

**THE NATION'S  
REPORT  
CARD**



**1996 Assessment**

**SCIENCE-PUBLIC RELEASE**

**Grade 12**

**Number of Items: 51**



**1996 ASSESSMENT**

**SCIENCE PUBLIC RELEASE**

**GRADE 12**

**NO. OF ITEMS: 51**

---

*This package of released items includes:*

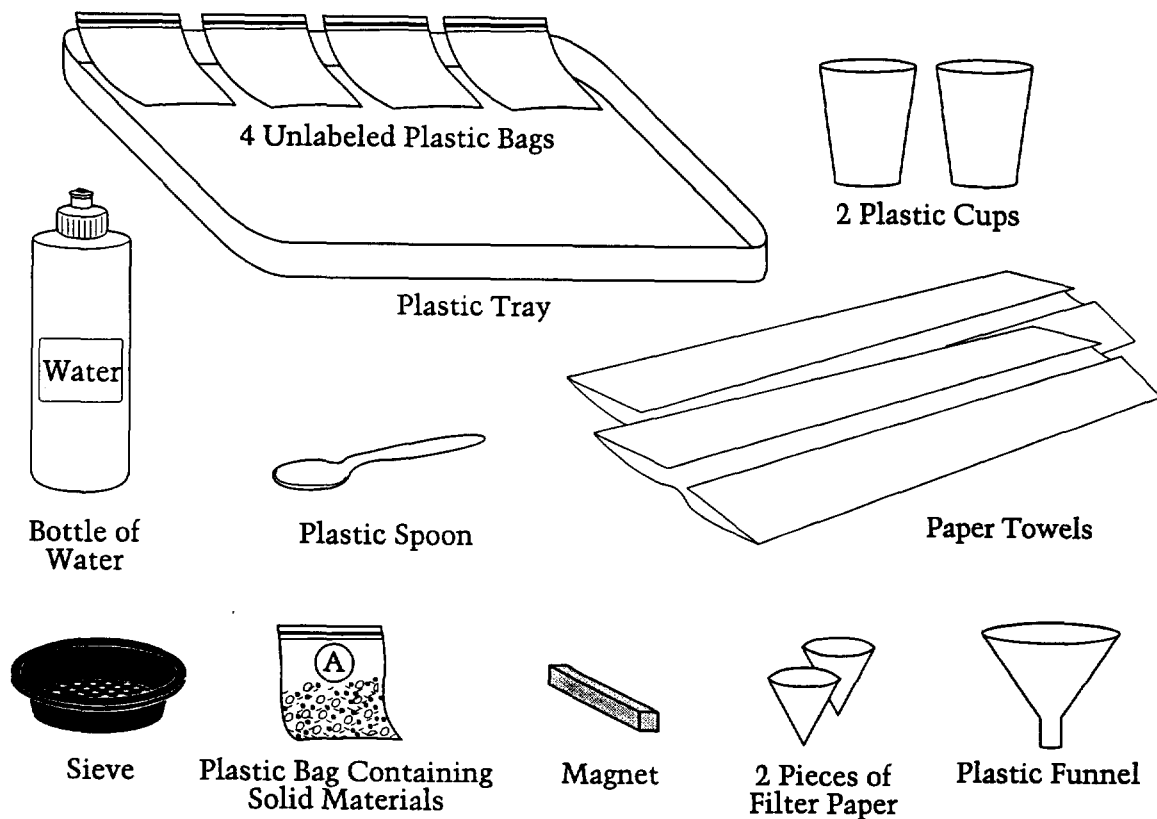
- *information about the framework classification codes available for each item,*
- *information about the item difficulty, as provided for each item,*
- *text of each item,*
- *item identification for each item, framework classification codes for each item, the key for each multiple-choice item, and the scoring guide for each constructed-response item.*

Further information about the 1996 NAEP Science Assessment is available in the Science Framework for the 1996 National Assessment of Educational Progress (Washington, DC: National Assessment Governing Board 1995), the 1996 Science Report Card for the Nation and the States (O'Sullivan, Reese, and Mazzeo, 1997), the 1996 NAEP Science State Technical Report (Allen, Swinton and Zelenak 1997), and the NAEP 1996 Technical Report (Allen Carlsson and Zelenak, in preparation). Information is also available on the World Wide Web at [www.ed.gov/NCES/NAEP](http://www.ed.gov/NCES/NAEP).

## SEPARATION

## Separating a Mixture of Solid Materials

For this task, you have been given a kit that contains materials that you will use to perform an investigation during the next 30 minutes. Please open your kit now and use the following diagram to check that all of the materials in the diagram are included in your kit. If any materials are missing, raise your hand and the administrator will provide you with the materials that you need.



Section 123

The Investigation: The plastic bag(A) contains a mixture of five solid materials. Your job is to design a procedure for separating the materials in the mixture using the equipment in your kit.

It is known that the mixture contains& different substances:

Three different metals

Sand

Salt

You will be asked to write a complete plan of all of the steps in your separation procedure. You will also be asked to save samples of the separated materials in small plastic bags.

As you perform this task, follow the directions step-by-step and write your answers to the questions in the space provided in your booklet.

Important Note: If you need more of the mixture, raise your hand and the administrator will give you another bag.

0P000725

1. Look at the contents of plastic bag (A) without opening it. What properties do the substances in the mixture have that would allow the following equipment to be used to separate the mixture?

0P000722

**Magnet:**

**Filter paper:**

**Sieve:**

Section 123

2. Now use this equipment to separate the five materials in the mixture. Each time you successfully separate a material from the mixture, place this separated material in one of the small unlabeled plastic bags. The materials that you separate do not have to be 100 percent pure, but they should be as pure as possible. Each separated material should be placed in its own plastic bag. The bags with the separated materials will be collected after you have completed the task.

[Notes: 1) If you have collected a material in the filter paper, you do not need to separate the material from the filter paper. Just put the filter paper in the plastic bag. 2) If you end up with one of the five materials dissolved in water, you can leave this material in the cup.]

0P000723

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

4. Suppose that you have a sample of water in which an unknown solid substance has been dissolved. Describe a procedure that you would use to effectively separate the substance from the water. 0P000726

---

---

---

---

---

---

---

---

---

---

### Cleaning Up

Pour any water that you used into one of the plastic cups and leave this cup on your desk for someone to collect. Wipe up any spills with the paper towels. Someone will collect the paper towels and four unlabeled plastic bags. Put everything else back into the large plastic bag.



---

### FOR ADMINISTRATIVE USE ONLY

	CP	SP	IF	SD	ST
<b>1</b>	0	0	0	0	0
<b>2</b>	0	0	0	0	0
<b>3</b>	0	0	0	0	0
<b>4</b>	0	0	0	0	0



**INFORMATION ABOUT THE FRAMEWORK CLASSIFICATION CODES  
AVAILABLE FOR EACH ITEM**

Following this description of the classification codes, there is a single sheet with NAEP ID numbers, short descriptions of the items, item keys(1-4 if the item is multiple-choice; blank if the item is open-ended), as well as the mean p-values for the items in the released block.

The classification codes for each item can be viewed within each item in the scoring guide.

- Field 1)                    Program Profile:**  
N27S NAEP, year 27 of Science
- Field 2)                    Grade:**  
1            Grade 4 only item  
1/2        Grade 4/8 overlap item  
2            Grade 8 only item  
2/3        Grade 8/12 overlap item  
3            Grade 12 only item
- Field 3)                    Field of science:**  
P S        Physical Science  
E S        Earth Science  
L S        Life Science  
**Field science of subcontent area:**  
*The letter corresponds to the subcontent areas described in the Science Assessment and Exercise specifications for the 1996 National Assessment of Educational Progress.*
- Field 4)                    Physical Science:**  
A        Matter and Its Transformations  
B        Energy and Its Transformations  
C        Motion  
**Earth Science:**  
A        Solid Earth (lithosphere)  
B        Water (hydrosphere)  
C        Air (atmosphere)  
D        Earth in Space  
**Life Science:**  
A        Change and Evolution  
B        Cells and Their Functions  
C        Organisms  
D        Ecology
- Field 5)                    Ways of knowing and doing science:**  
S I        Scientific Investigation  
P R        Practical Reasoning  
C U        Conceptual Understanding

**Field 6)**

**Theme:**

SYS Systems  
MOD Models  
PC Patterns of Change  
NA Not Applicable

**Field 7)**

**Nature of Science/Technology:**

NS Nature of Science  
NT Nature of Technology  
NA Not Applicable

**Field 8)**

**Item Type:**

MC Multiple-Choice  
SCR Short Constructed-Response  
ECR Extended Constructed-Response  
NA Not Applicable

# 1996 Science Items

GRADE: 12      BLOCK: 27S4

<u>ITEM</u>	<u>NAEP_ID</u>	<u>SHORT DESCRIPTION</u>	<u>KEY CONTENT</u>	<u>PROCESS</u>	<u>P-VALUE</u>	<u>RELEASE STATUS</u>
1A	K049601	SEPARATION: USE OF EQUIPMENT OE	1	1	0.179	P
2A	K049602	SEPARATION: SEPARATION OF MIXTURE OE	1	1	0.653	P
3A	K049603	SEPARATION: DESCRIBE SEPARATION OF MIXTURE OE	1		0.570	P
4A	K049604	SEPARATION: SEPARATION OF SUBSTANCE IN H2O OE	1	2	0.390	P

Content: 1 = Physical Sciences  
 2 = Earth & space sciences  
 3 = Life sciences

Process: 1 = Scientific investigation  
 2 = Practical reasoning  
 3 = Conceptual understanding

## Information about the Item Difficulty Available for Each Item

---

Item identification, a short item description, and the key (for multiple-choice items) are provided, in addition to information about the item difficulty, for each item. The items are identified by their position within a block and by their NAEP IDs. The NAEP IDs are used to identify items during the analysis of NAEP data in the summary of item level results in data almanacs, and in the secondary user data sources.

The numbers in the column labeled “P-Value” on the item statistic sheet vary for item types (multiple-choice and 2-category constructed-response items and constructed-response items with more than two categories). For the multiple-choice items and for the 2-category constructed-response items that were scored correct or incorrect the number in that column is the percent of students correctly responding to the item. This value is often called the p-value or the P+ for an item. For constructed-response items with more than two categories, the value in the column is the mean item score for the item.

For example, if the number of categories for a constructed-response item is 3 with a category/unsatisfactory/incorrect (category 1) worth 0 points, a partial category (category 2) worth 1/2 of a point and a complete category (category 3) worth 1 point, then a student can receive either 0, 1/2 or 1 point for his response to the item. The mean item score is the number that you would get if the scores on this item are averaged for all of the students in the assessment. This value varies from 0 to 1 just as the percent correct for a multiple-choice item could vary. It can be interpreted as an indication of where on the 0-1 scale for the item that an “average” student might score. For instance, if the mean item score for a 3-category constructed-response item is .8, then an “average” student would be expected to have a response in either category 2 (worth 1/2 or .5 of a point) or category 3 (worth 1 point). In fact it is a little more likely that the student would have a response in category 3, since .8 is closer to 1.0 than to .5.

Item Number: NONE Accession Number: OP000725

Key: NONE

Classification Codes:

N27S 3 PS A SI NA NA NA

Rationale Text:

*In this task students apply their understanding of basic physical principles and the use of simple laboratory equipment to separate a mixture of five solid materials that have different physical and chemical Properties (steel pellets, copper pellets, iron filings, sand, and salt). Students must design some of the procedures as well as use the procedures to accomplish the task. This task assesses students' ability to apply their conceptual knowledge of physical and chemical principles, to draw inferences from investigative results, and to evaluate and communicate their investigative procedures. It also assesses students' understanding of one aspect of the nature of technology by asking students to apply their knowledge to the design of a practical separation procedure.*

Item Number: 1 Accession Number: OP000722

Key: NONE

Classification Codes:  
N27S 3 PS A SI NA NT ECR

## Scoring Guide

**Scoring Rationale:** Student demonstrates an ability to recognize what properties of the substances in a mixture would allow for their separation using a magnet, filter paper, and a sieve.

**4 = Complete** - Student response demonstrates a complete understanding of the properties that may be useful for separating a mixture of substances using a magnet, filter paper, and a sieve by explaining all three properties.

**3 = Essential** - Student response demonstrates some understanding of the properties that may be useful for separating a mixture of substances using a magnet, filter paper, and a sieve by correctly explaining two of the properties.

**2 = Partial** - Student response demonstrates some understanding of the properties that may be useful for separating a mixture of substances using a magnet, filter paper, and a sieve by correctly explaining one of the properties.

**1 = Unsatisfactory/Incorrect** - Student response demonstrates no ability to recognize properties that may be useful for separating substances in a mixture.

### Credited responses include:

Magnet: (Ferro)magnetism - Some mixture components (such as iron and steel) are magnetic, and so are attracted by a magnet. Must be clear that not all metals are magnetic and that only certain metals (e.g., iron/steel) are attracted-

Filter paper: Volubility - some mixture components (salt) are soluble, and so can be dissolved in water and then passed through a filter paper leaving the insoluble components behind.

Sieve: Size - some mixture components have larger particles than others; the smaller particles would pass/filter/sift through the sieve, leaving the larger components behind.

Item Number: 2 Accession Number: OP000723

Key: NONE

Classification Codes:  
N27S 3 PS A SI NA NT ECR

**Scoring Guide:** This item is scored via the box on the last page of the task, where the administrator indicates which material(s) the student has in each of the bags.

**Scoring Rationale:** Student demonstrates an ability to separate the mixture of solids, when given the equipment and materials necessary to do the separation, by placing a relatively pure sample of each separated material into its own plastic bag.

**5 = Complete** - Student is able to separate all of the solids in the mixture, except for the salt, which remains dissolved in the water.

**4 = Essential** - Student is able to separate three or four of the solids in the mixture.

**3 = Adequate** - Student is able to separate two of the solids in the mixture.

**2 = Partial** - Student is able to separate one of the solids in the mixture.

**1 = Unsatisfactory/Incorrect** - Student fails to separate any, of the solids in the mixture.

Item Number: 3 Accession Number: OP000724

Key: NONE

Classification Codes:  
N27S 3 PS A SI NA NT ECR

**Scoring Rationale:** Student demonstrates an ability to describe the sequence of procedures necessary to separate a mixture of solids, given the available laboratory equipment and materials.

**5 = Complete** - Student response describes steps that lead to 5 separated components.

**4 = Essential** - Student response describes steps that lead to 3 separated components.

**3 = Adequate** - Student response describes steps that lead to 2 separated components.

**2 = Partial** - Student response describes steps that lead to 1 separated component.

**1 = Unsatisfactory/Incorrect** - Student response fails to describe any of the separations.

Credited responses include:

Example (Sample Answer A)

1. Use the sieve and the plastic cup to separate the larger particles from the smaller ones. Two different metallic materials remain in the sieve, while the rest is collected in the plastic cup.

2. Use the magnet to separate the two metals remaining in the sieve. The magnet attracts the balls, which are placed in Bag 1. The copper shot (pellets) are then placed in Bag 2.

3. Use the magnet to separate the small magnetic metal filings from the other materials in the plastic cup. Place the metal filings attached to the magnet in Bag 3.

4. Use a plastic cup, the funnel, filter paper and water to separate the nonmetallic material from the one that dissolves in water. Place the filter paper and the sandy material in it in Bag 4. The last material is dissolved in the water in the plastic cup.

(Sample Answer B)

1. Use the magnet to separate the magnetic materials in the tray from the other materials. Both the metal balls and small filings are attracted to the magnet.

2. Use the sieve and the plastic cup to separate the two metals attached to the magnet. The metal balls remain in the sieve while the metal filings are collected in the plastic cup. The balls are placed in Bag 1 and the filings in Bag 2.

3. Use the sieve and the plastic cup to separate the non-magnetic metal from the other materials. The non-magnetic metal is placed in Bag 3, and the other materials are collected in the plastic cup.

4. Use a plastic cup, the funnel, filter paper, and water to separate the non-metallic material from the one that dissolves in water. Place the filter paper and the sandy material in it in Bag 4. The last material is dissolved in the water in the plastic cup.



Item Number: 4 Accession Number: OP000726

Key: NONE

Classification Codes:  
N27S 3 PS A PR NA NT SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an ability to explain how a substance dissolved in a liquid can be separated from the liquid.

**3 = Complete** - Student response identifies an appropriate procedure to separate the substance from the water, and provides a complete explanation as outlined below.

**2 = Partial** - Student response identifies an appropriate procedure to separate the substance from the water, but does not provide a complete explanation.

