

MHSA Science – March 2013

Science Grade 11

The table below shows the entire eleventh-grade science test design. Scores are based on common items only, half of which are released and can be found in this document.

Test Design

CONTENT AREA	COMMON		FIELD TEST ITEMS		TOTAL ITEMS PER STUDENT		BASE TESTING TIME	POINTS
	MC	CR	MC	CR	MC	CR		
SCIENCE	40	4	8	1	48	5	120 MIN.	56

Each item on the MHSA measures a content standard of Maine's 2007 *Learning Results*.

Science Content Standards Assessed on the MHSA

D. The Physical Setting

1. Universe and Solar System
2. Earth
3. Matter and Energy
4. Force and Motion

E. The Living Environment

1. Biodiversity
2. Ecosystems
3. Cells
4. Heredity and Reproduction
5. Evolution

Item Information Chart

Please refer to the item information chart on the next page for in-depth information on each science released item. The released item numbers in the chart correspond to item numbers in the practice test and on the MHSA Class Analysis Report.

Constructed-Response Scoring Guides

A constructed-response scoring guide includes score point descriptions used to determine the score. Training notes that follow the scoring guide provide in-depth descriptions or particular information also used to determine the score.

Student Work

At least one sample student response is provided for each score point with annotations that explain the reasoning behind the assigned score.

MHSA Science Released Item Information

Released Item Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Practice Test Page Number	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	6	6
Content Strand (Maine 2007 Learning Results)	D2	E4	D4	E3	E2	D3	D3	D2	D3	E3	D4	D3	D3	E4	E2	E3	D4	D1	D4	D3	E1	D3
Depth of Knowledge Code	1	2	2	1	2	1	2	1	1	1	2	1	2	2	1	2	2	2	2	3	3	3
Item Type	MC	CR	CR																			
Possible Points	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4
Answer Key	C	B	D	C	D	A	D	B	B	A	B	B	C	A	D	A	A	D	D	C		
% Who Chose A or Earned 1 Point	19	14	9	9	7	51	10	6	7	69	30	5	18	68	4	62	20	42	5	6	20	42
% Who Chose B or Earned 2 Points	10	34	12	19	29	8	40	63	65	7	37	82	7	4	8	10	67	9	13	37	39	17
% Who Chose C or Earned 3 Points	52	21	10	52	4	25	16	23	7	17	13	6	57	5	5	19	7	20	25	36	25	5
% Who Chose D or Earned 4 Points	18	25	65	15	55	8	25	7	17	5	15	6	15	20	83	6	3	22	53	15	8	1
Statewide Average Student Score																					2.05	0.94

Content Strands: See "MDOE Regulation 132--Learning Results: Parameters for Essential Instruction" at <http://www.maine.gov/education/lres/pei/index.html>.

Item Type: MC = multiple choice, CR = constructed response

Answer Key: the letter of the correct answer choice

MHSA Science Released Items – Student Work

Constructed-Response Item 21

21. Mudflats are located in calm coastal waters where large areas of mud are exposed between high and low tides. The mudflat ecosystem supports many organisms, including green algae, crabs, snails, and clams. It is a feeding area for many shorebirds. In recent years, some mudflats have been dramatically changed by an invasive species of marsh grass called spartina. Spartina grows in the mud in large solid clumps and is rapidly changing mudflats into grassy marshland.
- Explain why changes to a mudflat ecosystem could affect the organisms living there. Describe an example.
 - Explain why some populations are more likely to survive a permanent change to the mudflats. Describe an example.

Scoring Guide for Constructed-Response Item 21

Score	Description
4	The response demonstrates a thorough understanding of how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will survive in a changing environment. The response explains why changes to a mudflat ecosystem will affect the organisms living there and describes an example. The response also explains why some populations are more likely to survive a permanent change to the mudflats and describes an example. The response has no errors or omissions.
3	The response demonstrates a general understanding of how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species survive in a changing environment. The response has one error or omission.
2	The response demonstrates a partial understanding of how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will survive in a changing environment. The response has errors or omissions.
1	The response demonstrates a minimal understanding of how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will survive in a changing environment. The response is minimal or has one correct piece of information.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 21

- a. Organisms living in a mudflat ecosystem have structural and behavioral characteristics that help them survive in that ecosystem. When the ecosystem changes, the organisms living there may not have the physical or behavioral characteristics that will help them survive in the new ecosystem. Therefore, the population may die out. The response needs to discuss survivability (or lack of). The response needs to include in discussion at least one organism other than *Spartina*.

Response may include, but is not limited to, one of the following examples:

- Clams dig down into mud to avoid predators. When the *Spartina* is growing in the mud, the clams can't dig down and are exposed to predators.
- When *Spartina* takes over, green algae will not get enough sunlight to survive.
- Snails eat green algae for food. When there are no green algae, the snails will not have enough food to survive.
- Shorebirds that eat snails and clams will move to a different area if the snails and clams are gone from the mudflats.
- Young fish and clams that use the mudflats like a nursery will not survive.

