



Maine
Department of
Education

GRADE

8

Maine Science Assessment
Released Items (2023)
Teacher Version



New Meridian

Included in this document are items and their associated stimuli that were operationally administered on the Maine Science Assessment. For each item, the correct answer is provided, along with the Next Generation Science Standards (NGSS) to which it aligns. This includes the disciplinary core idea (DCI), science and engineering practice (SEP), and cross-cutting concept (CCC). In some cases, one of these dimensions may not apply. The number of points the item is worth is also provided.

Use the information from Gravity Orbit to answer **questions 1–5**.

Gravity Orbit

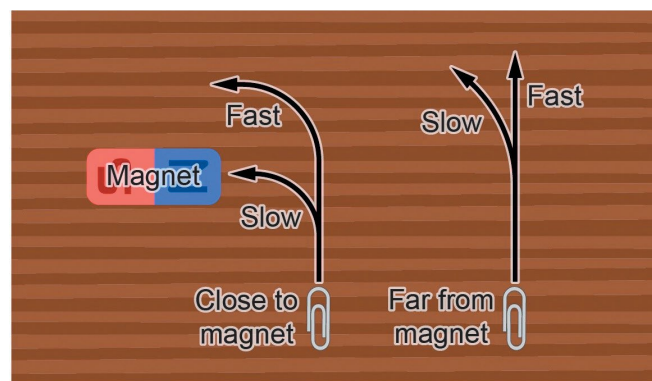
Valeria is completing a project for her science class. She wants to determine how the motion of objects in space are affected by gravity even though the objects are not touching.

Valeria finds a data table of objects in our solar system. She hopes this data can help her determine if there are patterns of motion for orbiting objects.

Objects in Motion in Our Solar System					
Object Being Orbited	Object Orbiting	Distance Between Objects (10^6 km)	Speed of Orbiting Object (km/s)	Mass of Orbiting Object (10^{24} kg)	Time to Orbit Earth (Earth Days)
Earth	Moon	0.38	1.0	0.07	27
Sun	Mercury	57.9	47.4	0.33	88
Sun	Venus	108.2	35.0	4.87	225
Sun	Earth	149.6	29.8	5.97	365
Sun	Mars	227.9	24.1	0.65	687

Valeria's lab partner, Justin, suggests that observing magnetic forces might help them answer the question because magnetic force also affects the motion of objects without touching.

Valeria and Justin experiment with a paperclip and a magnet. To do this, they slide a paperclip past the magnet at different distances and speeds. They also noticed that the friction between the table and the paperclip eventually cause the paperclip to stop moving. They design a model to show how the magnet affects the paperclip's motion, and then record their results.



Results of How the Magnet Affects the Paperclip's Motion		
	Close to Magnet	Far from Magnet
Slow Speed	paperclip pulled to magnet	paperclip curved past magnet
Fast Speed	paperclip curved past magnet	paperclip went straight past the magnet

1. Valeria notices that the Moon orbits Earth, while all the other objects in the table orbit the Sun.

Why does the Moon orbit Earth?

1 point

- (A) The mass of Earth is more than that of any other object in the table.
- (B) Earth orbits the Sun at a greater speed than any other object in the table.
- (C) The distance between Earth and Moon is much less than any two other objects in the table.
- (D) The number of days it takes for Earth to orbit the Sun is less than any other object in the table.

Standards Alignment

Discipline: Earth and Space Science

NGSS Topic: Space Science

DCI: ESS1.B


The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.


