Early Adolescence/Science

Component 1:
Content Knowledge

SAMPLE ITEMS AND SCORING RUBRICS

NATIONAL BOARD
for Professional Teaching Standards®

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Contents

Overview

This document provides information about the Early Adolescence/Science (EA/Science) Component 1 computer-based assessment. It includes sample assessment center selected response items and answer key, constructed response exercises, and the scoring rubric used to assess each constructed response exercise.

Component 1: Content Knowledge

Component 1: Content Knowledge is a computer-based assessment requiring candidates to demonstrate knowledge of and pedagogical practices for their teaching content area. Candidates must demonstrate knowledge of developmentally appropriate content, which is necessary for teaching across the full age range and ability level of the chosen certificate area.

EA/Science Component 1 Computer-Based Assessment

In the EA/Science Component 1 computer-based assessment, content knowledge is assessed through the completion of approximately 45 selected response items and three constructed response exercises.

EA/Science Standards Measured by Selected Response Items

The EA/Science selected response items focus on the following Standards:

Standards Content	Approximate Percentage of Selected Response Item Section*
Knowledge of Science Practices and Context (Standard II) • Nature of Science • Understanding of Inquiry • Context of Science	30%
Knowledge of Science Content (Standard II) • Earth and Space Science • Life Science • Physical Science	50%
Curriculum, Instruction, and Learning Environment (Standards III, V) • Crosscutting Principles • Assessing and Addressing Preconceptions • Safety	20%

* These percentages are an approximation only. Following field testing and review of data, the final assessment will be created. The final assessment content may vary from these estimates.

For the complete EA/Science Standards, refer to **www.boardcertifiedteachers.org.**

EA/Science Constructed Response Exercises

The EA/Science constructed response exercises assess the following:

- **Exercise 1: Data Analysis**
  In this exercise, you will use your knowledge of science to read a description of a student-designed experiment, study a student collection of data, and analyze a student conclusion concerning the experiment. You will be asked to respond to one prompt.
- **Exercise 2: Contexts of Science**
  In this exercise, you will use your knowledge of science to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society. You will be asked to respond to one prompt.
- **Exercise 3: Development of Scientific Concepts**
  In this exercise, you will demonstrate your knowledge of scientific conceptual development by evaluating and describing a student's conceptual understanding of scientific concepts, and by describing instruction that would help move the student toward the accepted understanding of the scientific concept. You will be asked to respond to one prompt.

Each constructed response exercise will be assessed using a scoring rubric. Each EA/Science Component 1 scoring rubric is derived from the EA/Science Standards and defines the levels of accomplished teaching that you must demonstrate.

You should read the rubric while preparing to take Component 1 to understand how the rubric guides assessors in evaluating your responses to the constructed response exercises.

Inside This Document

This document includes the following two sections: "Sample Selected Response Items and Answer Key for EA/Science Component 1" and "Sample Constructed Response Exercises and Scoring Rubrics for EA/Science Component 1."

Selected Response Section

This section includes the following:

- five sample selected response items
- answer key

Constructed Response Section

This section includes the following:

- three sample constructed response exercises
- associated scoring rubric for each exercise

For information about scheduling and taking your test at the assessment center, please refer to the *Assessment Center Policy and Guidelines*. For more information about how the assessment is scored, please refer to the *Scoring Guide*.

Sample Selected Response Items and Answer Key for EA/Science Component 1

This section includes

- **sample selected response items** to help you become familiar with the content and format of the items on an actual computer-based assessment.

  Although this section illustrates some of the types of items that appear on the assessment, note that these sample items do not necessarily define the content or difficulty of an entire actual assessment.

  Please note that the selected response items cover the *entire* age range of the certificate. Be aware that you are expected to demonstrate knowledge of developmentally appropriate content across the full range of your certificate.
- **reference material,** as appropriate, provided as part of the assessment, such as formula and constants pages and the periodic table.
- an **answer key.**

Sample Selected Response Items

1. At the introduction of a unit about ecosystems, a middle school teacher encourages students to pose questions that can be answered through an investigation. Which student question about a certain ecosystem could most easily be developed into a scientific investigation?

