Test Design and Navigation

- Screen is split vertically, scene on left and questions on right
- Multiple questions can be on the right side of the screen which requires vertical scrolling
- Students are required to answer all questions on a page before they can go on, but they can mark individual questions for later review
- A review screen at the end of the test reminds students about the questions they marked for review and provides an opportunity to review any questions taken during the current testing period
- Text-to-speech (TTS) in most cases replaces the recorded audio which auto-played in MCA-II. Students select the text they want to hear aloud. Accommodated text is available for graphics and tables, but needs to be part of the student’s IEP or ELL designation
- Online tools include a highlighter and strike-through font options, a zoom in/out function and a calculator.
- All items in the item samplers are worth one point unless otherwise noted on individual items.
Purpose of the Item Samplers

Item samplers are provided to help teachers and students become familiar with the format and type of content included in the MCAs. Item samplers contain fewer items than an actual full-length test and are aligned to the Minnesota Academic Standards. They are not suitable for predicting how students will perform on the MCAs.

For more information on the proportions of items aligned to each standard and clarifications on how each standard will be assessed, see the MCA-III Test Specifications for Science at http://www.education.state.mn.us/MDE/EdExc/Testing/TestSpec/index.html.

In order to have students experience the new Text-to-Speech functionality, use the Secure Browser. This browser can be found at www.mnstateassessments.org along with other testing resources, like the item samplers and the Online MCA Tutorials. Text-to-Speech replaces many of the recorded audio files that were used in the MCA-II program.

Cognitive Complexity

Cognitive complexity refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the type and level of thinking and reasoning required of the student on a particular item. MCA-III levels of cognitive complexity are based on Norman L. Webb’s Depth of Knowledge\(^1\) levels. Although certain verbs, such as “recall,” “classify” or “reason,” are commonly associated with specific cognitive levels, Webb’s Depth of Knowledge (DOK) levels are not determined by the verbs that describe them, but rather the contexts in which the verbs are used and the depth of thinking required.

DOK 1 (recall) items require the recall of information such as a fact, definition, term or simple science process or procedure.

DOK 2 (skill/concept) items call for the engagement of some mental processing beyond a habitual response, with students required to make some decisions as to how to approach a problem or activity.

DOK 3 (strategic thinking) items require students to reason, plan or use evidence to solve a problem.

The MCA-III Science Test Specifications give a more detailed explanation of DOK levels used in the MCA-III assessments.

If you have further questions concerning the MCA Science Assessments please contact the following MDE staff:

Dawn Cameron, dawn.cameron@state.mn.us, 651-582-8551

Jim Wood, jim.wood@state.mn.us, 651-582-8541
Scenario: How Does a Garden Grow

Question 1

Benchmark:

7.4.2.1.3- Explain how the number of populations an ecosystem can support depends on the biotic resources available as well as abiotic factors such as amount of light and water, temperature range and soil composition.

DOK: 1

Answer: B

Rationale: Bacteria are living and therefore this factor is biotic.
Question 2

Benchmark:

7.4.2.2.1- Recognize that producers use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

DOK: 1

Answer: From the Sun="light"; To the air="oxygen"; From the air="carbon dioxide"; Through the roots="water".

The student is planning an experiment to determine how the amount of light a pepper plant receives affects the amount of fruit it produces. To prepare for her experiment, she reviews photosynthesis and why it is important in making fruit. She draws a diagram of a pepper plant and all the parts of photosynthesis.
Question 3

Benchmark:

7.1.3.4.2-Determine and use appropriate safety procedures, tools, measurements, graphs and mathematical analyses to describe and investigate natural and designed systems in a life science context.

DOK: 2

Answer: one single line showing an increase in the mean mass of the plant as the hours of light per day increases.

The student tests how the amount of light a pepper plant receives affects the mass of the plants. She sets up 9 pots, each with 1 pepper plant. The plants are divided into 3 groups with 3 plants in each group. The first group receives 8 hours of light per day. The second group receives 12 hours of light per day. The third group receives 18 hours of light per day.

After 10 weeks, the student measures the mass of each plant and averages the results for each group. She notices that the more light her pepper plants received, the more mass they had. Use the Connect Line tool to graph a single line that shows the trend for her results.

Which variables in this investigation are controlled?
Question 4

Benchmark:

7.1.1.2.2 Plan and conduct a controlled experiment to test a hypothesis about a relationship between two variables, ensuring that one variable is systematically manipulated, the other is measured and recorded, and any other variables are kept the same (controlled). For example: The effect of various factors on the production of carbon dioxide by plants.

