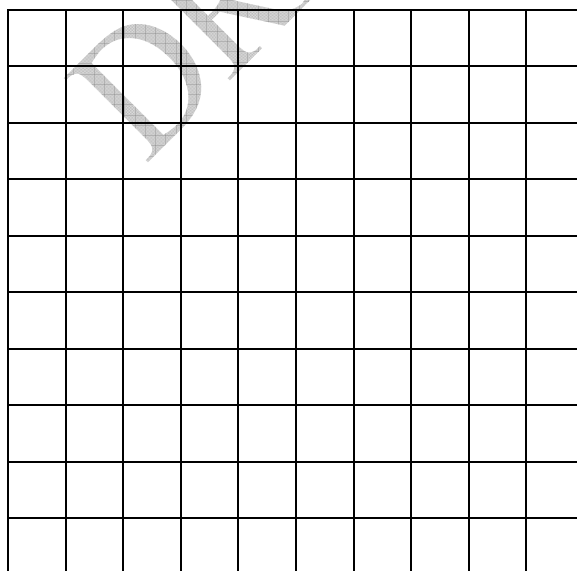
Student	Number of Monarch Eggs
Shelley	2
Debi	6
Darrell	10
Michael	4
Sheila	3

Complete the bar graph below, using the information from the data table.

Be sure to do the following:

- finish labeling both axes with categories or number scales
- draw bars to represent the data (DO NOT color, underline or shade inside the bars)