SEP4: Analyzing and Interpreting Data


CCC: None

2. Justin knows that there are satellites orbiting Earth at different altitudes.

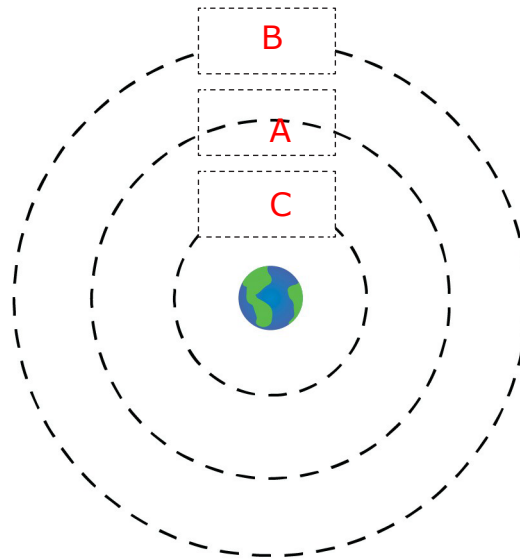
In which orbit would a satellite be located based on its given speed? Write the letter for each satellite in the box that corresponds with its orbit.

A.  7.58 km/s

B.  3.14 km/s

C.  7.78 km/s

1 point for all 3 correct



Not to scale

Standards Alignment

Discipline: Earth and Space Science

NGSS Topic: Space Science

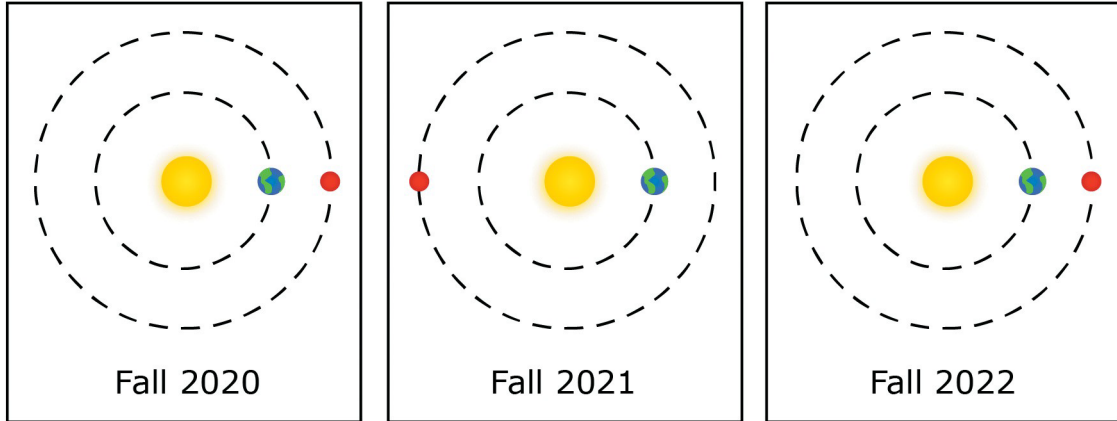
DCI: ESS1.B

The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.

SEP2: Developing and Using Models

CCC4: Systems and System Models

3. Valeria and Justin investigate the orbits of Mars and Earth around the Sun. They find diagrams that show the location of Earth and Mars in relation to the Sun during the same season on Earth over three years.



Not to scale

What is the relationship between distance, speed, and the force of gravity in the diagrams of Earth and Mars orbiting the Sun? Use the information in the table and in the diagrams to support your answer.

See next page for rubric

Standards Alignment

Discipline: Earth and Space Science
NGSS Topic: Space Science

DCI: ESS1.B

The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.