- b. The response needs to discuss behavior and/or genetic adaptation. The response may include, but is not limited to, one of the following reasons/examples:

Reason	Example
Populations that are genetically diverse have a better likelihood of surviving changes in their ecosystem because some individuals in the population may have behaviors or structures that give them an advantage in the new ecosystem. They pass on those characteristics to offspring that will more likely survive.	Quickly multiplying bacteria with an adaptation to living with <i>Spartina</i>
Populations that reproduce often or quickly, with many offspring have a better likelihood of surviving changes in their ecosystem because the offspring may genetically adapt.	Quickly multiplying bacteria with an adaptation to living with <i>Spartina</i>
Populations that are not overly specialized, (i.e., have numerous food sources) because individuals have other options for food/shelter even though the environment changed, and populations that have the ability to change behavior in order to survive have a better likelihood of surviving changes in their ecosystem.	If the mudflats cause the snails to die off, the shorebirds would still be able to feed on the crabs and the clams.
Populations with the ability to move to an ecosystem that is more suitable have a better likelihood of surviving changes in their ecosystem.	Shorebirds can fly away to a mudflat that has not been invaded by <i>Spartina</i> .
Populations that are not affected by the change in the ecosystem have a better likelihood of surviving changes in their ecosystem.	Some types of insects may not be affected by the <i>Spartina</i> because there are still enough wet areas for them to survive, though maybe not as well.
Populations that thrive due to changes in the ecosystem have a better likelihood of surviving changes in their ecosystem.	A grassier marshland may provide some types of rodents with better shelter.

Notes:

- Naming an organism in the example without a description receives no credit.
- Categories of organisms are acceptable for the example (i.e., shore birds).

Part (a) and (b) are worth 2 points each.

(A) Changes to the mudflat could cause many issues. For the organisms living there, they might need to have the open environment where they can get the sun directly on them or rain, without being shielded by the *Spartina*. For example algae need sunlight to grow and feed themselves but if the *Spartina* are blocking the algae from getting that sunlight then the algae would die off, but then the other organisms who may have fed off of the algae would die then the organisms who ate them would die, it would be the end to that cycle. (B) Some populations may survive more easily because they may not need all of that sunlight to grow and live. For example most bacteria prefer to grow in damp, cold, or humid conditions this would allow them to grow in that environment more easily.

Summary annotation statement:

This response includes a detailed part (a) with a good discussion of survivability of the food chain in the presence of *Spartina*. In part (b), discussion of adaptation is complete and includes a specific example (bacteria). This response is thorough and receives a score of 4.

a.) If a mudflat ecosystem were to change then it could affect everything living in it because the organisms are used to a specific climate and surroundings and if that were to change then it could be devastating. An example could be if this Spartina destroys the mudflat and turns it into a marshy grassland then a lot of organisms could die and would no longer be food for other creatures.

B.) Some might be able to survive a permanent change because they have adaptations that enable it to. The birds that feed off things in the mudflats could easily fly away to another location or harvest some new food in the new marshland.

Summary annotation statement:

Part (a) of this response contains a good explanation of what would occur, but the example given, "a lot of organisms could die," is too general for full credit. In part (b), the explanation of adaptation is also general but does contain a specific example of what would happen as a result of the change to the mudflats by stating, "the birds...could easily fly away." This response is general overall and receives a score of 3.

The changes to a mudflat ecosystem could affect the organisms living there because the certain organisms living there are used to the surroundings they live in and may not be suitable for these changes. an example would be that clams need water and if grass grows in the mud the grass is soaking up a greater deal of that water.

Some organisms may not be affected by any changes. This happens because some populations are stronger through evolution, meaning they are more able to survive big changes.

Summary annotation statement:

This response gives a good example in part (a) of how clams would be affected but never explicitly states how this change would affect the organisms' survivability within the mudflats. Part (b) refers to adaptation in a limited way by stating, "stronger through evolution" but gives no specific example. Overall this is a limited response and receives a score of 2.

could be affected if mudflats dried up because
living organisms probably wouldn't die without water.
Some populations might survive because they might
adapt to the change.

Summary annotation statement:

This response receives no credit in part (a). The reasoning does not follow a logical path: "if the mudflats dried [dried] up...organisms probably wouldn't die." The second sentence in the response does convey weak understanding of survival due to adaptation. As a result this response is considered minimal and receives a score of 1.

Sample 0-Point Response with Annotations for Constructed-Response Item 21

a. Changes to a mud flat could affect the ecosystems
that live there because there are some ecosystems out
there that can only survive in mud flats. Must monitor!
b. so they can do studies to find new organisms, etc.