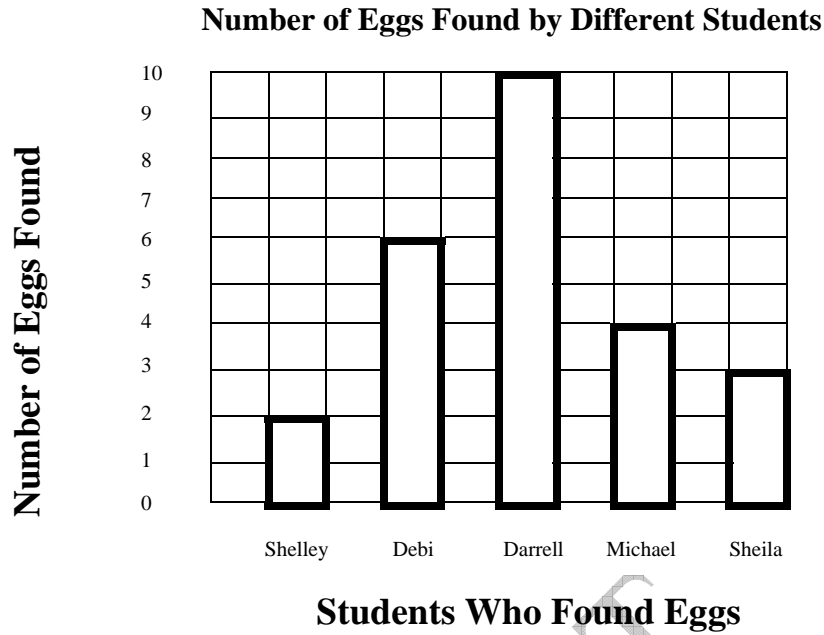
Number of Eggs Found



Students Who Found Eggs

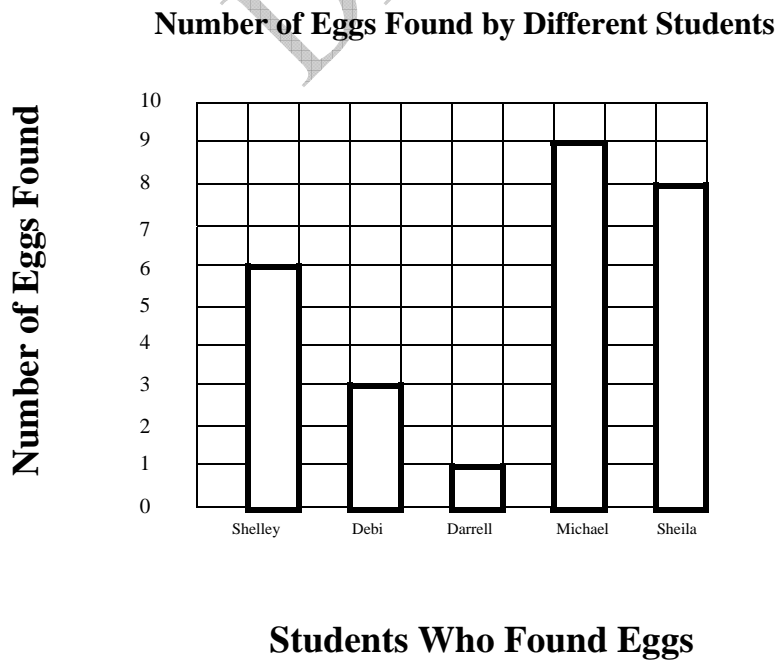
Elementary Anchors:

A.



A.
4 points earned:
First key element:
1 point = labeling of x-axis
Second key element:
1 point = labeling of y-axis
Third key element:
1 point = 4 bars plotted correctly
Fourth key element:
1 point = 5 bars plotted correctly

B.

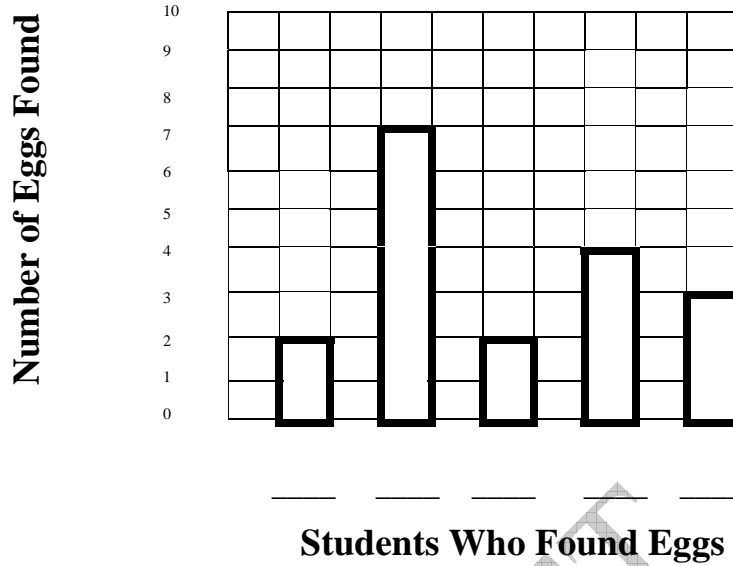


B.
2 points earned:
First key element:
1 point = labeling of x-axis
Second key element:
1 point = labeling of y-axis

Errors:
Third and Fourth key elements:
0 points = all bars plotted incorrectly

C.

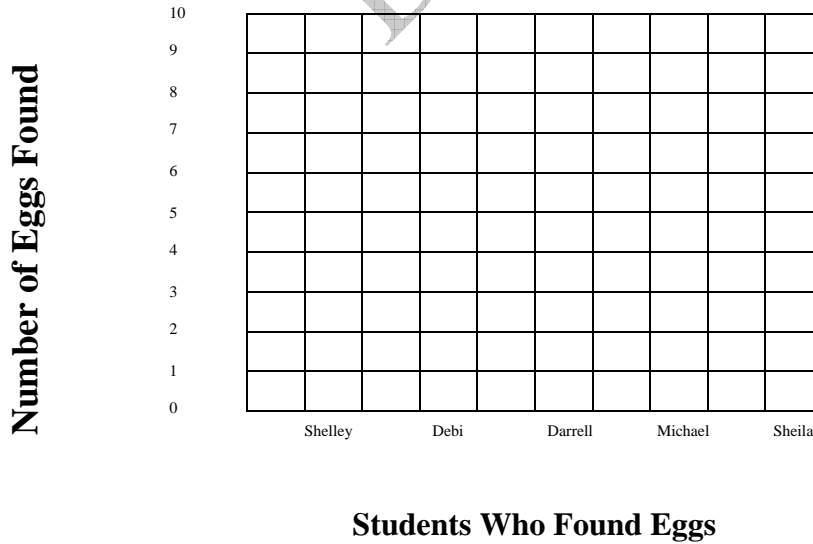
Number of Eggs Found by Different Students



C.
1 point earned:
Second key element:
1 point = labeling of y-axis
Errors:
First key element:
no labeling of x-axis
Third and Fourth key elements:
0 points = only 3 bars correctly plotted

D.