**1 = Unsatisfactory/Incomplete** - Student response fails to identify any appropriate procedure that can be used to separate a substance that dissolves in water from the water.

Credited responses include:

Heat the water so that it evaporates leaving the salt behind.

Student Sample Responses

1. Look at the contents of plastic bag (A) without opening it. What properties do the substances in the mixture have that would allow the following equipment to be used to separate the mixture?

OP000722

**Magnet:** Some of the material is magnetic or iron.

**Filter paper:** Some of the mixture looks as though it doesn't dissolve in water.

**Sieve:** Some of the mixture is much larger than other parts.

**Level:**  
**Complete (4)**

## Student Sample Responses

1. Look at the contents of plastic bag (A) without opening it. What properties do the substances in the mixture have that would allow the following equipment to be used to separate the mixture?

OP000722

**Magnet:** *Metal pieces collected*

**Filter paper:** *Salt will dissolve when water is poured through substance with filter paper.*

**Sieve:** *Largest pieces would be caught.*

**Level:**  
**Essential (3)**

Student Sample Responses

1. Look at the contents of plastic bag (A) without opening it. What properties do the substances in the mixture have that would allow the following equipment to be used to separate the mixture?

OP000722

Magnet: — Will attract the metal

Filter Paper: — will separate the sand + salt.

Sieve: will separate it from the big things.

Level:  
Partial (2)

Student Sample Responses

1. Look at the contents of plastic bag (A) without opening it. What properties do the substances in the mixture have that would allow the following equipment to be used to separate the mixture?

OP000722

Magnet: separate the metals

Filter paper: separate the sand and salt

Sieve: separate the sand and salt from the metals: balls.

Level:  
Unsatisfactory/Incorrect (1)

## Student Sample Responses

2. Now use this equipment to separate the five materials in the mixture. Each time you successfully separate a material from the mixture, place this separated material in one of the small unlabeled plastic bags. The materials that you separate do not have to be 100 percent pure, but they should be as pure as possible. Each separated material should be placed in its own plastic bag. The bags with the separated materials will be collected after you have completed the task.

	CP	SP	IF	SD	ST
1	●	0	0	0	0
2	0	●	0	0	0
3	0	0	●	0	0
4	0	0	0	●	0

**Level:**  
**Complete (5)**

Student Sample Responses

	CP	SP	IF	SD	ST
1	●	●	0	0	0
2	0	0	●	0	0
3	0	0	0	●	0
4	0	0	0	0	●

Level:  
Essential (4)

	CP	SP	IF	SD	ST
1	0	0	●	●	0
2	●	0	0	0	0
3	0	0	0	0	0
4	0	●	0	0	0

Level:  
Adequate (3)

	CP	SP	IF	SD	ST
1	●	●	0	0	0
2	0	0	0	0	0
3	0	0	●	0	0
4	0	0	●	●	0

Level:  
Partial (2)

	CP	SP	IF	SD	ST
1	●	●	●	●	●
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0

Level:  
Unsatisfactory/Incorrect (1)

## Student Sample Responses

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

Start by sifting the sand, salt, and metal shavings from the metal balls. Separate the balls using the magnet. Then use the magnet to separate the metal shavings from the sand and salt. Then take the sand and salt and place it in a cup along with water and stir until the salt dissolves. Then filter the salt water out of the sand by using the filter paper.

Level:  
Complete (5)



Student Sample Responses

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

① Using the sieve, sift out the metal balls, ② pour the contents onto the tray and pull the magnet through the contents to attract and separate another metal ③ pour the contents into the funnel with a filter on it, ④ pour water over the material to dissolve the salt ⑤ the sand is left

Level:  
Essential (4)

Student Sample Responses

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

Dump all of the sediment into the sieve over the tray. After the smaller sediment runs through the sieve collect all of the metal balls with the magnet. Put them in a bag. The remaining balls put them into another bag. With the remaining sediment, filter it out using the Funnel Filter paper and water in some way or another

Level:  
Adequate (3)

Student Sample Responses

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

Use the sieve to separate metal balls from other mixture -  
use magnet to separate metal from mixture use filter to separate water from entire mixture dissolving salt

Level:

Partial (2)

Student Sample Responses

3. Based on what you discovered as you worked to separate the materials in the mixture, write in the space below step-by-step instructions that would allow someone else to separate all five solids using the same set of equipment.

OP000724

First I separated all materials. I separated the metals by magnets and the salt and sand by water. Get rid of the metal first by running the magnet through the substance. Then gather some of the leftover substance and put in what the salt will evaporate.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

4. Suppose that you have a sample of water in which an unknown solid substance has been dissolved. Describe a procedure that you would use to effectively separate the substance from the water. OP000726

*In order to separate, one must boil the water. The solid will appear when the water has evaporated. It will only leave the solid.*

Level:  
Complete (3)

4. Suppose that you have a sample of water in which an unknown solid substance has been dissolved. Describe a procedure that you would use to effectively separate the substance from the water. OP000726

*Boil the water away*

Level:  
Partial (2)

## Student Sample Responses

4. Suppose that you have a sample of water in which an unknown solid substance has been dissolved. Describe a procedure that you would use to effectively separate the substance from the water. OP000726

One would line the inside of a funnel with filter paper, and drain the the water through the funnel into a cup. The residue on the filter paper is the one dissolved substance.

Level:

Unsatisfactory/Incorrect (1)

# SECTION 123

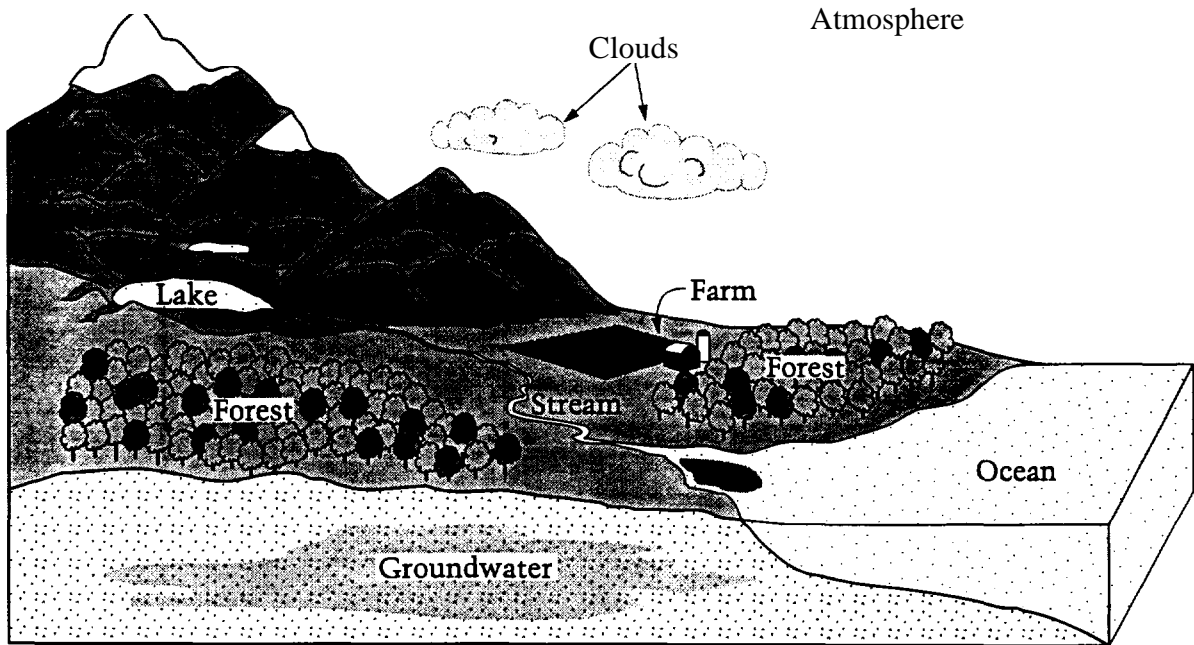
Section 123

In this section, you will have 30 minutes to answer 15 questions. Mark your answers in your booklet. Fill in only one oval for each question or write your answer on the lines. Please think carefully about your answers. When you are writing your answers, be sure that your handwriting is clear,

Do not go past the **STOP** sign at the end of the section. If you finish before time is called, you should go over your work again.

PLEASE TURN THE PAGE AND BEGIN NOW.

Section 123



The diagram above shows a region near the coast of a large continent. A range of high, snowcapped mountains lies near the ocean. There is a farm between the mountains and a forest.

The following questions ask you to think about water and the water cycle in the system shown in the diagram. In the system, water exists as a gas, a liquid, and a solid.

HE001355



1. In what part of the system does water exist primarily in a gaseous form?

- A Lake
- B Atmosphere
- C Ocean
- D Groundwater

HE001356

2. Where and in what form does water exist in a solid state in this system?

HE001357

---

---

---

---

---

3. In which part of the water cycle are dissolved solid impurities separated from the water?

- A Cloud formation in the atmosphere
- B Precipitation from the clouds
- C Evaporation from the ocean
- D Water flow from the lake to the ocean

HE001362

Section 123

4. Describe what role the trees in the forests play in the water cycle in this system. HE001360

---

---

---

---

---

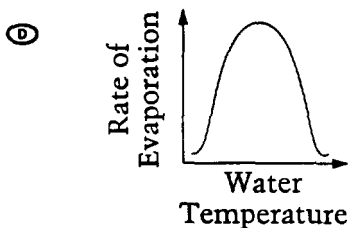
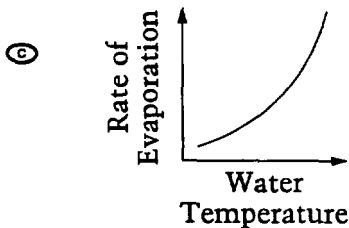
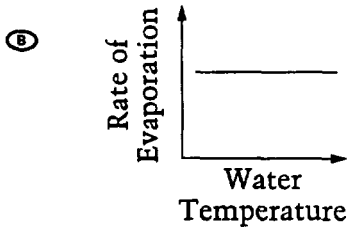
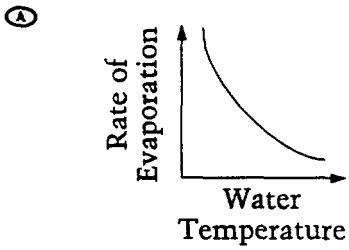
5. What is the main cause of water evaporation from the ocean?

- Ⓐ Wind and wave action along the shore
- Ⓑ Currents in the ocean
- Ⓒ Heat energy from the ocean floor
- Ⓓ Heat energy from the Sun

HE001358

6. Which of the following graphs shows how the rate of evaporation changes with changes in water temperature?

HE001361



Section 123

7. Some students were studying water in the environment. They filled one sample jar with ocean water and another sample jar with fresh water from the lake. The labels on the jars fell off, and the water in both jars looked the same. Describe a test, other than tasting or smelling the water, that the students could do to determine which jar held the ocean water and which jar held the lake water. Explain how the test would work.

XI000871

---

---

---

---

---

---

---

---

---

---

---

---

8. During which of the following processes is there a decrease in the heat content of the form of water indicated?

- Ⓐ Ice as it forms on a lake
- Ⓑ Water droplets as they fall to the ground
- Ⓒ Water as it evaporates from a pond
- Ⓓ Snow as it melts on a mountainside

HE001363

9. Explain how clouds can form as air rises. You may draw a diagram as part of your explanation.

HE001364

---

---

---

---

---

---

---

---

---

---



Section 123

10. Describe how water in the lake can become snow on the mountains in the system shown in the diagram on page 2.

HE001365

---

---

---

---

---

---

---

---

---

---

---

11. Referring specifically to the system shown in the diagram on page 2, explain why fresh water is a natural resource that is renewable.

HE001366

---

---

---

---

---

12. In the system shown in the diagram on page 2, the prevailing winds blow from the ocean toward the mountains in September. In June, however, the winds blow mostly from the mountains toward the ocean. In which month, June or September, would the farm get more precipitation? Explain your answer.

HE001368

---

---

---

---

---

Section 123

13. Further inland on the continent, just beyond the mountain range shown in the diagram on page 2, there is a desert that receives very little precipitation. Give an explanation of why this desert receives such a small amount of precipitation.

HE001369

---

---

---

---

---

14. Describe a technological process that can be used to obtain fresh water from ocean water.

HE001367

---

---

---

---

---



15. Suppose that a coal-burning power plant near the farm releases sulfur dioxide ( $\text{SO}_2$ ) into the atmosphere. Write a chemical equation for the reaction that occurs between sulfur dioxide and water. Describe how the product of this reaction would affect the fish in the lake and the trees and other plants on the mountains and in the forests. HE001371

---

---

---

---

---

---

---

---

---

---

---

---



**INFORMATION ABOUT THE FRAMEWORK CLASSIFICATION CODES  
AVAILABLE FOR EACH ITEM**

Following this description of the classification codes, there is a single sheet with NAEP ID numbers, short descriptions of the items, item keys(1-4 if the item is multiple-choice; blank if the item is open-ended), as well as the mean p-values for the items in the released block.

The classification codes for each item can be viewed within each item in the scoring guide.

- Field 1)                    Program Profile:**  
N27S NAEP, year 27 of Science
- Field 2)                    Grade:**  
1            Grade 4 only item  
1/2        Grade 4/8 overlap item  
2            Grade 8 only item  
2/3        Grade 8/12 overlap item  
3            Grade 12 only item
- Field 3)                    Field of science:**  
P S        Physical Science  
E S        Earth Science  
L S        Life Science  
**Field science of subcontent area:**  
*The letter corresponds to the subcontent areas described in the Science Assessment and Exercise specifications for the 1996 National Assessment of Educational Progress.*
- Field 4)                    Physical Science:**  
A        Matter and Its Transformations  
B        Energy and Its Transformations  
C        Motion  
**Earth Science:**  
A        Solid Earth (lithosphere)  
B        Water (hydrosphere)  
C        Air (atmosphere)  
D        Earth in Space  
**Life Science:**  
A        Change and Evolution  
B        Cells and Their Functions  
C        Organisms  
D        Ecology
- Field 5)                    Ways of knowing and doing science:**  
S I        Scientific Investigation  
P R        Practical Reasoning  
C U        Conceptual Understanding

**Field 6)**

**Theme:**

SYS Systems

MOD Models

PC Patterns of Change

NA Not Applicable

**Field 7)**

**Nature of Science/Technology:**

NS Nature of Science

NT Nature of Technology

NA Not Applicable

**Field 8)**

**Item Type:**

MC Multiple-Choice

SCR Short Constructed-Response

ECR Extended Constructed-Response

NA Not Applicable

1996 Science Items

GRADE: 12 BLOCK: 27S7

ITEM	NAEP ID	SHORT DESCRIPTION	KEY	CONTENT	PROCESS	P-VALUE	RELEASE STATUS
1	K049801	WATER CYCLE: GASEOUS FORM MC	2	2	3	0.927	P
2A	K049802	WATER CYCLE: SOLID FORM OE		2	3	0.607	P
3	K049803	WATER CYCLE: SEPARATION OF IMPURITIES MC	3	2	3	0.576	P
4A	K049804	WATER CYCLE: ROLE OF FORESTS OE		2	3	0.269	P
5	K049805	WATER CYCLE: CAUSE OF EVAPORATION MC	4	2	3	0.830	P
6	K049806	WATER CYCLE: EVAPORATION V. TEMPERATURE MC	3	1	3	0.676	P
7A	K049807	WATER CYCLE: TEST TO RECOGNIZE WATER OE		2	1	0.456	P
8	K049808	WATER CYCLE: DECREASE IN HEAT CONTANT MC	1	1	3	0.638	P
9A	K049809	WATER CYCLE: CLOUD FORMATION OE		2	3	0.175	P
10A	K049810	WATER CYCLE: LAKE H2O TO SNOW ON MOUNTAIN OE		2	3	0.548	P
11A	K089811	WATER CYCLE: WATER AS A RENEWABLE RESOURCE DE		2	3	0.175	P
12A	K049812	WATER CYCLE: PREVAILING WINDS OE		2	3	0.392	P
13A	K049813	WATER CYCLE: CAUSE OF DESERT CONDITIONS OE		2	3	0.369	P
14A	K049814	WATER CYCLE: FRESH WATER FROM OCEAN WATER OE		2	2	0.244	P
15A	K049815	WATER CYCLE: S02 POLLUTION OE		2	2	0.218	P

Content: 1 = Physical Sciences  
 2 = Earth & space sciences  
 3 = Life sciences

Process: 1 = Scientific investigation  
 2 = Practical reasoning  
 3 = Conceptual understanding

## Information about the Item Difficulty Available for Each Item

---

Item identification, a short item description, and the key (for multiple-choice items) are provided, in addition to information about the item difficulty, for each item. The items are identified by their position within a block and by their NAEP IDs. The NAEP IDs are used to identify items during the analysis of NAEP data in the summary of item level results in data almanacs, and in the secondary user data sources.