   A. Why are there so many different species in this ecosystem?
   B. What effect will the removal of the apex predator have on this ecosystem?
   C. Has a natural disaster ever disturbed this ecosystem?
   D. Will the population of squirrels increase as the trees in this ecosystem age?

2. Which concept in a lesson on weather would best prepare students to study convection cells?
   A. condensation
   B. density
   C. friction
   D. polarity

3. Hemoglobin (Hb) is an important protein in blood. A biologist has obtained sequence data for the Hb protein isolated from a rare species of panda. The biologist is comparing the sequence data from the rare species of panda to the sequence data for Hb in another panda species. What is the most likely purpose of this investigation?
   A. to determine whether one species could donate Hb to the other species
   B. to determine whether the two species require comparable oxygen levels
   C. to determine the evolutionary relationship between the two species
   D. to determine whether Hb has the same function in the two species

4. Which type of chemical bond exists between chlorine atoms in Cl_2?
   A. ionic
   B. nonpolar covalent
   C. metallic
   D. polar covalent

5. Knowledge of safety data sheets (SDSs) is an important part of teaching science. Which statement describes the purpose of the SDS?

   A. It provides information for teachers about chemicals, including precautionary measures and storage guidelines.

   B. It is a lab safety contract for teachers to give to students and parents before conducting classroom experiments.

   C. It is a list of lab safety instructions to be posted in the classroom for students to refer to when conducting classroom experiments.

   D. It includes detailed procedures for science teachers on the safe handling of scientific equipment commonly found in science labs.

Resource Material

CONSTANTS

Description	Value
Standard atmospheric pressure	1 atm = 760 mm Hg
Speed of light in a vacuum (c)	3.00×10^8 m/s
1 watt (W)	1 J/s
Acceleration of gravity on Earth (g)	9.80 m/s^2
Gravitational constant (G)	6.67×10^{-11} N•m^2/kg^2
Avogadro's number (N_A)	6.02×10^{23} particles/mole
Ideal gas constant (R)	0.0821 L•atm/(mol•K) = 8.31 J/(mol•K)
Specific heat (s) of water (liquid)	4.184 J/(g•K) = 4.184 J/(g•°C) = 1.0 cal/(g•°C)

NOTES FOR EARLY ADOLESCENCE SCIENCE TEST

Not all constants necessary are listed, nor are all constants listed used on this test.

While attention has been paid to significant figures, no answer should be considered incorrect solely because of the number of significant figures.

PERIODIC TABLE OF THE ELEMENTS

1 **1A**																	18 **8A**
1 **H** 1.01	2 **2A**											13 **3A**	14 **4A**	15 **5A**	16 **6A**	17 **7A**	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.0	12 **Mg** 24.3	3 **3B**	4 **4B**	5 **5B**	6 **6B**	7 **7B**	8	9 **8B**	10	11 **1B**	12 **2B**	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc**	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57–71	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po**	85 **At**	86 **Rn**
87 **Fr**	88 **Ra**	89–103	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**	110 **Ds**	111 **Rg**	112 **Cn**	113	114 **Fl**	115	116 **Lv**	117	118

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm**	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinide Series	89 **Ac**	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

Elements 113, 115, 117, and 118 have been reported, but they have not yet been named by the IUPAC.
Standard atomic weight values are not listed for elements with no stable isotopes.
Conventional atomic weights have been provided for B, C, Cl, H, Li, N, O, Si, S, and Tl.

Answer Key to Sample Selected Response Items

Item Number	Correct Response
1	D
2	B
3	C
4	B
5	A

Sample Constructed Response Exercises and Scoring Rubrics for EA/Science Component 1

This section includes

- **sample constructed response exercises** to help you become familiar with the content and format of the exercises on an actual computer-based assessment. These exercises include instructions for using the computer, stimulus materials (if applicable), and prompts requiring responses.