Number of Eggs Found by Different Students

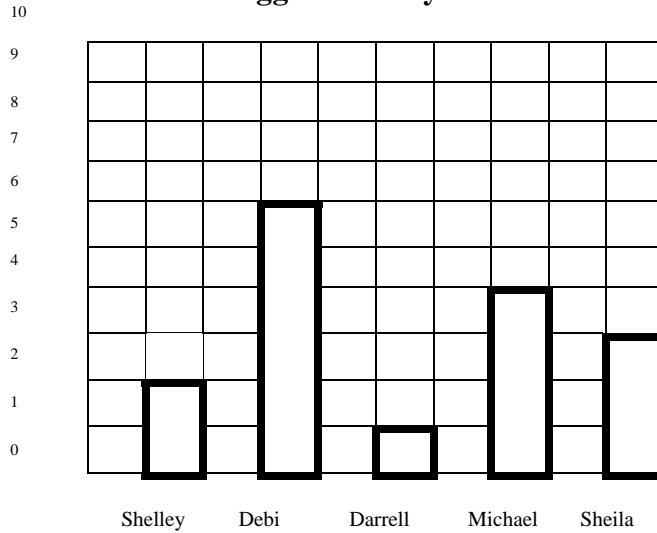


D.
2 points earned:
First key element:
1 point = labeling of x-axis
Second key element:
1 point = labeling of y-axis
Errors:
Third and Fourth key elements:
0 points = no bars plotted

E.

Number of Eggs Found

Number of Eggs Found by Different Students



Students Who Found Eggs

E.

2 points earned:

First key element:

1 point = labeling of x-axis

Third key element:

1 point=4 bars plotted correctly

Errors:

Second key element:

0 points = numbering of y-axis is incorrect (numbers not on lines)

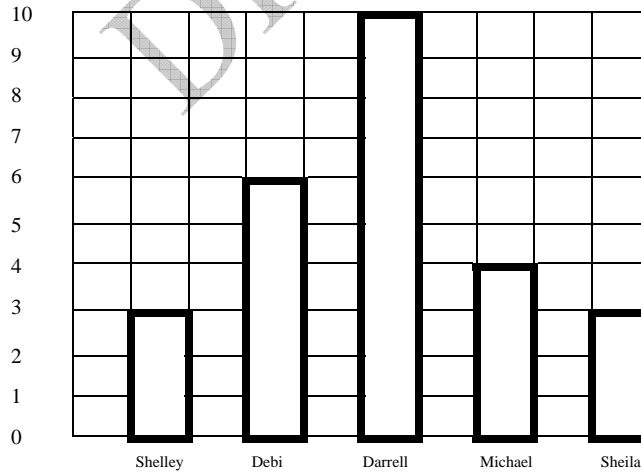
Fourth key element:

0 points=1 bar incorrectly plotted

F.

Number of Eggs Found

Number of Eggs Found by Different Students



Students Who Found Eggs

F.