The numbers in the column labeled “P-Value” on the item statistic sheet vary for item types (multiple-choice and 2-category constructed-response items and constructed-response items with more than two categories). For the multiple-choice items and for the 2-category constructed-response items that were scored correct or incorrect the number in that column is the percent of students correctly responding to the item. This value is often called the p-value or the P+ for an item. For constructed-response items with more than two categories, the value in the column is the mean item score for the item.

For example, if the number of categories for a constructed-response item is 3 with a category/unsatisfactory/incorrect (category 1) worth 0 points, a partial category (category 2) worth 1/2 of a point and a complete category (category 3) worth 1 point, then a student can receive either 0, 1/2 or 1 point for his response to the item. The mean item score is the number that you would get if the scores on this item are averaged for all of the students in the assessment. This value varies from 0 to 1 just as the percent correct for a multiple-choice item could vary. It can be interpreted as an indication of where on the 0-1 scale for the item that an “average” student might score. For instance, if the mean item score for a 3-category constructed-response item is .8, then an “average” student would be expected to have a response in either category 2 (worth 1/2 or .5 of a point) or category 3 (worth 1 point). In fact it is a little more likely that the student would have a response in category 3, since .8 is closer to 1.0 than to .5.

Item Number: NONE Accession Number: HE001355

Key: NONE

Classification Codes:  
N27S 2/3 ES B CU SYS NA NA

Item Number: 1 Accession Number: HE001356

Key: B

Classification Codes:

N27S 2/3 ES B CU SYS NA MC

Item Number: 2 Accession Number: HE001357

Key: NONE

Classification Codes:  
N27S 2/3 ES B CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of what the solid forms of water are by giving an example of where ice or snow can be found on the diagram of the system.

**3 = Complete** - Student indicates at what location and in what form ice or snow are found.

**2 = Partial** - Student implies or mentions specifically either ice or snow, but does not indicate at what locations or in which circumstances they might exist in the system, or gives a location mentioning subfreezing temperatures but does not give the form.

**1 = Unsatisfactory** - Student does not imply or mention specifically either ice or snow, nor does the student indicate at what locations ice or snow exist in the system.

#### Credited responses include:

Snow on the mountain top  
Ice on the lake in winter (or sub-zero temperatures)  
Ice crystals in the clouds



Item Number: 3 Accession Number: HE001362

Key: C

Classification Codes:

N27S 2/3 ES B CU SYS NA MC

Item Number: 4 Accession Number: HE001360

Key: NONE

Classification Codes:  
N27S 2/3 ES B CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates a knowledge of the process of transpiration as an important way in which ground moisture can enter the atmosphere.

**3 = Complete** - Student indicates that A/trees absorb water and then B/release it into the atmosphere (through the process of transpiration)

**2 = Partial** - Student mentions only that A/trees absorb water through their roots, or from the ground, or drink rain-water, or B/give off water from the leaves.

**1 = Unsatisfactory/Incorrect** - Student demonstrates no knowledge of the role trees play in the water cycle.

Credited responses include:

Transpiration - water is given off through the leaves. Water is first absorbed from the ground through the roots, moves up through the tree and is then given off to the atmosphere through the leaves.

Item Number: 5 Accession Number: HE001358

Key: D

Classification Codes:

N27S 2/3 ES B CU SYS NA MC

Item Number: 6 Accession Number: HE001361

Key: C

Classification Codes:  
N27S 2/3 PS A CU SYS NA MC

Item Number: 7 Accession Number: XI000871

Key: NONE

Classification Codes:  
N27S 2/3 ES B SI SYS NS ECR

### Scoring Guide

Scoring Rationale: Student demonstrates an ability to Plan a scientific test by describing a method to distinguish between fresh and salt water.

**4 = Complete** - Student describes both a method and its results.

**3 = Essential** - Student describes a method and its results but provides minimal detail, or provides a partial or flawed method-

**2 = Partial** - Student describes a method but does not indicate how it would work (e.g., “measure the density of the water in each jar”).

**1 = Unsatisfactory/Incorrect** - Student describes an inconclusive method (e.g., “look at the water”).

#### Credited responses include:

Float the same object in both jars - it will float higher in the salt water.

Let some water from each jar evaporate - the salt water will leave a lot more residue behind.

Salt water will probably evaporate more slowly (higher boiling point), requires more heat to boil.

Add silver nitrate - get silver chloride precipitating

Put in two wires - attach to battery. Hydrogen collects at cathode, chlorine gas at anode

Item Number: 8 Accession Number: HE001363

Key: A

Classification Codes:

N27S 2/3 PS B CU SYS NA MC

Item Number: 9 Accession Number: HE001364

Key: NONE

Classification Codes:

N27S 2/3 ES C CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the process of cloud formation by providing an explanation of how clouds form as moist air rises.

**3 = Complete** - Student demonstrates an understanding of the process of cloud formation. Student understands change in temperature causes condensation of water.

**2 = Partial** - Student demonstrates a partial understanding of the process by stating that as moist air rises, droplets of water form clouds. Student understands moisture in the air condenses but does not give a correct cause.

**1 = Unsatisfactory/Incorrect** - Student may demonstrate an understanding of clouds being made up of water droplets and/or ice crystals, but no explanation is given for how clouds form.

Credited Responses include:

AS warm moist air rises it cools and condenses (response may or may not say that cool air holds less water than warm air, hence droplets of water condense, forming clouds) .

Item Number: 10 Accession Number: HE001365

Key: NONE

Classification Codes:  
N27S 2/3 ES B CU SYS NA ECR

## Scoring Guide

**Score Rationale:** Student shows an understanding of the water cycle by describing the events by which lake water can end up as snowfall on a mountain.

**4 = Complete** - Student demonstrates an understanding of the processes that lead to lake water becoming snow on a mountain, as described below. Students obtain 3 credited elements.

**3 = Essential** - Student demonstrates some understanding of the processes that lead to lake water becoming snow on a mountain by indicating 2 of the 3 elements listed below.

**2 = Partial** - Student demonstrates partial understanding of the processes that lead to lake water becoming snow on a mountain by indicating 1 of the elements listed below.

**1 = Unsatisfactory/Incorrect** - Student response shows no understanding of how water in the lake can become snow on the mountains.

### Credited responses include:

Water evaporates from the lake and enters the atmosphere, where it rises, cools, and forms ice crystals that then fall on the mountains as snow. Student also may include details in the description, such as how heat energy from the sun causes the water to evaporate, or how the ice crystals in the clouds must reach a certain size to become heavy enough to fall.

Elements :

1. Water from the lake evaporates (due to Sun), evaporated water rises ----->
2. Water condenses to form clouds or “enters” an existing cloud ----->
3. Temperature effects - cool/freeze water to form snow in clouds ----->



Item Number: 11 Accession Number: HE001366

Key: NONE

Classification Codes:

N27S 2/3 ES B CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the concept of a renewable resource by explaining why fresh water is renewable in natural systems.

**3 = Complete** - Student demonstrates an understanding of water as a renewable resource by using the diagram to explain that fresh water is replenished through processes that occur in the water cycle.

**2 = Partial** - Student demonstrates an understanding of the meaning of renewable, but fails to relate it to the diagram or gives a partial explanation. Student may use terminology without explaining the cycle (e.g., evaporation, precipitation make it renewable)

**1 = Unsatisfactory/Incorrect** - Student demonstrates no understanding of what the term renewable means (e.g., “renewable means it can be made by people”).

Item Number: 12 Accession Number: HE001368

Key: NONE

Classification Codes:  
N27S 2/3 ES C CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of how changes in wind patterns can affect rainfall by explaining that winds from the ocean carry more moisture than winds that come from the land.

**3 = Complete** - Student indicates that the farm would have more precipitation in September than in June, and explains that in September the prevailing winds bring in moist air from the ocean, causing more precipitation.

**2 = Partial** - Student indicates that the farm would receive the most precipitation in September and gives an incomplete explanation (e.g., misses out water source - ocean)

**1 = Unsatisfactory/Incorrect** - Student indicates that the farm “would receive the same amount of precipitation in June and September, or says June or September but gives an incorrect or no explanation or correctly identifies September and repeats stem.

Item Number: 13 Accession Number: HE001369

Key: NONE

Classification Codes:  
N27S 2/3 ES C CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the rain-shadow effect that mountain ranges can cause in certain geographical areas.

**3 = Complete** - Student demonstrates some understanding of why the desert receives little rainfall by explaining that the clouds release the water as they are forced to rise over the mountain.

**2 = Partial** - Student response indicates some understanding (e.g., “the mountains block the moist air”), but does not state that the clouds lose moisture on the mountain.

**1 = Unsatisfactory/Incorrect** - Student does not provide any reasonable explanation (e.g., “the sun is hotter on the desert side of the mountains”).

Item Number: 14 Accession Number: HE001367

Key: NONE

Classification Codes:  
N27S 2/3 ES B PR SYS NT SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of desalinization by describing a process by which fresh water can be obtained from ocean water.”

**3 = Complete** - Student describes how ocean water can be desalinated by distillation.

**2 = Partial** - Student partially describes a method that can be used for extracting salt from ocean water.

**1 = Unsatisfactory/Incorrect** - Student answer fails to describe a process, or student answers in generalized terms (e.g., they make it pure, or it must be filtered, or purified, or heated, or a desalinization plant must be built).

#### Credited responses include:

Distillation - the ocean water can be boiled, and the vapor condensed and collected. This is pure water, the salt will be left behind.

Reverse osmosis - energy used to force sea water through a membrane whose pores only allow water to pass through not salts.

Item Number: 15 Accession Number: HE001371

Key: NONE

Classification Codes:

N27S 3 ES C PR SYS NT ECR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of acid precipitation by writing a chemical equation for its formation and describing the effects that the product of the reaction can have on living things in the environment.

**4 = Complete** - Student writes (1) an acceptable chemical equation (see below) for the reaction between sulfur dioxide and water; (2) mentions or describes acid deposition (rain, snow, fog, etc.); (3) indicates that fish in lake waters will be deformed or killed; and (4) indicates that the trees and plants will be damaged or die.

**3 = Essential** - Student response incorporates 2 or 3 of the above parts

**2 = Partial** - Student response incorporates either 1, 2, 3 or 4 above.

**1 = Unsatisfactory/Incorrect** - Student gives an incorrect equation and shows no understanding of how acid rain affects fish, trees, and other plants.

Note: The product of the reaction falls as acid rain. Acid rain causes lakes to become more acidic which can lead to the death of fish both directly and through leaching out of toxic substances such as aluminum ions into the water (below pH 5.6 most fish would die). Acid rain also leaches vital plant nutrients out of soil. This can lead to the death of plants and trees and makes them more susceptible to diseases. It also makes metals such as aluminum more soluble – these become toxic to the plant.

### Credited responses include:

(1) Acceptable Equations:  
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2\text{S O}_3$$
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{S H}_2\text{O}_3$$
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{S O}_3\text{H}_2$$
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2\text{O}_3\text{S}$$
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2 + \text{SO}_3$$
$$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2\text{S} + \text{O}_3$$

Student Sample Responses

2. Where and in what form does water exist in a solid state in this system?

HE001357

The water is found in a solid state  
at the top of the mountains in the form  
of snow

Level:

Complete (3)

2. Where and in what form does water exist in a solid state in this system?

HE001357

Water exists in a solid state in this  
system in the clouds.

Level:

Partial (2)

Student Sample Responses

2. Where and in what form does water exist in a solid state in this system?

HE001357

Water exist in the lake, stream,  
and ocean. It also exists as  
groundwater.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

4. Describe what role the trees in the forests play in the water cycle in this system. HE001360

Trees take in water from roots  
and, release it during transpiration

Level:

Complete (3)

4. Describe what role the trees in the forests play in the water cycle in this system. HE001360

The trees in the forests play a major role  
in the water cycle. The trees take in the flowing  
water and make food with it ( $H_2O$ ).

Level:

Partial (2)

4. Describe what role the trees in the forests play in the water cycle in this system. HE001360

IN case of a flood - The trees  
roots help prevent erosion

Level:

Unsatisfactory/Incorrect (1)



## Student Sample Responses

7. Some students were studying water in the environment. They filled one sample jar with ocean water and another sample jar with fresh water from the lake. The labels on the jars fell off, and the water in both jars looked the same. Describe a test, other than tasting or smelling the water, that the students could do to determine which jar held the ocean water and which jar held the lake water. Explain how the test would work.

XI000871

The students could boil both jars to examine any solids that may have remained in the jars. The jar of ocean water should have left salt behind in the jar. Fresh water does not consist of any salt.

Level:  
Complete (4)

Student Sample Responses

7. Some students were studying water in the environment. They filled one sample jar with ocean water and another sample jar with fresh water from the lake. The labels on the jars fell off, and the water in both jars looked the same. Describe a test, other than tasting or smelling the water, that the students could do to determine which jar held the ocean water and which jar held the lake water. Explain how the test would work.

X1000871

Another test that could be done would be distillation. In which you heat up the water in both jars and by heating the salt separates from the water.

Level:  
Essential (3)

Student Sample Responses

7. Some students were studying water in the environment. They filled one sample jar with ocean water and another sample jar with fresh water from the lake. The labels on the jars fell off, and the water in both jars looked the same. Describe a test, other than tasting or smelling the water, that the students could do to determine which jar held the ocean water and which jar held the lake water. Explain how the test would work. X1000871

*They could test the waters  
for salt. By letting the water dry  
up.*

**Level:**

**Partial (2)**

7. Some students were studying water in the environment. They filled one sample jar with ocean water and another sample jar with fresh water from the lake, The labels on the jars fell off, and the water in both jars looked the same. Describe a test, other than tasting or smelling the water, that the students could do to determine which jar held the ocean water and which jar held the lake water. Explain how the test would work. X1000871

*You could do a a test to  
measure the Salinity of  
the water.*

**Level:**

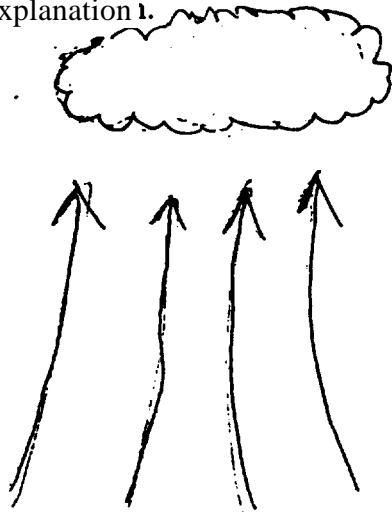
**Unsatisfactory/Incorrect (1)**

Student Sample Responses

9. Explain how clouds can form as air rises. You may draw a diagram as part of your explanation.

HE001364

dust

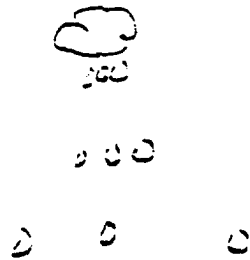


As air rises, it is cooled and the vapor pressure of water is reduced. When the air cannot hold all of the evaporated water because it is too cold, the water vapor condenses on dust particles to form clouds.

Level:  
Complete (3)

Student Sample Responses

9. Explain how clouds can form as air rises. You may draw a diagram as part of your explanation. HE001364



As water evaporates  
it condenses in the  
sky and forms clouds

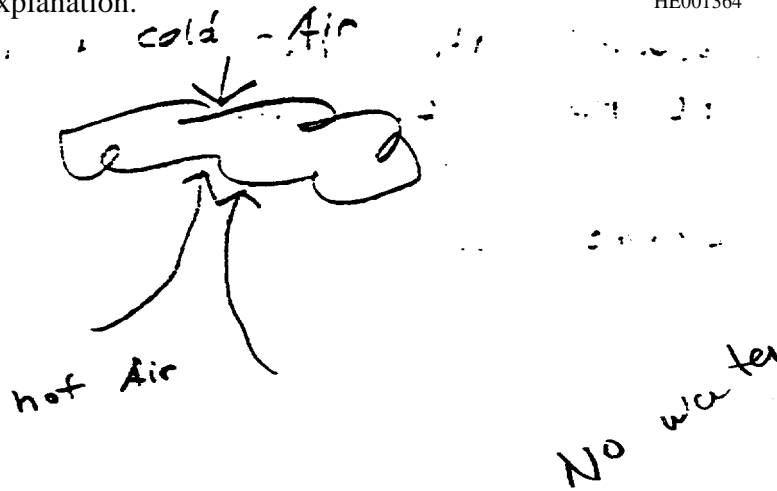
Level:  
Partial (2)

Student Sample Responses and Assigned Scores

Grade : 12

Block : S3S7

9. Explain how clouds can form as air rises. You may draw a diagram as part of your explanation. HE001364



As hotter air rises into a cooler air that is trying to drop pressure increase. The more dense air becomes condensed and clouds form.