  Although this section illustrates some of the types of exercises that appear on the assessment, note that these sample exercises do not necessarily define the content or difficulty of the exercises on an actual assessment.

  Please note these constructed response exercises cover the **entire** age range of the certificate. Be aware that you are expected to demonstrate knowledge of developmentally appropriate content across the full range of your certificate.

- **scoring rubrics** that are used by assessors in evaluating your responses to help you understand how your responses are assessed.

Sample Exercise 1 and Scoring Rubric

Sample Exercise 1

Exercise 1: Data Analysis - Candidate Name — Time Remaining 29:31

Data Analysis

Introduction

In this exercise, you will use your knowledge of science to read a description of a student-designed experiment, study a student collection of data, and analyze a student conclusion concerning the experiment. You will be asked to respond to one prompt.

Criteria for Scoring

To satisfy the highest level of the scoring rubric, your response must provide clear, consistent, and convincing evidence of the following:

- an accurate identification of the components of the experiment;
- an accurate identification of the errors found in the student work sample;
- an accurate identification and a thorough discussion of possible sources of error in the experimental design;
- an accurate identification and an informed discussion of errors in the correlation between the student hypothesis, conclusion, and collected data; and
- an accurate discussion of the science content knowledge that is needed in order to understand an experiment.

Directions

You may view the prompt by clicking the **Next** button. Compose your response in the space provided.

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Exercise 1: Data Analysis - Candidate Name

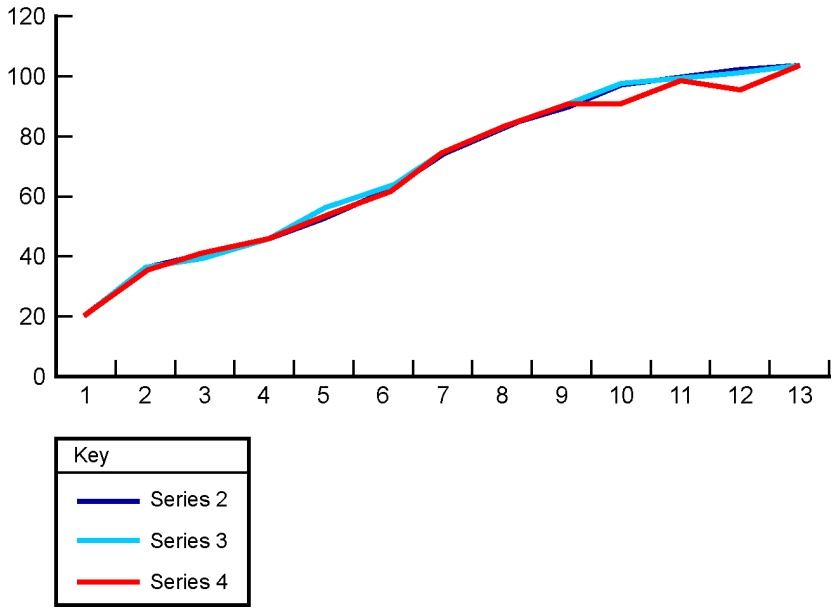
Time Remaining 29:31

Stimulus

Below you will find a description of a student experiment, a sample of student data, and a conclusion derived by the students following the experiment.

Working in a group of three, students designed and carried out an experiment testing the principle of boiling point elevation. The students' hypothesis was that salt does not affect the boiling point of water. For their experiment, they filled each of three identical beakers with water and placed each on a separate electric hot plate. Each hot plate was set to 8 on the heating control dial. The temperature was verified using a temperature probe to ensure that the temperatures of the hot plates were all the same. Beaker A contained 250 milliliters (mL) of water only. Beaker B contained 250 mL of water and 20 grams (g) of table salt (NaCl). Beaker C contained water only, but when the first signs of boiling were noted, the students added 20 g of table salt to observe the effects.