3 points earned:

First key element:

1 point = labeling of x-axis

Second key element:

1 point = labeling of y-axis

Third key element:

1 point = 4 bars plotted correctly

Error:

Fourth key element:

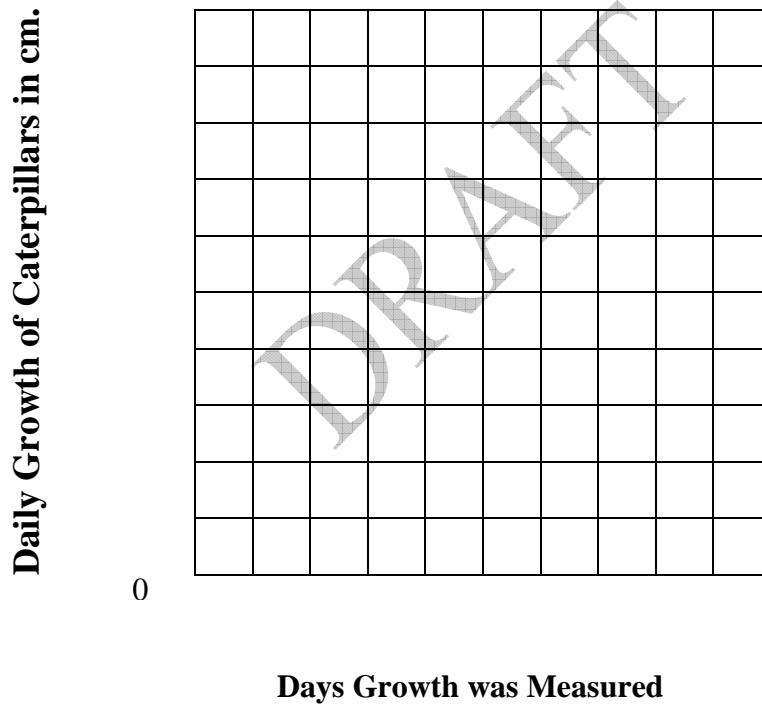
0 points = 1 bar incorrectly plotted

1. The fifth grade kept track of the Monarch eggs. Several of the eggs hatched at the end of the first day. The class decided to monitor the growth rate of the caterpillars. Below in the data table is the average daily growth of the caterpillars.

	Day 1	Day 2	Day 3	Day 4	Day 5
Average Length in cm.	.5 cm	1 cm	2 cm	3 cm	4 cm

Construct a single line graph below, using the information from the data table. Be sure to finish labeling both axes with number scales.

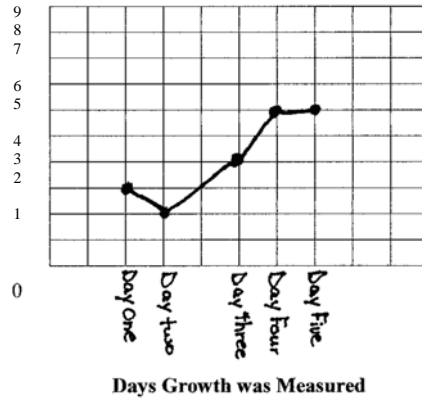
Average Daily Growth of the Monarch Caterpillars



G.

Daily Grow in caterpillars in cm.

Average Daily Growth of the Monarch Caterpillar



G.

0 points earned:

Errors:

First key element:

0 points = numbering of x-axis is incorrect (not equally spaced)

Second key element:

0 points = numbering of y-axis is incorrect (skipped first and fourth grid line from origin)

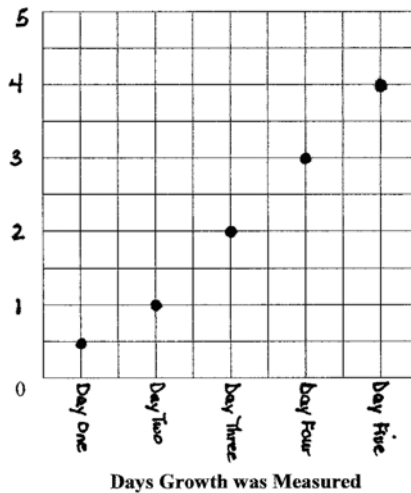
Third and Fourth key elements:

0 points = one point is plotted correctly

H.

Daily Growth of Caterpillars in cm.

Average Daily Growth of the Monarch Caterpillars



H.