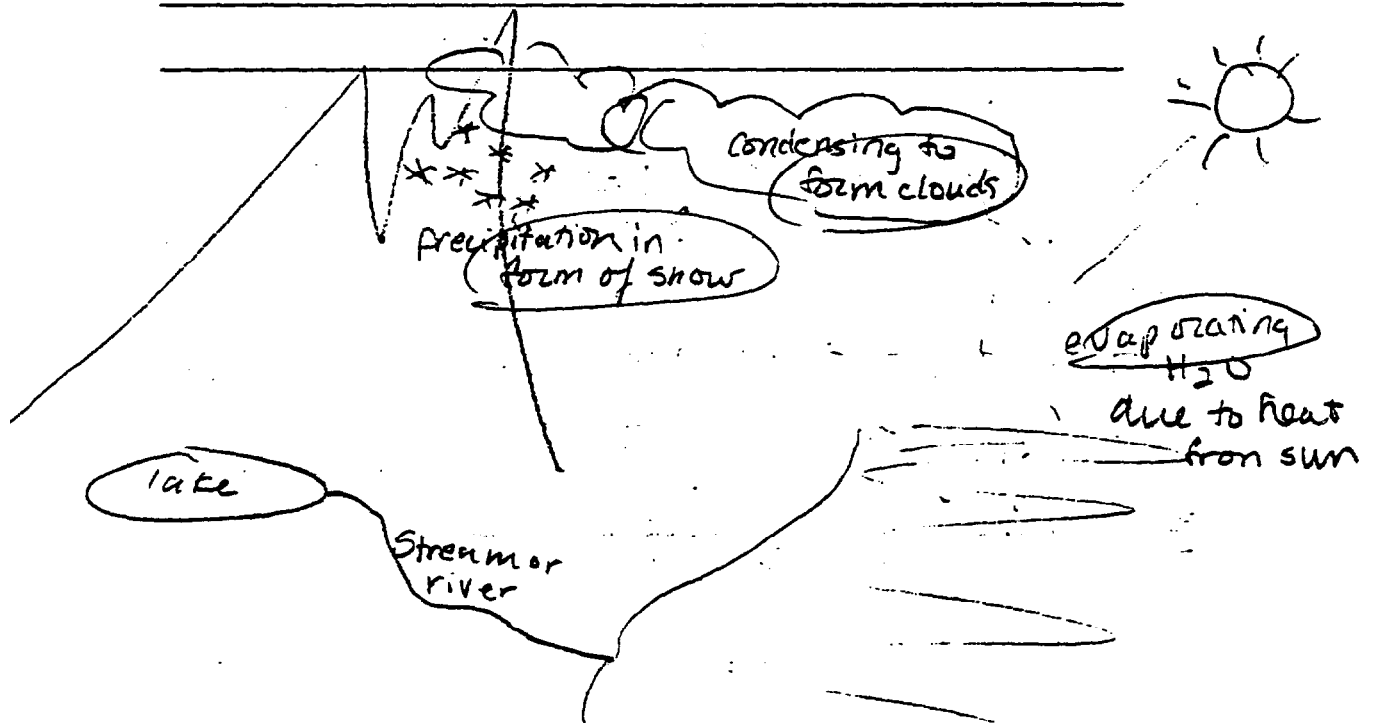
Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

10. Describe how water in the lake can become snow on the mountains in the system shown in the diagram on page 2.

HE001365

The water in the lake runs down to the ocean where it evaporates and becomes clouds. The gaseous water condenses and falls on the mountains in form of snow because the mountain tops are far up in the atmosphere and it is cold up there.



Level:  
Complete (4)

Student Sample Responses

10. Describe how water in the lake can become snow on the mountains in the system shown in the diagram on page 2.

HE001365

Water in the lake flows down the stream into the ocean. <sup>OR</sup> Water molecules ~~evaporate~~ and clouds are filled with the molecules. They float over the mountains, it rains, and the water droplets become snow on the mountains due to the cold temperatures.

Level:  
Essential (3)



Student Sample Responses

10. Describe how water in the lake can become snow on the mountains in the system shown in the diagram on page 2.

HE001365

When water evaporates, it travels to the tops of the mountains and freezes into snow.

Level:

Partial (2)

10. Describe how water in the lake can become snow on the mountains in the system shown in the diagram on page 2.

HE001365

Due to the fact that the lake is so close to the mountain if it gets to cold the water will eventually turn to ice than snow!

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

11. Referring specifically to the system shown in the diagram on page 2, explain why fresh water is a natural resource that is renewable.

because it rains, the goes into the lake <sup>HE001366</sup>  
and other water holding places then evaporates  
leaving the impurities and when enough water  
is collected in the clouds it rains and  
the whole process begins again.

Level:  
Complete (3)

11. Referring specifically to the system shown in the diagram on page 2, explain why fresh water is a natural resource that is renewable.

Evaporation water is the <sup>HE001366</sup>  
only substance carried. Ev water  
is evaporated and it rains, the  
water is pure and drinkable.

Level:  
Partial (2)

11. Referring specifically to the system shown in the diagram on page 2, explain why fresh water is a natural resource that is renewable.

Fresh water is a natural <sup>HE001366</sup>  
resource because it is  
renewable. You can get  
fresh water out of ocean  
water by boiling it @ 270°F

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

12. In the system shown in the diagram on page 2, the prevailing winds blow from the ocean toward the mountains in September. In June, however, the winds blow mostly from the mountains toward the ocean. In which month, June or September, would the farm get more precipitation? Explain your answer.

HE001368

In september, because the evaporation is greater over the ocean, so more clouds to rain. The wind will blow the clouds towards the farm.

Level:

Complete (3)

12. In the system shown in the diagram on page 2, the prevailing winds blow from the ocean toward the mountains in September. In June, however, the winds blow mostly from the mountains toward the ocean. In which month, June or September, would the farm get more precipitation? Explain your answer.

HE001368

IN SEPTEMBER Because the winds carry the water into the farm lands

Level:

Partial (2)

12. In the system shown in the diagram on page 2, the prevailing winds blow from the ocean toward the mountains in September. In June, however, the winds blow mostly from the mountains toward the ocean. In which month, June or September, would the farm get more precipitation? Explain your answer.

HE001368

September because there is nothing to block moisture from the atmosphere. The mountains would pick up more in June because they use more moisture.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

13. Further inland on the continent, just beyond the mountain range shown in the diagram on page 2, there is a desert that receives very little precipitation. Give an explanation of why this desert receives such a small amount of precipitation.

HE001369

The mountains are cold enough so that when a cloud passes over, all its water is released. Therefore, not many clouds get past the mountains to the desert.

Level:

Complete (3)

13. Further inland on the continent, just beyond the mountain range shown in the diagram on page 2, there is a desert that receives very little precipitation. Give an explanation of why this desert receives such a small amount of precipitation.

HE001369

The mountains are blocking the desert from receiving precipitation.

Level:

Partial (2)

13. Further inland on the continent, just beyond the mountain range shown in the diagram on page 2, there is a desert that receives very little precipitation. Give an explanation of why this desert receives such a small amount of precipitation.

HE001369

Because it is so dry and so close to the equator.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

14. Describe a technological process that can be used to obtain fresh water from ocean water.

HE001367

Boil the ocean water on a burner but in place a tube going from the ocean water into a flask. As the the evaporation turns to liquid, the fresh water will fall into the flask.

Level:

Complete (3)

14. Describe a technological process that can be used to obtain fresh water from ocean water.

HE001367

You can set bins of water outside to filter the salt out by evaporation.

Level:

Partial (2)

Student Sample Responses

14. Describe a technological process that can be used to obtain fresh water from ocean water.

HE001367

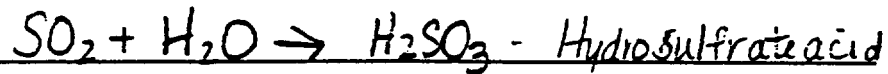
Purification is separating the impurities from water to make it fresh. This would take the salt and other impurities out of the ocean water to make it fresh.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

15. Suppose that a coal-burning power plant near the farm releases sulfur dioxide ( $\text{SO}_2$ ) into the atmosphere. Write a chemical equation for the reaction that occurs between sulfur dioxide and water. Describe how the product of this reaction would affect the fish in the lake and the trees and other plants on the mountains and in the forests. HE001371



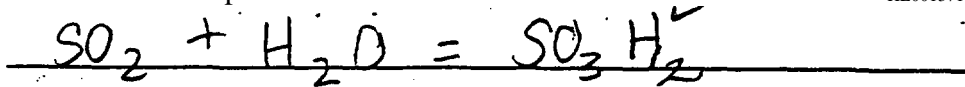
This is an acid so it would make acid rain that would fall on everything. The water would eventually change pH levels killing the fish because they are unable to adapt. The trees and plants would take the acids into their systems slowly killing them also.

Level:

Complete (4)

Student Sample Responses

15. Suppose that a coal-burning power plant near the farm releases sulfur dioxide ( $\text{SO}_2$ ) into the atmosphere. Write a chemical equation for the reaction that occurs between sulfur dioxide and water. Describe how the product of this reaction would affect the fish in the lake and the trees and other plants on the mountains and in the forests. HE001371



The pollution from the coal burning plants would affect the environment. It would cause an acid rain that affects the entire environment.

Level:

Essential (3)

15. Suppose that a coal-burning power plant near the farm releases sulfur dioxide ( $\text{SO}_2$ ) into the atmosphere. Write a chemical equation for the reaction that occurs between sulfur dioxide and water. Describe how the product of this reaction would affect the fish in the lake and the trees and other plants on the mountains and in the forests. HE001371

$\text{SO}_2 + \text{H}_2\text{O} = \text{SH}_2\text{O}^{\text{OK}}$  The life would die because of the new chemical introduced to their digestive and respiratory systems, their bodies are not able to process sulfur and so would fail.

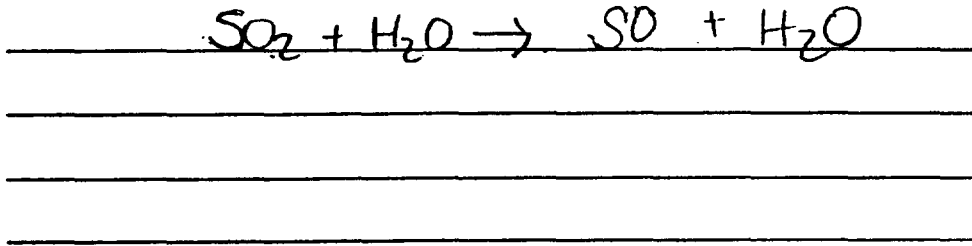
Level:

Partial (2)



Student Sample Responses

15. Suppose that a coal-burning power plant near the farm releases sulfur dioxide (SO<sub>2</sub>) into the atmosphere. Write a chemical equation for the reaction that occurs between sulfur dioxide and water. Describe how the product of this reaction would affect the fish in the lake and the trees and other plants on the mountains and in the forests. HE001371



**Level:**  
**Unsatisfactory/Incorrect (1)**

# SECTION 123

Section 123

In this section, you will have 30 minutes to answer 16 questions. Mark your answers in your booklet. Fill in only one oval for each question or write your answer on the lines. Please think carefully about your answers. When you are writing your answers, be sure that your handwriting is clear.

Do not go past the STOP sign at the end of the section. If you finish before time is called, you should go over your work again.

PLEASE TURN THE PAGE AND BEGIN NOW.

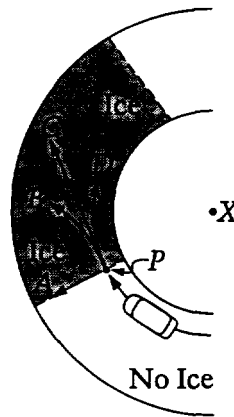
**GO ON TO THE NEXT PAGE** 

Section 123

1. In an experiment, 12.0 grams of solid carbon reacted with oxygen gas to form 44.0 grams of carbon dioxide gas. How many grams of oxygen reacted with the carbon?

- (A) 12.0 grams
- (B) 32.0 grams
- (C) 44.0 grams
- (D) 56.0 grams

JL001138



2. A car initially travels with constant speed around a tight, unbanked curve in a circular arc with center X, as shown in the diagram above. At position P, the car encounters a patch of ice, which reduces the frictional force on the tires to zero.

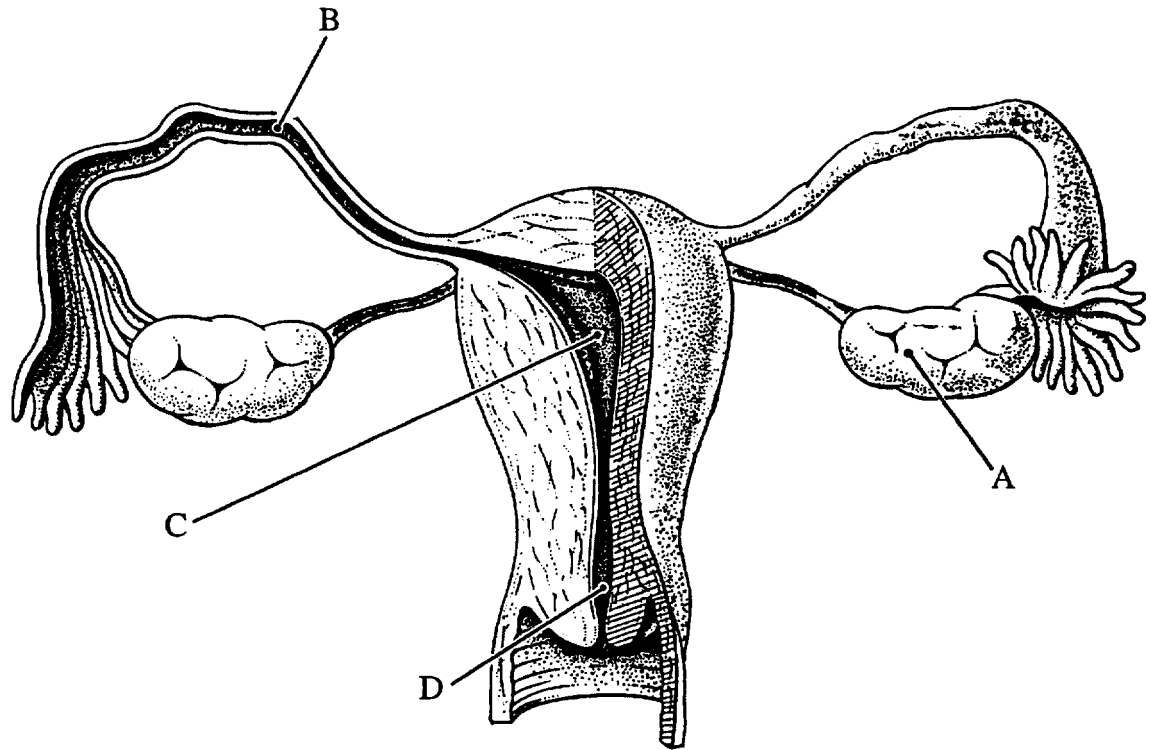
Which of the following best shows the path that the car takes while it is on the ice?

- (A) A
- (B) B
- (C) C
- (D) D

HE001646

3. A woman traveling in a train watches a train on an adjacent track go past her window. The time the other train takes to completely pass her depends on all of the following EXCEPT
- Ⓐ the speed of the train on which the woman is traveling
  - Ⓑ the speed of the other train
  - Ⓒ the length of the train on which the woman is traveling
  - Ⓓ whether the trains are traveling in the same direction or in opposite directions

JL001126



4. The diagram above shows the human female reproductive system. In which portion of this system does the fertilization of the egg by the sperm usually occur?

- A
- B
- C
- D

JL001145

5. When very small particles in a dish of water are examined with a powerful microscope, the particles often appear to move in a rapid, random motion. Explain what causes this movement of the particles.