Summary annotation statement:

This response contains no information that correctly responds to the question. No credit is earned.

Constructed-Response Item 22

22. A student has a sealed container of helium gas. The student gently heats the container.
- Describe the difference between heat and temperature at the atomic level.
 - Explain how and why the helium gas pressure is affected when the container of helium gas is heated.

Scoring Guide for Constructed-Response Item 22

Score	Description
4	The response demonstrates a thorough understanding of the relationship among heat, temperature, and pressure in terms of the actions of molecules. The response describes the difference between heat and temperature at the molecular level and explains how and why the helium gas pressure is affected when the container of helium gas is heated. The response has no errors or omissions.
3	The response demonstrates a general understanding of the relationship among heat, temperature, and pressure in terms of the actions of molecules. The response has an error or omission.
2	The response demonstrates a partial understanding of the relationship among heat, temperature, and pressure in terms of the actions of molecules. The response has errors or omissions.
1	The response demonstrates a minimal understanding of the relationship among heat, temperature, and pressure in terms of the actions of molecules. The response is minimal or has one piece of correct information.
0	The response is incorrect or contains some correct information that is irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 22

a. Sample response for 2 points:

- Heat is the total amount of kinetic energy of all the atoms in the container. The response must include reference to the container or the system for an overall score of 4. (Heat can be transferred by radiation, conduction, or convection. Heat can be transferred without increasing the temperature of the container. Heat is directly related to the kind of substance, its mass, and the change in (temperature.)
- Temperature is a measure of the average kinetic energy (atomic motion) of atoms in the container. Using only the phrase “average KE” implies measurement.

Sample response for 1 point:

- Heat is energy. Temperature is a measurement of heat energy.

b. Sample response for 2 points:

- The pressure in the container increases. Pressure increases because the atoms have more energy (increased atomic motion), so the atoms of gas hit the sides of the container with a greater force or frequency. The response must include discussion of atoms hitting (colliding with) sides of the container.

Sample response for 1 point:

- The pressure increases because the energy of the atoms increases and the atoms move faster and spread out.

a. Temperature is the average kinetic energy of all particles within a specified system. Heat is the total energy within the system. A bath of cold water has a lower temperature than a glass of hot cocoa but it has a greater amount of heat.

b. Relate to the equation $PV=nRT$, assuming V and n remain constant P and T are the only variables as temperature goes up pressure must go up according to the equation. The pressure goes up because as the gas is heated the particles begin to move around more freely and separate from each other, normally this would cause the volume to expand but as the jar remains at a constant volume all the particles can do is exert more force trying to expand out, increasing the pressure. Think of it as trying to blow a helium balloon up in the jar.

Summary annotation statement:

The explanations of both heat and temperature are correct in this response. Part (b) gives valid reasoning for the increased pressure on the walls of the container using the correct equation. This response is thorough and earns a score of 4.

a) Heat is the amount of energy being added to the atoms, in this case the helium atoms, and temperature is the measure of the amount of energy the atoms are exerting as a result of heat.

b) The pressure in the container is growing steadily as the container is heated. When atoms are heated, or when energy is added to them, they move more rapidly and move more quickly in every direction. The pressure increases because as these atoms move more rapidly, they want a larger space to move in and they bounce off of the container walls at a higher rate, creating greater movement on the inside and for atoms to want to move more freely.

Summary annotation statement:

Part (a) has general definitions of both heat and temperature. Part (b) includes a correct explanation referring to the increased impact of the atoms on the container's walls. Overall this is a general response and earns a score of 3.

a. Heat is an amount of energy, where temperature is the physical state of being hot or cold.

b. The pressure of the gas in the sealed container is directly proportional to temperature of the container. When the container is heated, the temperature increases. The increase of temperature, being directly proportional to the pressure, increases the pressure of the container.

Summary annotation statement:

This response discusses the correct definition of heat but is explained in a limited fashion. The description of temperature in part (a) is incorrect. Part (b) has a reference to the increase of energy within this system but does not discuss collision of particles or why the pressure within the container increases. This is a limited response and receives a score of 2.

@? (b) The helium gas pressure is affected when the container is heated because when things are heated they expand. How this happens: The molecules and atoms within the helium, when not heated, move around at a normal pace, when heated up, they move faster and faster.

Summary annotation statement:

Part (a) was not attempted in this response. Part (b) has a correct identification of the increased pressure but does not discuss how increased atomic impacts within the container leads to the increase in pressure. This response is minimal and receives a score of 1.

a. Heat is what makes temperature. So depending on how much heat you apply would make the temperature go up.

b. Because helium is a very dangerous gas so basically its very sensitive. and when heated up or tipped over theres a good chance it would explode.

Summary annotation statement:

Neither part of this response earns credit. There is no discussion of energy and its effects at the atomic level.