DOK: 1

Answer: “The number of pots in each group” AND “The number of plants per pot” AND “The type of plant” are selected.
Scenario: Properties of Matter Investigation

Question 5

Benchmark:

6.2.1.2.2 Describe how mass is conserved during a physical change in a closed system. For example: The mass of an ice cube does not change when it melts.

DOK: 2

Answer: “Mass” AND “Phase” AND “Volume” are selected

Rational: Pouring water into a different container will only result in a change of shape since there is no chemical reaction occurring or change in temperature resulting in a phase change.
Question 6

Benchmark:

6.2.3.2.3- Describe how heat energy is transferred in conduction, convection and radiation.

DOK: 1

Answer: B

Rationale: Convection involves the transfer of heat in liquids and gases.

In order to compare the effect of temperature on the dissolving rate of sugar, the students prepare 3 beakers of water at different temperatures, one at 30°C, one at 60°C, and one at 90°C.

Which method of heat transfer is shown by the arrows?

- Conduction
- Convection
- Precipitation
- Radiation
Question 7

Benchmark:

6.2.1.1.1- Explain density, dissolving, compression, diffusion and thermal expansion using the particle model of matter.

DOK: 2

Answer: B

Rationale: The molecules of the sugar cube are broken down into individual sugar molecules and are absorbed into the spaces between the water molecules.
Question 8

Benchmark:

6.2.1.2.3- Use the relationship between heat and the motion and arrangement of particles in solids, liquids and gases to explain melting, freezing, condensation and evaporation.

DOK: 2

Answer: B

Rationale: After heating, water has evaporated and changed to water vapor.
Question 9

Benchmark:

8.2.1.2.2- Distinguish between chemical and physical changes in matter.

DOK: 2

Answer: D

Rationale: A physical change has taken place because the sugar can be separated from the water by another physical process (evaporation).
Question 10

**Benchmark:**

6.1.3.4.1- Determine and use appropriate safe procedures, tools, measurements, graphs, and mathematical analyses to describe and investigate natural and designed systems in a physical science context.

**DOK:** 1

**Answer:** Left bar to 30 seconds, middle bar to 15 seconds, and right bar to 5 seconds

The data that was recorded from dissolving sugar is shown in the table below.

<table>
<thead>
<tr>
<th>Sugar Water Experiment</th>
<th>Beaker 1</th>
<th>Beaker 2</th>
<th>Beaker 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>30°C</td>
<td>60°C</td>
<td>90°C</td>
<td></td>
</tr>
<tr>
<td>30 sec</td>
<td>15 sec</td>
<td>5 sec</td>
<td></td>
</tr>
</tbody>
</table>

The data show results of the experiment. Make a graph of this data. Click on a point above each bar where the top of the bar should be.
Question 11

**Benchmark:**

8.1.1.2.1-Use logical reasoning and imagination to develop descriptions, explanations, predictions and models based on evidence.

**DOK:** 2

**Answer:** Multiple correct answers. Any number greater than 0 and less than 5 seconds.

**Rationale:** The 90 degree Celsius beaker took 5 seconds to dissolve so a beaker with 100 degree Celsius water will take less time.

<table>
<thead>
<tr>
<th>Sugar Water Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaker 1</td>
</tr>
<tr>
<td>30°C</td>
</tr>
<tr>
<td>30 sec</td>
</tr>
</tbody>
</table>

The students slowly heat a fourth beaker to 100°C. Using the data they have collected the students want to predict how long it will take for the sugar to dissolve in this beaker.

Predict how long it will take the sugar to dissolve, based on the student’s data.

Use the keypad or type your answer in the box.

[Keypad Image]
Scenario Name-Weather

Question 12

Benchmark:

8.3.2.3.1- Describe the location, composition and use of major water reservoirs on the Earth, and the transfer of water among them.

DOK: 2

Answer: A

Rationale: As the air temperature increases, the air molecules move faster and get farther apart creating more room for the water molecules. The increase in temperature also causes the phase change from liquid water (fog) to water vapor.

On the way to school, students saw fog in low-lying areas. Students also noticed that the air was very calm, and there was little wind.

Later in the day the sun moves higher in the sky and the temperature increases. The fog cannot be seen. How does the air temperature increase during the day affect the water in the fog?

- The increasing temperature keeps the water in the atmosphere.
- The increasing temperature moves the water to local lakes.
- The increasing temperature forces the water underground.
- The increasing temperature returns the water to the ocean.
Question 13

Benchmark:

8.3.2.1.3- Explain how heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and hydrosphere producing winds, ocean currents and the water cycle, as well as influencing global climate.