JL001149

---

---

---

---

---

Section 123

6. The Pacific Ring of Fire is a belt-shaped region that roughly coincides with the seacoasts bordering the Pacific Ocean. Explain why volcanic activity and earthquakes occur frequently in this region. JL001134

---

---

---

---

---

---

---

---

---

---

7. The setting Sun often appears red. What is the best explanation for this?
- Ⓐ The surface temperature of the Sun is lower at sunset than at other times of the day.
  - Ⓑ The Earth's atmosphere scatters blue light, so that at the Earth's surface mostly red light is visible at sunset.
  - Ⓒ The path of light through the Earth's atmosphere is shorter at sunset than at noon.
  - Ⓓ The surface of the Earth changes infrared radiation into red light.
- JL001108
8. All of the following are considerations when planning a nuclear power facility EXCEPT
- Ⓐ emission of chemicals that produce acid rain
  - Ⓑ disposal of radioactive waste
  - Ⓒ thermal pollution of surrounding waterways
  - Ⓓ location of earthquake fault zone
- JL001135

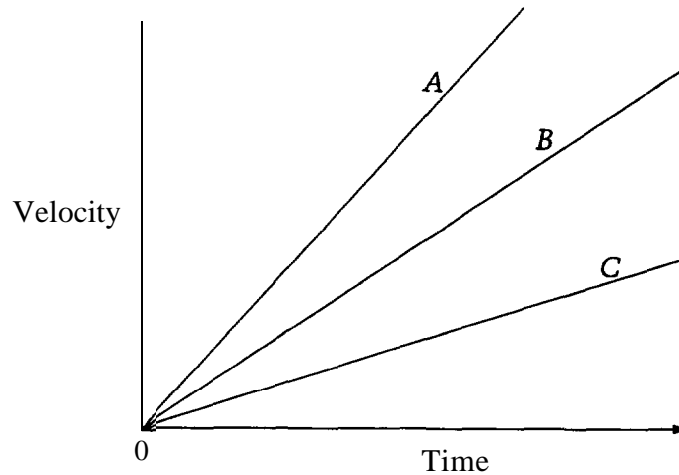


Section 123

**Questions 9-10** refer to the following information.

A graph of velocity as a function of time when the same net force is applied to three different objects is shown below.

JL001122



9. Which object has the greatest acceleration?

- A
- B
- C
- They all have the same acceleration.

JL001123

10. Which object has the greatest mass?

- A
- B
- C
- They all have the same mass.

JL001124

11. Igneous rock and sedimentary rock can be transformed into metamorphic rock by similar processes. Explain these processes.

JL001158

---

---

---

---

---

---

Section 123

Questions 12-13 refer to the following information.

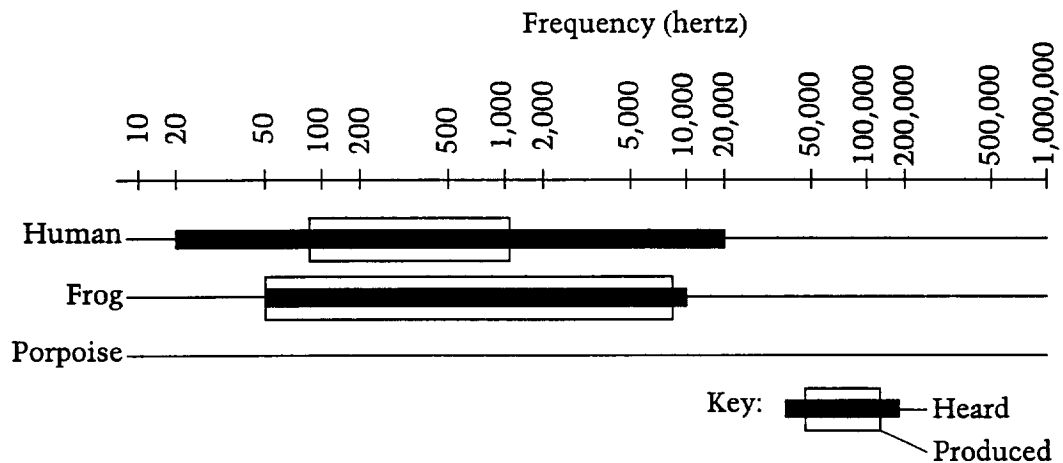
The table below shows the frequencies of sound heard and produced by several animals.

JL001115

FREQUENCIES HEARD AND PRODUCED BY PEOPLE AND SOME OTHER ANIMALS		
Animal	Frequency Heard (hertz)	Frequency Produced (hertz)
Human	20-20,000	85-1,100
Frog	50-10,000	50-8,000
Porpoise	150-150,000	7,000-120,000

12. The graph below can be used to compare the ranges of sound frequencies heard and produced by humans, frogs, and porpoises. The data for humans and frogs are already shown. Use the same method to graph the ranges for porpoises.

JL001116



13. Use the data in the table to determine if each of the following statements is true or false. For each statement, write one or two sentences to explain why you think the statement is either true or false.

a. Some sounds produced by porpoises cannot be heard by frogs.

---

---

---

---

---

b. Some sounds produced by frogs can be heard by porpoises but not by humans.

---

---

---

---

---

c. The range of frequencies heard by frogs is greater than the range of frequencies produced by humans.

JL001117

---

---

---

---

---

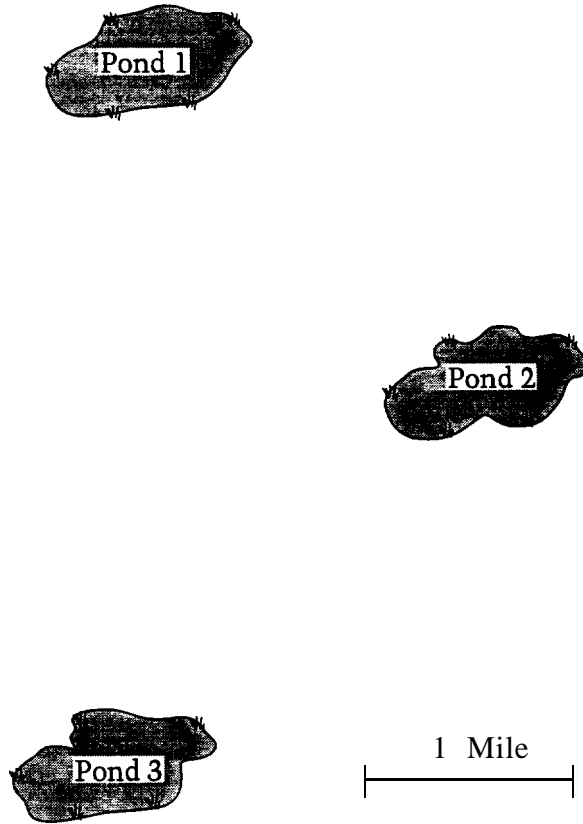


Section 123

**Questions 14-15** refer to the following information.

Biologists can study how new species form by studying established populations of plants and animals. One biologist was studying the populations of frogs in three ponds that were isolated, as shown in the figure below.

VK000001



The biologist collected information about the physical appearance, mating behavior, and reproduction compatibility of the three frog populations. Some of this information is shown in the table below.

Frog Population	Body Color Pattern	Mating Behavior	Reproduction Compatibility
Pond 1	Green with few large brown spots	Looks for mates in shallow water at pond's edge	Can also reproduce with frogs from Pond 2 and Pond 3
Pond 2	Green with many dark brown spots	Looks for mates in shallow water at pond's edge	Can also reproduce with frogs from Pond 1 and Pond 3
Pond 3	Light brown with many dark brown spots	Looks for mates in grasses and other plants on land near the pond	Can also reproduce with frogs from Pond 1 and Pond 2

14. Based on the information in the table, do you think that the three populations of frogs all belong to the same species or are members of two or three different frog species? Justify your answer, and explain what information in the table was most important in helping you determine your answer.

HE001626

---

---

---

---

---

---



Section 123

15. The biologist wondered what would happen if the frogs could not easily travel from one pond to another. Do you think the frogs from the populations in Ponds 1, 2, and 3 would still be able to mate with each other and reproduce after hundreds of generations of being separated from one another? Explain your answer. HE001627

---

---

---

---

---

---

---

---

---

---

16. For a long-term ecology study, a meadow in a large forest is divided into two plots. One plot is mowed once a year, while the other plot is not. Describe what each plot will look like after 40 years and justify your answer. HE001406

---

---

---

---

---

---

---

---

---

---



**INFORMATION ABOUT THE FRAMEWORK CLASSIFICATION CODES  
AVAILABLE FOR EACH ITEM**

Following this description of the classification codes, there is a single sheet with NAEP ID numbers, short descriptions of the items, item keys(1-4 if the item is multiple-choice; blank if the item is open-ended), as well as the mean p-values for the items in the released block.

The classification codes for each item can be viewed within each item in the scoring guide.

- Field 1)                    Program Profile:**  
N27S NAEP, year 27 of Science
- Field 2)                    Grade:**  
1            Grade 4 only item  
1/2        Grade 4/8 overlap item  
2            Grade 8 only item  
2/3        Grade 8/12 overlap item  
3            Grade 12 only item
- Field 3)                    Field of science:**  
P S        Physical Science  
E S        Earth Science  
L S        Life Science  
**Field science of subcontent area:**  
*The letter corresponds to the subcontent areas described in the Science Assessment and Exercise specifications for the 1996 National Assessment of Educational Progress.*
- Field 4)                    Physical Science:**  
A        Matter and Its Transformations  
B        Energy and Its Transformations  
C        Motion  
**Earth Science:**  
A        Solid Earth (lithosphere)  
B        Water (hydrosphere)  
C        Air (atmosphere)  
D        Earth in Space  
**Life Science:**  
A        Change and Evolution  
B        Cells and Their Functions  
C        Organisms  
D        Ecology
- Field 5)                    Ways of knowing and doing science:**  
S I        Scientific Investigation  
P R        Practical Reasoning  
C U        Conceptual Understanding



**Field 6)**

**Theme:**

SYS Systems

MOD Models

PC Patterns of Change

NA Not Applicable

**Field 7)**

**Nature of Science/Technology:**

NS Nature of Science

NT Nature of Technology

NA Not Applicable

**Field 8)**

**Item Type:**

MC Multiple-Choice

SCR Short Constructed-Response

ECR Extended Constructed-Response

NA Not Applicable

# 1996 Science Items

GRADE: 12      BLOCK: 27S10

<u>ITEM</u>	<u>NAEP ID</u>	<u>SHORT DESCRIPTION</u>	<u>KEY</u>	<u>CONTENT</u>	<u>PROCESS</u>	<u>P-VALUE</u>	<u>RELEASE STATUS</u>
1	K050001	DETERMINATION OF GRAMS OF REACTANT MC	2	1	3	0.763	P
2	K050101	PATH OF CAR ON ICE MC	3	1	3	0.540	P
3	K050201	PASSING OF TRAINS: RELEVANT FACTORS MC	3	1	2	0.429	P
4	K050301	LOCATION OF FERTILIZATION IN HUMANS MC	2	3	3	0.322	P
5A	K050401	MOVEMENT OF PARTICLES IN WATER OE		1	3	0.093	P
6A	K050501	EXPLAIN ACTIVITY AT RING OF FIRE OZ		2	3	0.264	P
7	K050601	CAUSE OF COIOR OF SETTING SUN MC	2	2	3	0.467	P
8	K050701	FACTORS CONSIDERED WHEN PLANNING NUCLEAR PLANT MC	1	1	2	0.327	P
9	K050601	V/T GRAPH: GREATEST ACCELERATION MC	1	1	3	0.518	P
10	K050601	V/T GRAPH: GREATEST MASS MC	3	1	3	0.526	P
11A	K050901	PROCESS NEEDED FOR ROCK TRANSFORMATIONS OE		2	3	0.120	P
12A	K051001	GRAPH FREQUENCIES HEARD AND PRODUCED OE		3	1	0.622	P
13A	K051002	INTERPRETATION OF FREQUENCY DATA OE		3	1	0.370	
13G	K051W3	INTERPRETATION OF FREQUENCY DATA OE		3	1	0.330	P
13M	K051004	INTERPRETATION OF FREQUENCY DATA OE		3	1	0.240	P
14A	K051101	3 FROG POPULATIONS: SAME/DIFFERENT SPECIES OE		3	3	0.276	P
15A	K051102	3 ISOLATED FROG POPS: MATING CHANCES OE		3	3	0.093	P
16A	K051201	ECOLOGY STUDY: NOWING VERSUS NON-MOWING OE		3	3	0.159	P

Content: 1 = Physical Sciences  
 2 = Earth & space sciences  
 3 = Life sciences

Process: 1 = Scientific investigation  
 2 = Practical reasoning  
 3 = Conceptual understanding

## Information about the Item Difficulty Available for Each Item

---

Item identification, a short item description, and the key (for multiple-choice items) are provided, in addition to information about the item difficulty, for each item. The items are identified by their position within a block and by their NAEP IDs. The NAEP IDs are used to identify items during the analysis of NAEP data in the summary of item level results in data almanacs, and in the secondary user data sources.

The numbers in the column labeled “P-Value” on the item statistic sheet vary for item types (multiple-choice and 2-category constructed-response items and constructed-response items with more than two categories). For the multiple-choice items and for the 2-category constructed-response items that were scored correct or incorrect the number in that column is the percent of students correctly responding to the item. This value is often called the p-value or the P+ for an item. For constructed-response items with more than two categories, the value in the column is the mean item score for the item.

For example, if the number of categories for a constructed-response item is 3 with a category/unsatisfactory/incorrect (category 1) worth 0 points, a partial category (category 2) worth 1/2 of a point and a complete category (category 3) worth 1 point, then a student can receive either 0, 1/2 or 1 point for his response to the item. The mean item score is the number that you would get if the scores on this item are averaged for all of the students in the assessment. This value varies from 0 to 1 just as the percent correct for a multiple-choice item could vary. It can be interpreted as an indication of where on the 0-1 scale for the item that an “average” student might score. For instance, if the mean item score for a 3-category constructed-response item is .8, then an “average” student would be expected to have a response in either category 2 (worth 1/2 or .5 of a point) or category 3 (worth 1 point). In fact it is a little more likely that the student would have a response in category 3, since .8 is closer to 1.0 than to .5.

Item Number: 1 Accession Number: JL001138

Key: B

Classification Codes:

N27S 3 PS A CU NA NA MC

Item Number: 2 Accession Number: HE001646

Key: C

Classification Codes:

N27S 3 PS C CU NA NA MC

Item Number: 3 Accession Number: JL001126

Key: C

Classification Codes:

N27S 3 PS C PR NA NA MC

Item Number: 4 Accession Number: JL001145

Key: B

Classification Codes: N27S 3 LS C CU NA NA MC

Item Number: 5 Accession Number: JL001149

Key: NONE

Classification Codes:  
N27S 3 PS A CU NA NA SCR

### Scoring Guide

**Score Rationale:** Student demonstrates an understanding of Brownian motion by explaining that the motion of the small particles is caused by collisions with the water molecules.

**3 = Complete** - Student response explains that the motion of the small particles is caused by the random collision of water molecules with the small particles.

**2 = Partial** - Student response makes reference to the small particles bumping each other, but no mention is made of the water molecules.

**1 = Unsatisfactory/Incorrect** - Student response demonstrates no understanding of Brownian motion (e.g., "motion is caused by the heat of the microscope light").



Item Number: 6 Accession Number: JL001134

Key: NONE

Classification Codes:  
N27S 3 ES A CU NA NA ECR

## Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the causes of volcanoes and earthquakes around the Pacific rim by explaining that tectonic plates meet and interact there.

**4 = Complete** - Student response demonstrates a thorough understanding of why volcanic activity and earthquakes occur in the region of the Pacific rim as outlined below.

**3 = Essential** - Student response demonstrates some understanding of the causes of volcanic activity and earthquakes around the Pacific rim. Student mentions plates or faults and relative movement of them, but does not specifically describe the activity that causes earthquakes and volcanoes or student mentions plates and some aspect of volcanic (igneous) activity, but does not describe relative movement.

**2 = Partial** - Student response mentions the term “tectonic plate” or “plate” or “faults,” but does not describe any relative movement of these, or explains that the motion of parts of the earth relative to each other causes volcanic activity and earthquakes without mentioning plates or faults.

**1 = Unsatisfactory/Incorrect** - Student response does not mention the movement of tectonic plates as the cause of the volcanoes and earthquakes.