The students noted that the water in Beaker A boiled at 98°C. They noted that Beaker B gained heat at a greater rate than Beaker A, but that they did not see signs of boiling until 100°C. They were surprised that when they added the salt to Beaker C, by the next temperature reading the temperature had dropped by 2 degrees. Then the water boiled at 100°C.



Student Conclusion

The students concluded that table salt was necessary to make water reach its normal boiling point.

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Exercise 1: Data Analysis - Candidate Name

Time Remaining 29:31

You must address each of the following in your response.

- Identify the **control (if present), constant(s)**, the **experimental dependent variable**, and the **experimental independent variable**.
- Identify the **errors** found in the mechanics of the graph.
- Identify and thoroughly discuss the possible **sources of error** resulting from the experimental design.
- Identify and discuss **errors** in the correlation between the **hypothesis**, the **conclusion**, and the **collected data**.
- Discuss **two** concepts related to boiling that a **ninth-grade** student must know to understand this investigation.

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Scoring Rubric for Exercise 1

The **LEVEL 4** response provides *clear, consistent, and convincing* evidence of the ability to evaluate a student-designed experiment, identify the components of the experiment, and analyze a student conclusion concerning the experiment.

Characteristics:

- an accurate and thorough identification of the components of the experiment
- an accurate and thorough identification of the errors found in a student work sample
- an accurate identification and a thorough discussion of possible sources of error in an experimental design
- an accurate and thorough identification and an informed discussion of errors in the correlation between the student hypothesis, conclusion, and collected data
- an accurate and thorough discussion of the science content knowledge that is needed in order to understand the experiment

The **LEVEL 3** response provides *clear* evidence of the ability to evaluate a student-designed experiment, identify the components of the experiment, and analyze a student conclusion concerning the experiment.

Characteristics:

- an accurate identification of the components of the experiment
- an accurate identification of the errors found in a student work sample
- an accurate identification and a discussion of possible sources of error in the experimental design, although the discussion may not be as thorough as a Level 4 response
- an accurate identification and an informed discussion of errors in the correlation between the student hypothesis, conclusion, and the collected data, but the discussion is not as informed as a Level 4 response
- an accurate discussion of the science content knowledge that is needed in order to understand an experiment, although the discussion may not be as detailed as in a Level 4 response

The **LEVEL 2** response provides *limited* evidence of the ability to evaluate a student-designed experiment, identify the components of the experiment, and analyze a student conclusion concerning the experiment.

Characteristics:

- an incomplete identification of the components of the experiment
- an incomplete identification of the errors found in a student work sample
- an incomplete identification or a limited discussion of possible sources of error in the experimental design
- an accurate identification but the discussion of errors in the correlation between the student hypothesis, conclusion, and the collected data may only be partially related to the student errors, or the identification of errors is incomplete or limited
- a discussion of the science content knowledge that is needed in order to understand the experiment is limited

The **LEVEL 1** response provides *little or no* evidence of the ability to evaluate a student-designed experiment, identify the components of an experiment, and analyze a student conclusion concerning the experiment.

Characteristics:

- an inaccurate or missing identification of the components of the experiment
- an inaccurate or missing identification of the errors found in a student work sample
- an inaccurate identification or missing discussion of possible sources of error in the experimental design
- an inaccurate or missing identification and discussion of errors in the correlation between the student hypothesis, conclusion, and the collected data
- a discussion of the science content knowledge that is needed in order to understand the experiment is inaccurate or missing

Sample Exercise 2 and Scoring Rubric

Sample Exercise 2

Exercise 2: Contexts of Science - Candidate Name — Time Remaining 29:31

Contexts of Science

Introduction

In this exercise, you will use your knowledge of science to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society. You will be asked to respond to one prompt.