DOK: 2

Answer: C

Rationale: The Sun heating the air unequally produces winds.
Question 14

Benchmark:

8.3.2.1.3- Explain how heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and hydrosphere producing winds, ocean currents and the water cycle, as well as influencing global climate.

DOK: 1

Answer: Sun
Question 15

Benchmark:

6.2.3.2.3- Describe how heat energy is transferred in conduction, convection and radiation.

DOK: 1

Answer: “Radiation” in the left box and “Convection” in the right box

Rationale: The sun transfers energy by radiation and the air transfers energy by convection.
Scenario: Water Bottle Rockets

Question 16

Benchmark:

6.1.3.4.1- Determine and use appropriate safe procedures, tools, measurements, graphs, and mathematical analyses to describe and investigate natural and designed systems in a physical science context.

DOK: 1

Answer: C

Rationale: Graduated cylinders are used to measure the volume of liquids.

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.
Question 17

**Benchmark:**

6.1.3.4.2- Demonstrate the conversion of units within the International System of Units (SI, or metric) and estimate the magnitude of common objects and quantities using metric units.

**DOK:** 1

**Answer:** 0.65

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.
Question 18

Benchmark:

6.2.1.1.1- Explain density, dissolving, compression, diffusion and thermal expansion using the particle model of matter.

DOK: 1

Answer:

Rationale: As the pressure increases the distance between molecules decreases.
Question 19

Benchmarks:

6.2.1.2.1- Identify evidence of physical changes, including changing phase or shape, and dissolving in other materials.

DOK: 1

Answer: D

Rationale: A physical change occurs when a substance dissolves.

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.

Some of the air that is pumped into the bottle dissolves in the water. What type of change happens when air dissolves in water?

- Chemical
- Color
- Molecular
- Physical

Question 19 is the last question in the large print (18 and 24 point) item samplers. Questions 20-25 require online interaction. These types of questions are not included in the Science MCA large print item samplers or the large print test.
Question 20 is a simulative scene and does not require the student to answer a question.

Question 21

**Benchmark:**

6.2.2.2.2-Identify the forces acting on an object and describe how the sum of the forces affects the motion of the object. *For example:* Forces acting on a book on a table or a car on the road.

**DOK:** 2

**Answer:** A downward arrow in each of the three response boxes

**Rationale:** Gravity is the attractive force acting between the water bottle and earth. Because the force of gravity is proportional to the masses of the objects, the water bottle would be attracted to earth.
Question 22

Benchmark:

6.2.2.2.1-Recognize that when the forces acting on an object are balanced, the object remains at rest or continues to move at a constant speed in a straight line, and that unbalanced forces cause a change in the speed or direction of the motion of an object.

DOK: 2

Answer: Positions 2 AND 3 AND 4 are selected

Rationale: Positions 2, 3 and 4 are where the water bottle rocket is accelerating which is the result of unbalanced forces.
Question 23

Benchmark:

6.2.2.1.1- Measure and calculate the speed of an object that is traveling in a straight line.

DOK: 1

Answer: A

Rationale: Solving using the formula for speed $S = \frac{d}{t}$ ($S = \frac{20}{5}$) the rocket would have a speed of 4 m/s
Question 24

Benchmark:

6.2.3.2.1-Differentiate between kinetic and potential energy and analyze situations where kinetic energy is converted to potential energy and vice versa.

DOK: 2

Answer: Greatest Potential Energy=Point 2 AND Greatest Kinetic Energy=Point 4

Rationale: Point 2 is the highest point from the ground which has the highest gravitational potential energy. Point 4 is where the water bottle rocket has the greatest velocity and therefore the greatest kinetic energy.
Question 25

**Benchmark:**

7.1.1.2.2- Plan and conduct a controlled experiment to test a hypothesis about a relationship between two variables, ensuring that one variable is systematically manipulated, the other is measured and recorded, and any other variables are kept the same (controlled). *For example:* The effect of various factors on the production of carbon dioxide by plants.

**DOK:** 3

**Answer:** Student performs 3 trials varying only the amount of water. Bottle type and amount of air pressure remains the same.

**Rationale:** The student understands that in this controlled experiment, the only variable that should change is the variable tested, the amount of water.

![Image of a controlled experiment setup with options to select bottle type, amount of water, and air pressure. The image also includes a table to record data on bottle type, amount of water, air pressure, height of flight, and flight time.]