### Credited responses include:

Three-part answer

1. plates and/or faults
2. relative movement (collide, push, shift of plates)
3. subduction - plates slip under, convergent, divergent movement.

The Pacific “ring of fire” corresponds to boundaries between the Pacific tectonic plate and other plates. At such boundaries, the plates move with respect to each other causing volcanic and earthquake activity.

Inclusion of an explanation of how subduction (one plate pushing underneath the other) causes volcanic activity and lateral movements of plates causes earthquakes is needed for a complete answer.

Item Number: 7 Accession Number: JL001108

Key: B

Classification Codes:  
N27S 3 ES C CU NA NA MC

Item Number: NONE Accession Number: JL001122

Key: NONE

Classification Codes:  
N27S 3 PS

C

NA

NA

NA

NA

Item Number: 8 Accession Number: JL001135

Key: A

Classification Codes:  
N27S 3 PS

B

PR

NA

NT

MC

Item Number: 9 Accession Number: JL001123

Key: A

Classification Codes:  
N27S 3 PS

C

CU

NA

NA

MC

Item Number: 10 Accession Number: JL001124

Key: C

Classification Codes:  
N27S 3 PS

C

CU

NA

NA

MC

Item Number: 11 Accession Number: SJL001158

Key: NONE

Classification Codes:

N27S 3 ES A CU PC NA SCR

### Scoring Guide:

**Scoring Rationale:** Student demonstrates an understanding of the rock cycle by describing the processes involved in the formation of metamorphic rock.

**3 = Complete** - Student response demonstrates a more thorough understanding of the process involved in the formation of metamorphic rock by the inclusion of the elements listed below.

**2a = Partial** - Student response demonstrates partial understanding of the process by mentioning two of the three agents responsible for the transformation (usually heat and pressure).

**2b = Partial** - Student response demonstrates partial understanding of the process by mentioning one of the three agents responsible for the transformation.

**1 = Unsatisfactory/Incorrect** - Student response gives an incorrect or irrelevant response.

Credited responses include:

Factors:

Heat

Pressure

Chemical reactions

Explanation:

when igneous and sedimentary rock are buried in the earth, great pressure, intense heat, and chemical reactions cause them to change into different rocks, (rocks with different structures).

The heat may be due to high temperatures that occur when rocks are deep in the earth or when they are near a mass of magma.

Item Number: NONE Accession Number: JL001115

Key: NONE

Classification	Codes:					
N27S 3	LS	C	NA	NA	NA	NA



Item Number: 12 Accession Number: JL001116

Key: NONE

Classification Codes:

N27S 3 LS C SI MOD NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an ability to translate numerical data from a table to a bar graph with reasonable accuracy.

**3 = Complete** - Student response indicates two sets of data transferred accurately.

**2 = Partial** - Student response indicates one set of data transferred accurately.

**1 = Unsatisfactory/Incorrect** - Student response indicates no data transferred accurately.

#### Credited responses include:

Accurately is defined as within plus or minus 1/10 of the appropriate interval on the scale. Both ends of a bar must be shown within the range for the bar to be scored correct.

Item Number: 13 Accession Number: JL001117

Key: NONE

Classification Codes:  
N27S 3 LS C SI NA NS SCR

**Scoring Guide:** 13a, 13b, and 13c, will be scored separately.

**Scoring Rationale:** Student demonstrates an ability to use the information in the table” to determine whether statements are true or false.

### 13a

**3 = Complete** - Student response correctly identifies the statement as true, and provides supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true, or false, but no explanation is given.

Credited responses include:

Porpoises can make sounds up to 120,000 hertz, but frogs can only hear up to 10,000 hertz, or porpoise can make sounds too high, too fast, or at a greater frequency for frogs to hear. Frogs can't hear upper range of porpoises.

### 13b

**Scoring Rationale:** Student demonstrates an ability to use the information in the table to determine whether statements are true or false.

**3 = Complete** - Student response correctly identifies the statement as false, and provides-supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true or false, but no explanation is given.

Credited responses include:

Humans can hear all the sounds (everything) that frogs can make. The frog sounds that porpoises can hear can also be heard by humans.

### 13c

**Scoring Rationale:** Student demonstrates an ability to use the information in the table to determine whether statements are true or false.

**3 = Complete** - Student response correctly identifies the statement as true, and provides supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true or false, but no explanation is given.

Credited responses include:

Frogs can hear over a range of almost 10,000 hertz, but people only produce sounds over a range of about 1,000 hertz.

Item Number: NONE Accession Number: VK000001

Key: NONE

Classification Codes:

N27S 3 LS A CU PC NA NA

Item Number : 14 Accession Number: HE001626

Key: NONE

Classification Codes:  
N27S 3 LS A CU PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the factors that affect the formation of new species by evaluating the information in the table and drawing reasonable conclusions about whether the three frog populations represent 1, 2, or 3 species.

**3 = Complete** - Student states that the information in the table regarding reproduction is the essential information needed to determine that the three frog populations represent one species since they can all mate with each other and reproduce.

**2 = Partial** - Student concludes that the three frog populations are all one species, but includes information such as color with statement on reproduction.

**1 = Unsatisfactory/Incorrect** - Student concludes that the three frog populations represent three different species because they have different physical appearances. (Reproduction is not included.)

Item Number: 15 Accession Number: HE001627

Key: NONE

Classification Codes:  
N27S 3 LS A CU PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student can evaluate data and apply an understanding of the effects of population isolation to predict whether the three frog populations could still mate and reproduce after a period of isolation.

**3 = Complete** - Student responds that the three populations may have changed enough during isolation so that they can no longer reproduce - but it depends on how much genetic change they accumulate (mutations) . Student may explain that the population in Pond 3 is the “best candidate” for this change because these frogs already differ in their mating behavior (where they look for mates), and, therefore, might become unable to mate and produce viable young with the other populations after a shorter ‘period of time.

**2 = Partial** - Student predicts that because of a period of isolation, the three frog populations may have changed enough so that they can no longer interbreed, or alternatively, student may state that the three frog populations might not have been isolated long enough for three separate species to form. A limited explanation is included such as “they would evolve separately. ”

**1 = Unsatisfactory/Incorrect** - Student does not provide an explanation that can justify his/her answer, or student states that the three populations will still be able to mate and reproduce because populations do not change over time.

Item Number: 16 Accession Number: HE001406

Key: NONE

Classification Codes:  
N27S 3 LS D CU SYS NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates comprehension of the ecological concept of succession by predicting natural changes in an undisturbed system over time.

**3 = Complete** - Student response demonstrates a good understanding of the ecological concept of succession by describing what each plot might look like in forty years and giving some justification.

**2 = Partial** - Student response demonstrates some understanding of, the ecological concept of succession by giving a minimal description of one or both plots.

**1 = Unsatisfactory/Incorrect** - Student response indicates no comprehension of the ecological concept of succession.

#### Credited responses include:

The mowed field will contain grasses and weeds (herbaceous vegetation). Shrubs and trees will not be able to establish themselves because of the mowing.

The field left alone will probably have a lot more trees in it because these have been allowed to establish themselves (e.g. of succession: weeds/shrubby vegetation to pines to oaks, hickory)

Student Sample Responses

5. When very small particles in a dish of water are examined with a powerful microscope, the particles often appear to move in a rapid, random motion. Explain what causes this movement of the particles.

JL001149

The movement is called Brownian movement. It is caused by the water molecules hitting the particles, as well as the particles hitting each other.

Level:

Complete (3)

5. When very small particles in a dish of water are examined with a powerful microscope, the particles often appear to move in a rapid, random motion. Explain what causes this movement of the particles.

JL001149

The particles move because of kinetic energy. They are in liquid form so their kinetic energy is rather high, this energy causes them to move about and knock into each other.

Level:

Partial (2)

Student Sample Responses

5. When very small particles in a dish of water are examined with a powerful microscope, the particles often appear to move in a rapid, random motion. Explain what causes this movement of the particles.

JL001149

The particles are moving  
because of the friction.

---

---

---

Level:  
Unsatisfactory/Incorrect (1)



## Student Sample Responses

6. The Pacific Ring of Fire is a belt-shaped region that roughly coincides with the seacoasts bordering the Pacific Ocean. Explain why volcanic activity and earthquakes occur frequently in this region. JL001134

Volcanic activity and earthquakes frequently occur where two plates, which make up the crust of the earth, coincide. The plates are constantly shifting. This causes pressure and friction between the plates. Sometimes the pressure is so great that earthquakes occur. The space between these plates leaves an open area to the mantle which is molten earth. When lava builds up in these crevices it sometimes explodes, causing a volcano.

Level:  
Complete (4)

Student Sample Responses

6. The Pacific Ring of Fire is a belt-shaped region that roughly coincides with the seacoasts bordering the Pacific Ocean. Explain why volcanic activity and earthquakes occur frequently in this region JL001134

Volcanic activity and earthquakes occur  
frequently in this region because this region  
contains several tectonic plates. when the  
plates move, the movement causes earthquakes  
(or a large amount of pressure that results)  
in a volcano.

Level:

Essential (3)

6. The Pacific Ring of Fire is a belt-shaped region that roughly coincides with the seacoasts bordering the Pacific Ocean. Explain why volcanic activity and earthquakes occur frequently in this region. JL001134

The Pacific Ring of Fire is an  
extremely hot area. This heat melts  
the rocks around it + causes it to  
bubble + flow out, such as a  
volcano. Also here the earth  
shifts a lot + causes much  
friction between layers causing  
earthquakes.

Level:

Partial (2)

Student Sample Responses

6. The Pacific Ring of Fire is a belt-shaped region that roughly coincides with the seacoasts bordering the Pacific Ocean. Explain why volcanic activity and earthquakes occur frequently in this region. JL001134

This occurs frequently  
in this region because there  
is more mountains in that  
area. Also there are more  
deserts and other land  
problems.

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

11. Igneous rock and sedimentary rock can be transformed into metamorphic rock by similar processes. Explain these processes.

They are transformed by compression. <sup>JL001158</sup>  
layers of rock and the earth's surface  
put pressure on these rocks, transforming  
them into metamorphic rock. Heat and  
chemical conditions also affect the process.

Level:

Complete (3)

11. Igneous rock and sedimentary rock can be transformed into metamorphic rock by similar processes. Explain these processes.

The process for the change is called <sup>JL001158</sup>  
metamorphosis. How it's change is  
by breaking up the chemicals in  
the rocks and combining them  
with other chemicals.

Level:

Partial (2)

Student Sample Responses

11. Igneous rock and sedimentary rock can be transformed into metamorphic rock by similar processes. Explain these processes.

JL001158

The only process that can transform igneous and sedimentary rocks into metamorphic is through time and weather erosion.

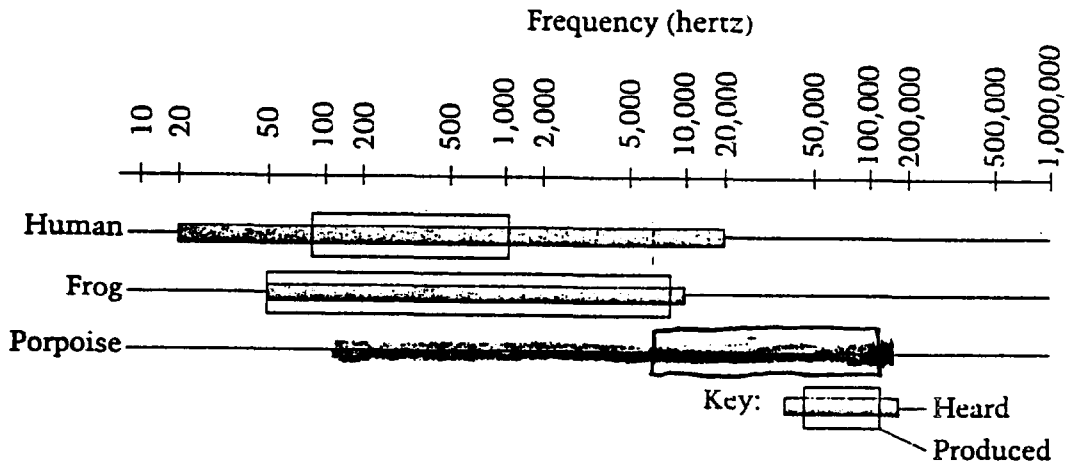
Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

- I2. The graph below can be used to compare the ranges of sound frequencies heard and produced by humans, frogs, and porpoises. The data for humans and frogs are already shown. Use the same method to graph the ranges for porpoises.

JL001116

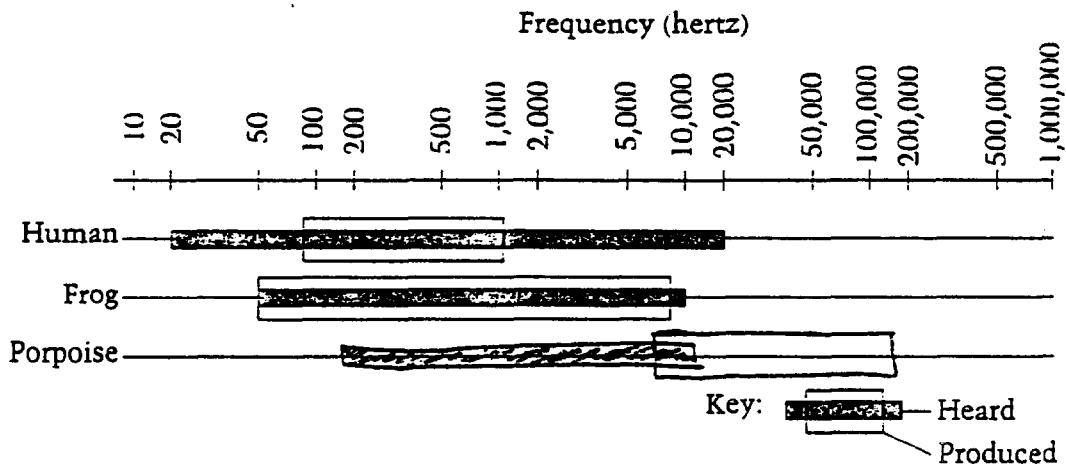


Level:  
Complete (3)

Student Sample Responses

12. The graph below can be used to compare the ranges of sound frequencies heard and produced by humans, frog, and porpoises. The data for humans and frogs are already shown. Use the same method to graph the ranges for porpoises.

JL00116

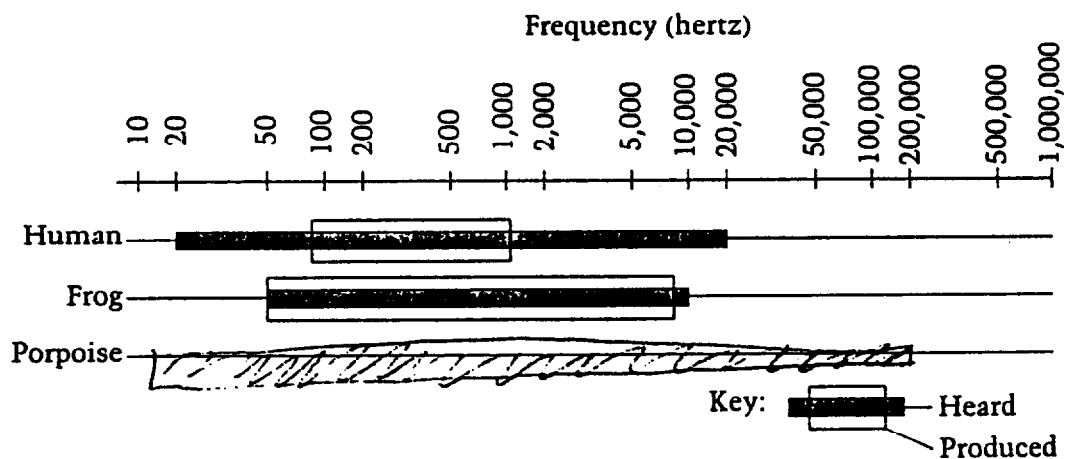


Level:  
Partial (2)

Student Sample Responses

12. The graph below can be used to compare the ranges of sound frequencies heard and produced by humans, frogs, and porpoises. The data for humans and frogs are already shown. Use the same method to graph the ranges for porpoises.

JL001116



Level:

Unsatisfactory/Incorrect (1)



Student Sample Responses

13. Use the data in the table to determine if each of the following statements is true or false. For each statement, write one or two sentences to explain why you think the statement is either true or false.

a. Some sounds produced by porpoises cannot be heard by frogs.

True. Frogs can only hear sounds up to 10,000 Hz. Porpoises produce sounds up to 120,000 Hz, which frogs are not able to hear.