Criteria for Scoring

To satisfy the highest level of the scoring rubric, your response must provide clear, consistent, and convincing evidence of the following:

- an accurate and informed description of a major scientific event or discovery;
- a thorough and insightful discussion of the scientific knowledge necessary to understand the event or discovery;
- an accurate and thorough explanation of how another science discipline is related to the event or discovery; and
- an informed description of effects the event or discovery has had on society.

Directions

You may view the prompt by clicking the **Next** button. Compose your response in the space provided.

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Exercise 2: Contexts of Science - Candidate Name — Time Remaining 29:31

Stimulus

The following was adapted from NASA information on Pluto.

Clyde Tombaugh discovered Pluto in 1930 using the 13-inch telescope at Lowell Observatory; it was only a point of light, detected among the background stars by its extremely slow motion. That motion translated to a 248-year orbital period, placing it at the edge of the solar system.

Pluto was then determined to have a mass only 1/400 of Earth and a diameter of less than 1,500 miles, considerably smaller than our moon. A low-grade debate began even then about the status of Pluto.

The situation ramped up considerably in the early 1990s, when astronomers began to discover a variety of objects beyond Pluto in what is known as the "Kuiper Belt" to most Americans, or the "Edgeworth-Kuiper Belt" to most Europeans. The situation was brought to a head in 2003 when Caltech astronomer Michael Brown discovered an object larger than Pluto, designated 2003 UB313. Was it the tenth planet, or was Pluto not a planet?

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Exercise 2: Contexts of Science - Candidate Name

Time Remaining 29:31

You must address each of the following in your response.

- Discuss the scientific event or discovery and the science knowledge necessary to understand the event or discovery.
- Explain how a science discipline other than Earth and space science is related to the event or discovery.
- Describe **two** effects the event or discovery has had on society.

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Scoring Rubric for Exercise 2

The **LEVEL 4** response provides *clear, consistent, and convincing* evidence of the ability to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society.

Characteristics:

- an accurate and thorough description of a major scientific event or discovery
- a thorough and insightful discussion of the scientific knowledge necessary to understand the event or discovery
- an accurate and thorough explanation of how another science discipline is related to the event or discovery
- a thorough description of effects the event or discovery has had on society

The **LEVEL 3** response provides *clear* evidence of the ability to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society.

Characteristics:

- an accurate and informed description of a major scientific event or discovery
- a thorough discussion of the scientific knowledge necessary to understand the event or discovery, although the discussion may not be as thorough as a Level 4 response
- an accurate explanation of how another science discipline is related to the event or discovery, but the discussion is not as informed as a Level 4 response
- an informed description of effects the event or discovery has had on society, although the discussion may not be as detailed as in a Level 4 response

The **LEVEL 2** response provides *limited* evidence of the ability to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society.

Characteristics:

- an incomplete description of a major scientific event or discovery
- an incomplete discussion of the scientific knowledge necessary to understand the event or discovery
- an incomplete explanation of how another science discipline is related to the event or discovery
- an incomplete description of how the event or discovery has affected society

The **LEVEL 1** response provides *little or no* evidence of the ability to describe a scientific event or discovery and discuss the scientific knowledge necessary to understand the event or discovery, explain how another science discipline is related to the event or discovery, and describe how the event or discovery has affected society.

Characteristics:

- an inaccurate or missing description of a major scientific event or discovery
- an inaccurate or missing discussion of the scientific knowledge necessary to understand the event or discovery
- an inaccurate or missing explanation of how another science discipline is related to the event or discovery
- an inaccurate or missing description of how the event or discovery has affected society

Sample Exercise 3 and Scoring Rubric

Sample Exercise 3

Exercise 3: Development of Scientific Concepts - Candidate Name — Time Remaining 29:31

Development of Scientific Concepts

Introduction

In this exercise, you will demonstrate your knowledge of scientific conceptual development by evaluating and describing a student's conceptual understanding of scientific concepts, and by describing instruction that would help move the student toward the accepted understanding of the scientific concept. You will be asked to respond to one prompt.