2 points earned:

First key element:

1 point = labeling of x-axis

Second key element:

1 point = labeling of y-axis

Errors:

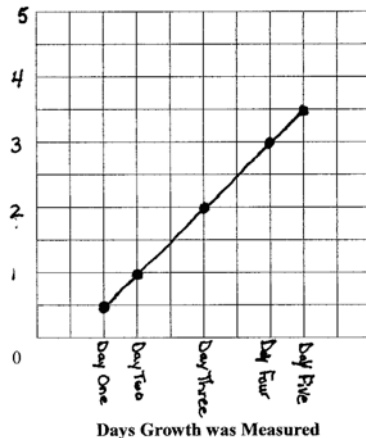
Third and Fourth key elements:

data points are plotted correctly but not connected to form a line graph

I.

Daily Growth of Caterpillars in cm.

Average Daily Growth of the Monarch Caterpillars



I.

2 points earned:

Second key element:

1 point = labeling of y-axis

Third key element:

1 point = four data points correctly plotted and correctly connected by a line

Errors:

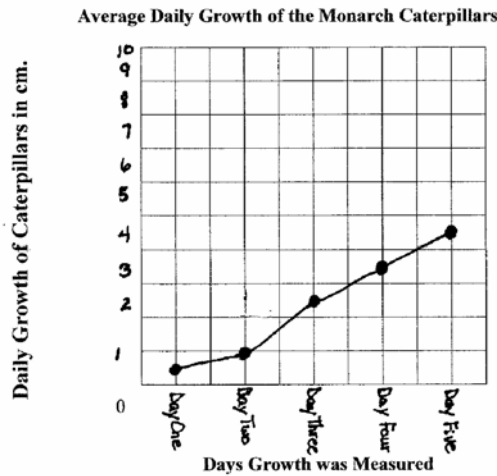
First key element:

0 points = labeling of x-axis

Fourth key element:

0 points = one data point is incorrectly plotted

J.



J.

3 points earned:

Second key element:

1 point = labeling of y-axis

Third and Fourth key elements:

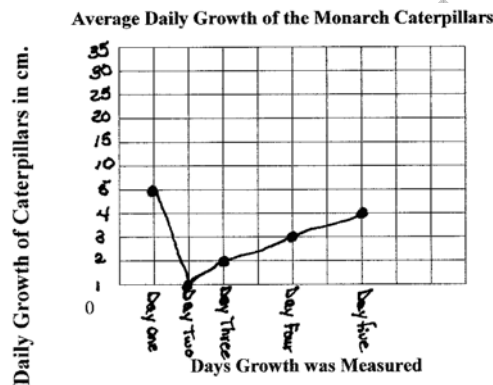
2 points = five data points correctly plotted and line connecting

Errors:

First key element:

0 points = labeling of x-axis (numbers are not on lines)

K.



K.

1 point earned:

Third key element:

1 point = four data points correctly plotted

Errors:

First key element:

0 points = numbering of x-axis is incorrect (not equally spaced)

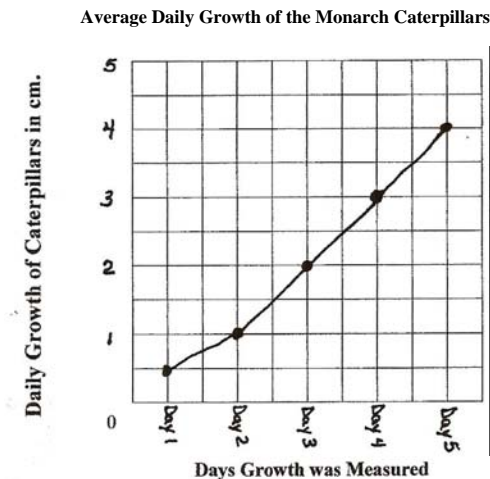
Second key element:

0 points = numbering of y-axis is incorrect (not consistently, sequentially scaled)

Fourth key element:

0 points = one data point is incorrectly plotted

L.



L.

4 points earned:

First key element:

1 point = labeling of x-axis

Second key element:

1 point = labeling of y-axis

Third and Fourth key elements:

2 points = all five points are correctly plotted and connected by a line