Level:

Complete (3)

b. Some sounds produced by frogs can be heard by porpoises but not by humans.

False. Humans can hear all the range of sounds frogs can produce. In fact, porpoises cannot hear sounds from 50 to 150 Hz that frogs produce.

Level:

Complete (3)

c. The range of frequencies heard by frogs is greater than the range of frequencies produced by humans.

JL001117

True. Frogs can hear a range of 50-10,000 Hz <math>\leftarrow</math> 9,950 Hz, whereas humans produce only a range of 85 - 1,100 Hz which is 1015 Hz.

Level:

Complete (3)

Student Sample Responses

13. Use the data in the table to determine if each of the following statements is true or false. For each statement, write one or two sentences to explain why you think the statement is either true or false.

a. Some sounds produced by porpoises cannot be heard by frogs.

False. Because the porpoise  
have a louder sound than  
frogs.

Level:

Unsatisfactory/Incorrect (1)

b. Some sounds produced by frogs can be heard by porpoises but not by humans.

False, humans can hear  
frogs almost all the time

Level:

Unsatisfactory/Incorrect (1)

c. The range of frequencies heard by frogs is greater than the range of frequencies produced by humans.

JL00117

True. On the diagram  
it shows you all the  
information you need.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

14. Based on the information in the table, do you think that the three populations of frogs all belong to the same species or are members of two or three different frog species? Justify your answer, and explain what information in the table was most important in helping you determine your answer. HE001626

\*They all belong to the same species.  
Their characteristics are similar and,  
most importantly, they can all reproduce  
with one another.

Level:

Complete (3)

14. Based on the information in the table, do you think that the three populations of frogs all belong to the same species or are members of two or three different frog species? Justify your answer, and explain what information in the table was most important in helping you determine your answer. HEZ001626

yes - I think they all belong  
to the same species b/c it  
says that they can all reproduce  
together and they all also have  
brown spots

Level:

Partial (2)

Student Sample Responses

14. Based on the information in the table, do you think that the three populations of frogs all belong to the same species or are members of two or three different frog species? Justify your answer, and explain what information in the table was most important in helping you determine your answer.

different, They have different ME001626  
color patterns and mating  
behavior

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

15. The biologist wondered what would happen if the frogs could not easily travel from one pond to another. Do you think the frogs from the populations in Ponds 1, 2, and 3 would still be able to mate with each other and reproduce after hundreds of generations of being separated from one another? Explain your answer. HE001627

No, because mutations would occur within each pond, and because these mutations would further differentiate the 3 types of frogs, I don't believe they would be able to reproduce as well.

Level:

Complete (3)

15. The biologist wondered what would happen if the frogs could not easily travel from one pond to another. Do you think the frogs from the populations in Ponds 1, 2, and 3 would still be able to mate with each other and reproduce after hundreds of generations of being separated from one another? Explain your answer. HE001627

No, they would evolve separately too different.

Level:

Partial (2)

Student Sample Responses

15. The biologist wondered what would happen if the frogs could not easily travel from one pond to another. Do you think the frogs from the populations in Ponds 1, 2, and 3 would still be able to mate with each other and reproduce after hundreds of generations of being separated from one another? Explain your answer.

HE001627

They would eventually die because  
there is no diversity, if  
one frog caught a disease  
eventually they would all  
have the disease.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

16. For a long-term ecology study, a meadow in a large forest is divided into two plots. One plot is mowed once a year, while the other plot is not. Describe what each plot will look like after 40 years and justify your answer.

HE001406

The mowed plot will only contain year-old plants, and few new trees. The unmowed plot will have grown trees, and developed its own ecosystem. This will be true because the other plot will be untouched and allowed to develop while the other is mowed.

Level:

Complete (3)

Student Sample Responses

16. For a long-term ecology study, a meadow in a large forest is divided into two plots. One plot is mowed once a year, while the other plot is not. Describe what each plot will look like after 40 years and justify your answer.

HE001406  
One plot would have nice grass while the other would be wild probably containing trees and bushes.

Level:  
Partial (2)

16. For a long-term ecology study, a meadow in a large forest is divided into two plots. One plot is mowed once a year, while the other plot is not. Describe what each plot will look like after 40 years and justify your answer.

HE001406  
The lot that <sup>isn't</sup> mowed will have more life and more variety of plants. —  
The other mowed plot will be bare with hardly any life and only a few types of plants.

Level:  
Unsatisfactory/Incorrect (1)



# SECTION 123

Section 123

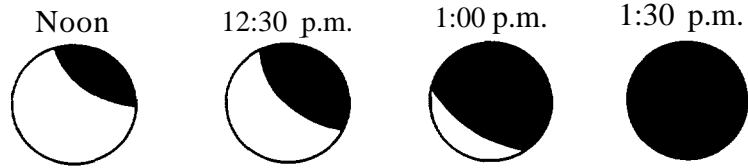
In this section, you will have 30 minutes to answer 16 questions. Mark your answers in your booklet. Fill in only one oval for each question or write your answer on the lines. Please think carefully about your answers. When you are writing your answers, be sure that your handwriting is clear.

Do not go past the **STOP** sign at the end of the section. If you finish before time is called, you should go over your work again.

PLEASE TURN THE PAGE AND BEGIN NOW.

GO ON TO THE NEXT PAGE 

Section 123



1. Four stages in the progression of a solar eclipse are shown above.  
How would the eclipse most likely look at 2:00 p.m.?  
HE001802



2. The color of a star provides a measure of its

- (A) size
- (B) mass
- (C) composition
- (D) surface temperature

HE001693

Questions 3-4 are based on the following situation and data table.

A laboratory technician places red blood cells into three different solutions. Observations are recorded each minute for five minutes.

Solution	Time				
	1 min.	2 min.	3 min.	4 min.	5 min.
Solution 1	No change	Cells are slightly larger.	Cells are much larger.	Cells are huge.	Cells are gone.
Solution 2	No change	No change	No change	No change	No change
Solution 3	No change	Cells are slightly smaller.	Cells are much smaller.	Cells look wilted.	Nothing that looks like a cell can be found.

HE001894

3. Which of the following best explains what is causing the red blood cells in solution 1 to change size over the five-minute period?

- Ⓐ Solvent is entering the cells faster than it is leaving the cells.
- Ⓑ Solute is entering the cells faster than it is leaving the cells.
- Ⓒ The cells are making new protein.
- Ⓓ The cell membranes are dissolving.

HE001895

4. The laboratory technician concludes that red blood cells cannot function in any fluid except serum. Which of the following best characterizes this conclusion?

- Ⓐ It is accurate on the basis of the information given.
- Ⓑ It is accurate because the cells changed in all the solutions but one.
- Ⓒ It is inaccurate because the cells were outside the body.
- Ⓓ It cannot be substantiated with the data provided.

HE001896

Section 123

5. You live along a major river, and your farm was flooded this spring. There are many larger farms and a few factories upriver that were also flooded. Provide two flood-related reasons for testing your soil before planting this year.

HE001794

---

---

---

---

---

6. You are taking ice cream in a cooler to a picnic and want to keep the ice cream colder than 0°C for several hours.

How could you do this?

---

---

---

---

---

Explain how your method works.

VK000016

---

---

---

---

---

7. Heart disease is a major cause of death in the United States. Describe two ways a person can reduce the risk of heart disease. HE001717

---

---

---

---

---

8. A person has just returned to the United States from the tropics and is found to have malaria. What is the risk of other people catching the disease from this person?

Explain your answer.

VK000013

---

---

---

---

---

Section 123

9. Amniocentesis can be used to detect which of the following in a fetus?

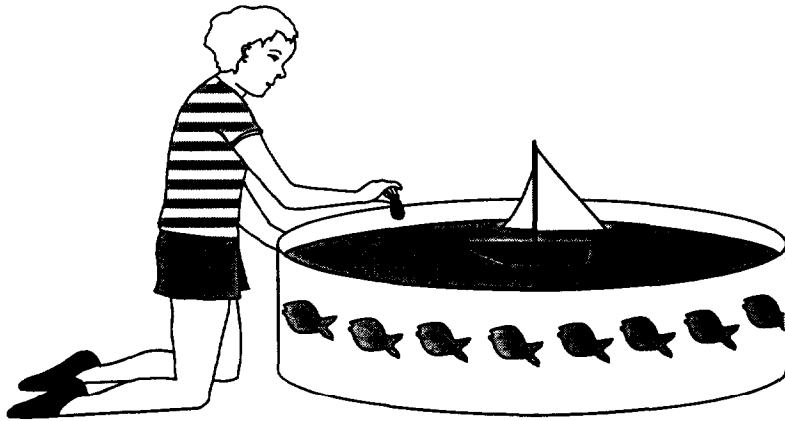
- Ⓐ Cholera
- Ⓑ Down syndrome
- Ⓒ Measles
- Ⓓ Acquired immunodeficiency syndrome (AIDS)

VK000036

10. Of the following statements, which best supports the continental drift theory?

- Ⓐ All oceans are salty.
- Ⓑ Igneous rocks are found on all continents.
- Ⓒ Fossils of the same species of extinct land plants have been found in both South America and Africa.
- Ⓓ Early humans migrated to North America over a land bridge from eastern Asia.

HE001789



11. A toy boat is floating in a wading pool. A child drops a stone into the pool to make small waves. How does the boat move in the presence of these waves?

---

---

Why does it move in this way?

HE001863

---

---

---

---

---

12. An airplane is flying at a speed of 170 meters per second (m/s) relative to the ground. A flight attendant is walking at a speed of 2 meters per second to the rear of the plane. Relative to the ground, the flight attendant has a speed of

- A 2 m/s
- B 168 m/s
- C 170 m/s
- D 172 m/s

VK000030

Section 123

13. List two specific types of problems or damage to houses and cars that can occur from subfreezing temperatures. Explain how each type of problem or damage can be prevented from happening by using means other than direct heat.

VK000017

---

---

---

---

---

14. Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

---

---

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

HE001722

---

---

---

---

---

---

---

---

---

---



15. The petroleum fields on the North Slope of Alaska are a major energy source. What does the presence of these fields indicate about the climate and ecology of the North Slope millions of years ago?

Climate:

---

---

---

Ecology:

HE001791

---

---

---

16. A mother with attached earlobes and a father with free earlobes have 5 children – 4 boys and 1 girl. All of the children have the father's type of earlobes. What can be predicted about the genotype of the father? Construct a genetic diagram to support your prediction. What additional information, if any, would you need to determine the genotype of the father? Explain.

HE001855

---

---

---

---

---

---

---

---

---

---

---



**INFORMATION ABOUT THE FRAMEWORK CLASSIFICATION CODES  
AVAILABLE FOR EACH ITEM**

Following this description of the classification codes, there is a single sheet with NAEP ID numbers, short descriptions of the items, item keys(1-4 if the item is multiple-choice; blank if the item is open-ended), as well as the mean p-values for the items in the released block.

The classification codes for each item can be viewed within each item in the scoring guide.

- Field 1)                    Program Profile:**  
N27S NAEP, year 27 of Science
- Field 2)                    Grade:**  
1            Grade 4 only item  
1/2        Grade 4/8 overlap item  
2            Grade 8 only item  
2/3        Grade 8/12 overlap item  
3            Grade 12 only item
- Field 3)                    Field of science:**  
P S        Physical Science  
E S        Earth Science  
L S        Life Science  
**Field science of subcontent area:**  
*The letter corresponds to the subcontent areas described in the Science Assessment and Exercise specifications for the 1996 National Assessment of Educational Progress.*
- Field 4)                    Physical Science:**  
A        Matter and Its Transformations  
B        Energy and Its Transformations  
C        Motion  
**Earth Science:**  
A        Solid Earth (lithosphere)  
B        Water (hydrosphere)  
C        Air (atmosphere)  
D        Earth in Space  
**Life Science:**  
A        Change and Evolution  
B        Cells and Their Functions  
C        Organisms  
D        Ecology
- Field 5)                    Ways of knowing and doing science:**  
S I        Scientific Investigation  
P R        Practical Reasoning  
C U        Conceptual Understanding

**Field 6)**

**Theme:**

SYS Systems

MOD Models

PC Patterns of Change

NA Not Applicable

**Field 7)**

**Nature of Science/Technology:**

NS Nature of Science

NT Nature of Technology

NA Not Applicable

**Field 8)**

**Item Type:**

MC Multiple-Choice

SCR Short Constructed-Response

ECR Extended Constructed-Response

NA Not Applicable

# 1996 Science Items

GRADE: 12    BLOCK: 27S20

<u>ITEM</u>	<u>NAEP ID</u>	<u>SHORT DESCRIPTION</u>	<u>KEY</u>	<u>CONTENT</u>	<u>PROCESS</u>	<u>P-VALUE</u>	<u>RELEASE STATUS</u>
1	K057101	RECOGNIZE ECLIPSE PROGRESSION MC	3	2	3	0.804	P
2	K057201	PROPERTY SHOWN BY STAR COLOR MC	4	2	3	0.572	P
3	K057301	CAUSE OF SIZE CHANGE OF CELLS IN FLUID MC	1	3	1	0.330	P
4	K057302	CELLS IN FLUID: ACCURACY OF CONCLUSION MC	4	3	1	0.431	P
5A	K057401	TESTING SOIL AFTER FLOOD OE		2	2	0.521	P
6A	K057501	HOW TO KEEP ICE CREAM COOLER THAN 0xC OE		1	2	0.219	P
7A	K057601	HOW TO REDUCE RISK OF HEART DISEASE OE		3	2	0.757	P
8A	K057701	RISK OF INFECTION FROM PEROSN WITH MALARIA OE		3	2	0.112	P
9	K057801	USE OF AMNIOCENTESIS MC	2	3	3	0.639	P
10	K057901	EVIDENCE FOR CONTINENTAL DRIFT THEORY MC	3	2	3	0.576	P
11A	K058001	EFFECT OF WAVES ON BOAT MOVEMENT OE		1	3	0.157	P
12	K058101	RELATIVE SPEED OF FLIGHT ATTENDANT MC	2	1	3	0.403	P
*13A	K058201	HOW TO PREVENT DAMAGE BY SUBFREEZING TEMPS OE					
14A	K058301	ENERGY TRANSFORMATIONS AND ENERGY DIFFS OE		1	2	0.162	P
15A	K058401	CLIMATE/ECOLOGY OF ALASKA LONG AGO OE		2	3	0.375	P
16A	K058501	GENOTYPE PRDCTN BASED ON EARLOBE PHENOTYPE OE		3	3	0.278	P

Content: 1 = Physical Sciences  
 2 = Earth & space sciences  
 3 = Life sciences

Process: 1 = Scientific investigation  
 2 = Practical reasoning  
 3 = Conceptual understanding

## Information about the Item Difficulty Available for Each Item

---

Item identification, a short item description, and the key (for multiple-choice items) are provided, in addition to information about the item difficulty, for each item. The items are identified by their position within a block and by their NAEP IDs. The NAEP IDs are used to identify items during the analysis of NAEP data in the summary of item level results in data almanacs, and in the secondary user data sources.

The numbers in the column labeled “P-Value” on the item statistic sheet vary for item types (multiple-choice and 2-category constructed-response items and constructed-response items with more than two categories). For the multiple-choice items and for the 2-category constructed-response items that were scored correct or incorrect the number in that column is the percent of students correctly responding to the item. This value is often called the p-value or the P+ for an item. For constructed-response items with more than two categories, the value in the column is the mean item score for the item.

For example, if the number of categories for a constructed-response item is 3 with a category/unsatisfactory/incorrect (category 1) worth 0 points, a partial category (category 2) worth 1/2 of a point and a complete category (category 3) worth 1 point, then a student can receive either 0, 1/2 or 1 point for his response to the item. The mean item score is the number that you would get if the scores on this item are averaged for all of the students in the assessment. This value varies from 0 to 1 just as the percent correct for a multiple-choice item could vary. It can be interpreted as an indication of where on the 0-1 scale for the item that an “average” student might score. For instance, if the mean item score for a 3-category constructed-response item is .8, then an “average” student would be expected to have a response in either category 2 (worth 1/2 or .5 of a point) or category 3 (worth 1 point). In fact it is a little more likely that the student would have a response in category 3, since .8 is closer to 1.0 than to .5.