Criteria for Scoring

To satisfy the highest level of the scoring rubric, your response must provide clear, consistent, and convincing evidence of the following:

- an accurate evaluation of the student's conceptual understanding through examination of the student's work;
- an accurate description of two scientific concepts the student would need to understand in order to move toward the accepted scientific conceptual understanding; and
- an informed description of the instruction you would use to address the student's conceptual understanding.

Directions

You may view the prompt by clicking the **Next** button. Compose your response in the space provided.

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Exercise 3: Development of Scientific Concepts - Candidate Name — Time Remaining 29:31

Stimulus

The following question appeared as an essay question on a Physical Science test. The student's answer follows the question.

QUESTION: When making calculations using Charles's Law, what temperature scale must be used and why? Express your answer in terms of energy and particle motion.

ANSWER: Temperature is how hot or cold something is. Basically with gases, hot gases need more space (volume) than colder gases. To make calculations with Charles's Law, the temperature must be measured in the Kelvin scale because the Celsius and Fahrenheit scales have numbers that can be negative and that would make you calculate the volume to a negative number sometimes. We have to use Kelvin because it is positive all the way down to absolute zero which is zero because there is absolutely zero particle motion and zero energy.

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Exercise 3: Development of Scientific Concepts - Candidate Name

Time Remaining 29:31

You must address each of the following in your response.

- Evaluate the student's conceptual understanding.
- Describe in detail **two** scientific concepts the student would need to understand in order to move toward the accepted scientific understanding of the concept presented in the stimulus.
- Briefly describe what you would do next in an instructional context to address the student's conceptual understanding.

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Scoring Rubric for Exercise 3

The **LEVEL 4** response provides *clear, consistent, and convincing* evidence of the ability to evaluate and describe the student's conceptual understanding of scientific concepts, and to describe how the student can be instructed in order to move toward the accepted understanding of the scientific concept.

Characteristics:

- an accurate and thorough evaluation of a student's conceptual understanding through examination of the student's work
- an accurate and thorough description of two scientific concepts the student would need to understand in order to move toward the accepted scientific conceptual understanding
- an informed and thorough description of the instruction you would use to address the student's conceptual understanding

The **LEVEL 3** response provides *clear* evidence of the ability to evaluate and describe the student's conceptual understanding of scientific concepts, and to describe how the student can be instructed in order to move toward the accepted understanding of the scientific concept.

Characteristics:

- an accurate evaluation of a student's conceptual understanding through examination of the student's work
- an accurate description of two scientific concepts the student would need to understand in order to move toward the accepted scientific conceptual understanding, although the description may not be as thorough as a Level 4 response
- an informed description of the instruction you would use to address the student's conceptual understanding, although the description may not be as thorough as a Level 4 response

The **LEVEL 2** response provides *limited* evidence of the ability to evaluate and describe the student's conceptual understanding of scientific concepts; and to describe how the student can be instructed in order to move toward the accepted understanding of the scientific concept.

Characteristics:

- an incomplete evaluation of a student's conceptual understanding through examination of the student's work
- an incomplete description of two scientific concepts the student would need to understand in order to move toward the accepted scientific conceptual understanding
- an incomplete description of the instruction you would use to the student's conceptual understanding

The **LEVEL 1** response provides *little or no* evidence of the ability to evaluate and describe the student's conceptual understanding of scientific concepts; and to describe how the student can be instructed in order to move toward the accepted understanding of the scientific concept.

Characteristics:

- an inaccurate or missing evaluation of a student's conceptual understanding through examination of the student's work
- an inaccurate or missing description of two scientific concepts the student would need to understand in order to move toward the accepted scientific conceptual understanding
- an inaccurate or missing description of the instruction you would use to address the student's conceptual understanding

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