Item Number: 1 Accession Number: HE001802

Key: C

Classification Codes:

N27S 3 ES D CU SYS NA MC

Item Number: 2 Accession Number: HE001693

Key: D

Classification Codes:  
N27S 3 ES D CU PC NA MC

Item Number: NONE Accession Number: HE001894

Key: NONE

Classification Codes:

N27S 3 LS B SI SYS NS NA



Item Number: 3 Accession Number: HE001895

Key: A

Classification Codes:

N27S 3 LS B SI SYS NS MC

Item Number: 4 Accession Number: HE001896

Key: D

Classification Codes:

N27S 3 LS B SI SYS NS MC

Item Number: 5 Accession Number: HE001794

Key: NONE

Classification Codes:  
N27S 3 ES B PR PC NT SCR

### Scoring Guide

**Scoring Rationale:** Student can synthesize knowledge of human activities and overuse of soil additives with the effect of natural processes, like flooding and erosion.

**3 = Complete** - Student response indicates two distinct reasons for testing the soil.

**2 = Partial** - Student response indicates one reason for testing the soil.

**1 = Unsatisfactory/Incorrect** - Student response shows no correct reasons for testing the soil.

#### Credited responses include:

Large amounts of pesticides or fertilizers from the farms may have been washed into the soil by flood waters.

Toxins carried by the floods from the factories may pollute the soil (poison, tainted, leak).

Erosion or loss of top soil may have occurred (e.g., sediments).

Nutrients in topsoil may have been washed out (e.g., minerals).

Nutrients may have been added to the soil by deposition (e.g., manure with change in pH) River water may have more salts in it than usual due to farms and factories. As water subsides many of these salts may remain in the soil.

Acid rain properties - changes in pH or acidic water.

Item Number: 6 Accession Number: VK000016

Key: NONE

Classification Codes:  
N27S 3 PS A PR PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of temperature and states of matter by describing and explaining a practical method of keeping ice cream below the temperature of 0°C for several hours .

**3 = Complete** - Student response provides a correct method and satisfactorily explains how it works.

**2 = Partial** - Student response provides a correct method but is unable to explain how it works.

**1 = Unsatisfactory/Incorrect** - Student response provides no method or an incorrect method for keeping the ice cream cool. No indication of sub-zero temperature requirements.

### Credited responses include:

Add salt to the cooler (may specifically mention rock salt). As the ice melts, the salt dissolves in the water, lowering its freezing point. As the salt water gives up its heat to the melting ice, the water's temperature is lowered.  
Add dry ice to the cooler. The temperature of dry ice is lower than 0°C.  
Add another layer of insulation. The insulation prevents the heat outside from entering the cooler, the temperature in the cooler remains constant. Must be explicit about making the ice or ice cream cold first.

Item Number: 7 Accession Number: HE001717

Key: NONE

Classification Codes:  
N27S 3 LS C PR SYS NS SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of how heart disease can be prevented.

**3 = Complete** - Student response describes two ways in which heart disease can be prevented, such as those below.

**2 = Partial** - Student response describes one way in which heart disease can be prevented.

**1 = Unsatisfactory/Incorrect** - Student response shows no understanding of how heart disease can be prevented.

Credited responses include:

Getting more exercise, regular exercise

Reducing stress/relaxing

Eating less saturated fat/avoiding greasy food

Item Number: 8 Accession Number: VK000013

Key: NONE

Classification Codes:  
N27S 3 LS C PR NA NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the cause and transmission of malaria.

**3 = Complete** - Student response states that malaria is spread by mosquitoes and states that a mosquito must bite the infected person and then bite an uninfected person for the disease to be transmitted.

**2 = Partial** - Student response states that malaria is spread by mosquitoes but does not connect it to the person in the question or student has a general sense of what causes malaria.

**1 = Unsatisfactory/Incorrect** - Student response demonstrates no understanding of the cause and transmission of malaria.

Item Number: 9 Accession Number: VK000036

Key: B

Classification Codes:  
N27S 3 LS

A

CU

NA

NA

MC

Item Number: 10 Accession Number: HE001789

Key: C

Classification Codes:

N27S 3 ES D CU MOD NA MC



Item Number: 11 Accession Number: HE001863

Key: NONE

Classification Codes:  
N27S 3 PS C CU PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates ability to recognize the direction of movement and is able to explain why the boat moves in this way.

**3 = Complete** - Student response indicates that the boat moves up and down and explains that the stone sets up vibrations that cause the molecules to vibrate in a vertical direction.

**2 = Partial** - Student response indicates that the boat moves up and down (or rocks back and forth) and gives an incomplete or no explanation.

**1 = Unsatisfactory/Incorrect** - Student response fails to indicate the correct direction of movement and gives no indication of a correct explanation.

Item Number: 12 Accession Number: VK000030

Key: B

Classification	Codes:					
N27S 3	PS	C	CU	NA	NA	MC

Item Number: 13 Accession Number: JL001117

Key: NONE

Classification Codes:  
N27S 3 LS C SI NA NS SCR

**Scoring Guide:** 13a, 13b, and 13c, will be scored separately.

**Scoring Rationale:** Student demonstrates an ability to use the information in the table to determine whether statements are true or false.

### 13a

**3 = Complete** - Student response correctly identifies the statement as true, and provides supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true, or false, but no explanation is given.

Credited responses include:

Porpoises can make sounds up to 120,000 hertz, but frogs can only hear up to 10,000 hertz, or porpoise can make sounds too high, too fast, or at a greater frequency for frogs to hear. Frogs can't hear upper range of porpoises.

### 13b

**Scoring Rationale:** Student demonstrates an ability to use the information in the table to determine whether statements are true or false.

**3 = Complete** - Student response correctly identifies the statement as false, and provides supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true or false, but no explanation is given.

Credited responses include:

Humans can hear all the sounds (everything) that frogs can make. The frog sounds that porpoises can hear can also be heard by humans.

### 13C

**Scoring Rationale:** Student demonstrates an ability to use the information in the table to determine whether statements are true or false.

**3 = Complete** - Student response correctly identifies the statement as true, and provides supporting evidence.

**1 = Unsatisfactory/Incorrect** - Student response identifies the statement as true or false, but no explanation is given.

Credited responses include:

Frogs can hear over a range of almost 10,000 hertz, but people only produce sounds over a range of about 1,000 hertz.

Item Number: 14 Accession Number: HE001626

Key: NONE

Classification Codes:  
N27S 3 LS A CU PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an understanding of the factors that affect the formation of new species by evaluating the information in the table and drawing reasonable conclusions about whether the three frog populations represent 1, 2, or 3 species.

**3 = Complete** - Student states that the information in the table regarding reproduction is the essential information needed to determine that the three frog populations represent one species since they can all mate with each other and reproduce.

**2 = Partial** - Student concludes that the three frog populations are all one species, but includes information such as color with statement on reproduction.

**1 = Unsatisfactory/Incorrect** - Student concludes that the three frog populations represent three different species because they have different physical appearances. (Reproduction is not included.)

Item Number: 15 Accession Number: HE001627

Key: NONE

Classification Codes:  
N27S 3 LS A CU PC NA SCR

### Scoring Guide

**Scoring Rationale:** Student can evaluate data and apply an understanding of the effects of population isolation to predict whether the three frog populations could still mate and reproduce after a period of isolation.

**3 = Complete** - Student responds that the three populations may have changed enough during isolation so that they can no longer reproduce - but it depends on how much genetic change they accumulate (mutations). Student may explain that the population in Pond 3 is the “best candidate” for this change because these frogs already differ in their mating behavior (where they look for mates), and, therefore, might become unable to mate and produce viable young with the other populations after a shorter “period of time.”

**2 = Partial** - Student predicts that because of a period of isolation, the three frog populations may have changed enough so that they can no longer interbreed, or alternatively, student may state that the three frog populations might not have been isolated long enough for three separate species to form. A limited explanation is included such as “they would evolve separately.”

**1 = Unsatisfactory/Incorrect** - Student does not provide an explanation that can justify his/her answer, or student states that the three populations will still be able to mate and reproduce because populations do not change over time.

Item Number: 16 Accession Number: HE001855

Key: NONE

Classification Codes:

N27S 3 LS A CU PC NA ECR

### Scoring Guide

**Scoring Rationale:** Student demonstrates an ability to predict what the father's genotype might be and list further information that could be used to determine his genotype.

**4 = Complete** - Student response addresses the three elements listed below.

**3 = Essential** - Student response addresses two of the three elements listed below.

**2 = Partial** - Student response addresses one of the three elements listed below.

**1 = Unsatisfactory/Incorrect** - Student response addresses none of the elements listed below.

Credited responses include:

Major elements:

a. Free earlobes dominant

b. For Punnet Square: the father's genotype is probably homozygous dominant (LL or FF, etc.) The mother's genotype is probably homozygous recessive (ll or ff, etc.)

All the children will be Ll, which explains why they all have ears like the father.  
c. Additional information about the father's parents genotypes would help determine his genotype ("background information" not specific enough for credit) .

Student Sample Responses

5. You live along a major river, and your farm was flooded this spring. There are many larger farms and a few factories upriver that were also flooded. Provide two flood-related reasons for testing your soil before planting this year.

HE001794

Test to make sure there are no toxins in the soil from the factories, and to make sure the nutrients are still in the soil.

Level:  
Complete (3)

For one the RIVER could have picked up about any thing from going over its NORMAL Boundaries. For two the factories could have contaminated the water in THE RIVER,

Level:  
Partial (2)

5. You live along a major river, and your farm was flooded this spring. There are many larger farms and a few factories upriver that were also flooded. Provide two flood-related reasons for testing your soil before planting this year.

HE001794

1. If the soil is moist it is most likely that much rainfall occurs there.
- 2.

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

6. You are taking ice cream in a cooler to a picnic and want to keep the ice cream colder than  $0^{\circ}\text{C}$  for several hours.

How could you do this?

Put ice all around it, then add  
Rock salt to it

Explain how your method works.

VK000016

It makes the freezing point  
much lower.

Level:  
Complete (3)



Student Sample Responses

6. You are taking ice cream in a cooler to a picnic and want to keep the ice cream colder than  $0^{\circ}\text{C}$  for several hours.

How could you do this?

You can keep it cooler  
by adding salt. Pouring  
the salt over the ice will  
help preserve the ice

Explain how your method works.

VK000016

Because of the Na present  
in the salt. And the different  
temperatures.

Level:

Partial (2)

Student Sample Responses

6. You are taking ice cream in a cooler to a picnic and want to keep the ice cream colder than  $0^{\circ}\text{C}$  for several hours.

How could you do this?

Pack the ice cream in ice and do not open the ice chest until you are ready to eat to ice cream.

Explain how your method works.

VK000016

The ice which is at freezing point, will keep the ice cream cold.

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

7. Heart disease is a major cause of death in the United States. Describe two ways a person can reduce the risk of heart disease. HE001717

You can reduce the risk by cutting down on your fat intake, watching what you eat and not smoking. (Try not to be around secondhand smoke, etc.)

Level:  
Complete (3)

7. Heart disease is a major cause of death in the United States. Describe two ways a person can reduce the risk of heart disease. HE001717

people can watch what they eat and kick away bad habits such smoking or eating lots of junk food.

Level:  
Partial (2)

7. Heart disease is a major cause of death in the United States. Describe two ways a person can reduce the risk of heart disease. HE001717

- Watching what they eat  
- Going to the doctor for check ups

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

8. A person has just returned to the United States from the tropics and is found to have malaria. What is the risk of other people catching the disease from this person?

The risk would be small.

Explain your answer.

VK000013

Malaria is spread through bodily fluids. The only way someone else would catch it is through physical contact involving bodily fluids or if the infected person was bitten by a mosquito and the mosquito bit someone else.

Level:

Complete (3)

Student Sample Responses

8. A person has just returned to the United States from the tropics and is found to have malaria. What is the risk of other people catching the disease from this person?

Malaria is a disease <sup>has ~~a few~~ some risk to</sup> others. Not much.

Explain your answer.

VK000013

Malaria is usually caught from  
mosquitos in swampy areas. Blood to  
blood contact will spread this disease.  
from one to another.

Level:  
Partial (2)

8. A person has just returned to the United States from the tropics and is found to have malaria. What is the risk of other people catching the disease from this person ?

1/100.

Explain your answer.

VK000013

Because of the vaccines  
that are provided in the  
United States.

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

11. A toy boat is floating in a wading pool. A child drops a stone into the pool to make small waves. How does the boat move in the presence of these waves?

It waves up and down and may move  
away from the boy

Why does it move in this way?

HE001863

The boat moves this way because of  
the wave motion.

Level:  
Partial (2)

11. A toy boat is floating in a wading pool. A child drops a stone into the pool to make small waves. How does the boat move in the presence of these waves?

in the opposite direction it was  
originally traveling.

Why does it move in this way?

HE001863

Because the force of the wave pushing  
against the boat is greater  
than the force holding it.

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

14. Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

The fire burns the coal, which releases stored energy,  
which heats steam, which powers a reactor, which produces  
electricity, which travels to the light bulb, which produces  
light.

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

HE001722

All amount of energy decreases with each  
transformation because some is lost and is  
used up each time.

Level:

Complete (4)

Student Sample Responses

14. Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

Coal is burned to heat water to steam to turn a generator to make electricity which is sent to house.

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

HE001722

The amount of energy burned by the light bulb is very small next to the total power of the house. Which is in turn much weaker than total energy of the power plant.

Level:  
Essential (3)



Student Sample Responses

14. Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

stored → heat → kinetic

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

HE001722

The energy is the same it is just in a different form.

Level:  
Partial (2)

Student Sample Responses

14. Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

The light bulb gets energy  
From the power plant

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

HE001722

The coal releases a lot of energy;  
The power plant receives a lot of  
energy, The light bulb produces  
a little bit of energy

Level:

Unsatisfactory/Incorrect (1)

Student Sample Responses

15. The petroleum fields on the North Slope of Alaska are a major energy source. What does the presence of these fields indicate about the climate and ecology of the North Slope millions of years ago?

Climate:

The climate on the North Slope was probably very warm and swampy.

Ecology:

HE001791

There were numerous plants and animals living on the North Slope millions of years ago.

Level:  
Complete (3)

Student Sample Responses

15. The petroleum fields on the North Slope of Alaska are a major energy source. What does the presence of these fields indicate about the climate and ecology of the North Slope millions of years ago?

Climate:

Before all the ice it believe  
it was warm

Ecology:

HE001791

The ice was at one time as  
large as large body of fresh  
water,

Level:  
Partial (2)

15. The petroleum fields on the North Slope of Alaska area major energy source. What dots the presence of these fields indicate about the climate and ecology of the North Slope millions of years ago?

Climate:

Very cold temp

Ecology:

HE001791

Very rich soil

Level:  
Unsatisfactory/Incorrect (1)

Student Sample Responses

16. A mother with attached earlobes and a father with free earlobes have 5 children — 4 boys and 1 girl. All of the children have the father's type of earlobes. What can be predicted about the genotype of the father? Construct a genetic diagram to support your prediction. What additional information, if any, would you need to determine the genotype of the father? Explain.

The father has a homozygous free earlobe trait.

Assuming free is dominant and attached is recessive

father	mother
FF	aa

all children have F<sub>a</sub> trait.

Free is dominant, so all children have free earlobes.

It would also be helpful to know the genotypes of the father's parents.

Level:  
Complete (4)

Student Sample Responses

16. A mother with attached earlobes and a father with free earlobes have 5 children—4 boys and 1 girl. All of the children have the father's type of earlobes. What can be predicted about the genotype of the father? Construct a genetic diagram to support your prediction. What additional information, if any, would you need to determine the genotype of the father? Explain.

HE001855

The father has the dominant trait for earlobes while the mother has the recessive gene.

Father  $EE$                       Mother  $ee$

	$E$	$e$	
$e$	$Ee$	$Ee$	therefore all the children would have both dominant and recessive genes for the attachment of the earlobes, but the dominant gene is the one that is shown.
$e$	$Ee$	$Ee$	

Level:  
Essential (3)

Student Sample Responses

16. A mother with attached earlobes and a father with free earlobes have 5 children—4 boys and 1 girl. All of the children have the father's type of earlobes. What can be predicted about the genotype of the father? Construct a genetic diagram to support your prediction. What additional information, if any, would you need to determine the genotype of the father? Explain.

HE001855  
The father's genotype is more dominant.

Level:  
Partial (2)

16. A mother with attached earlobes and a father with free earlobes have 5 children — 4 boys and 1 girl. All of the children have the father's type of earlobes. What can be predicted about the genotype of the father? Construct a genetic diagram to support your prediction. What additional information, if any, would you need to determine the genotype of the father? Explain.

HE001855  
That the father genes are stronger than the mother genes.

Level:  
Unsatisfactory/Incorrect (1)