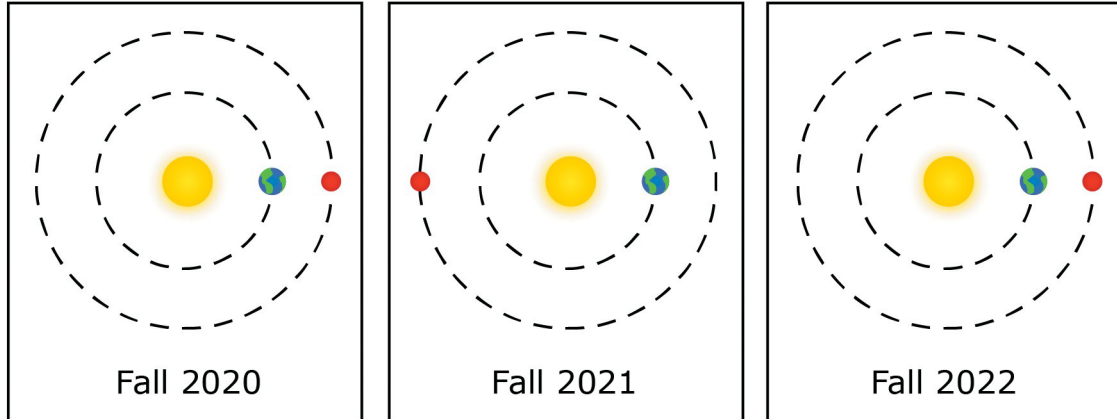
SEP6: Constructing Explanations and Designing Solutions

CCC4: Systems and System Models

Gravity Orbit Rubric

Points	Qualities of the Student Response
2	<p>For full credit, the response must address three elements: speed, distance, and gravity.</p> <p>For speed, the response must show understanding that because the Earth is closer to the Sun than Mars, Earth needs to travel faster around the Sun to stay in orbit (29.8 km/s vs 24.1 km/s). The distance between Earth and Sun and Earth and Mars is less which means that in order to overcome the force of gravity (the pull between the two objects) Earth will need to travel faster to avoid falling towards the Sun (i.e., maintaining a stable orbit).</p> <p>Note: The gravity element requires students to go beyond stating that the gravitational force is stronger for Earth (or weaker for Mars). In a 2-point response, MDOE wants students to recognize that the gravitational force has to be strong enough to keep the planet in a stable orbit. The gravitational force has to be strong enough to prevent the planet from escaping the orbit. However, the gravitational force also has to be weak enough to keep the planet from plunging into the sun.</p> <p>Example Student Response:</p> <p>Since the distance between Mars and the Sun is greater than Earth and the Sun, the gravitational attraction is less between Mars and the Sun therefore, Mars does not have to travel as fast to stay in orbit around the Sun.</p> <p>Note: Mass is not relevant to this prompt. Mass does not affect the orbital speed/velocity. If a response uses mass as a causal factor, treat it like an error.</p> <p>Note: A 2pt response may not include any errors or flawed logic.</p>
1	<p>The response should demonstrate an understanding that to stay in a stable orbit, Earth must travel around the Sun at a faster speed than Mars (29.8 km/s vs 24.1 km/s) because it is closer to the Sun.</p> <ul style="list-style-type: none"> • Response addresses 1 <u>or</u> 2 of the 3 total elements. • Includes response that address speed and distance, but the gravity explanation is insufficient/incomplete.
0	<p>The response demonstrates minimal understanding of the prompt. The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.</p> <ul style="list-style-type: none"> • e.g., Response addresses the duration of a planet's orbit instead of the orbital velocity ("Earth orbits twice in the time it takes Mars to orbit once.")

4. Valeria and Justin investigate the orbits of Mars and Earth around the Sun. They find diagrams that show the location of Earth and Mars in relation to the Sun during the same season on Earth over three years.



Not to scale

What would happen to the orbit of Mars if the orbital speed of Mars changes significantly? Write the letter for the statement in the **Statement** box. Then, write the letter for each prediction in the **Predictions** boxes.

Statement:

A

Statements

A. The orbital speed of Mars increases.

B. The orbital speed of Mars decreases.

Predictions:

C

or

E

Possible Predictions

C. Mars will move farther away and no longer orbit the Sun.

D. The orbit of Mars would move closer to the Sun.

E. The orbit of Mars would move farther from the Sun.

F. The orbit of Mars would decay and Mars would fall into the Sun.

1 point for all 3 correct

Standards Alignment for Item 4

Discipline: Earth and Space Science

NGSS Topic: Space Science

DCI: ESS1.B

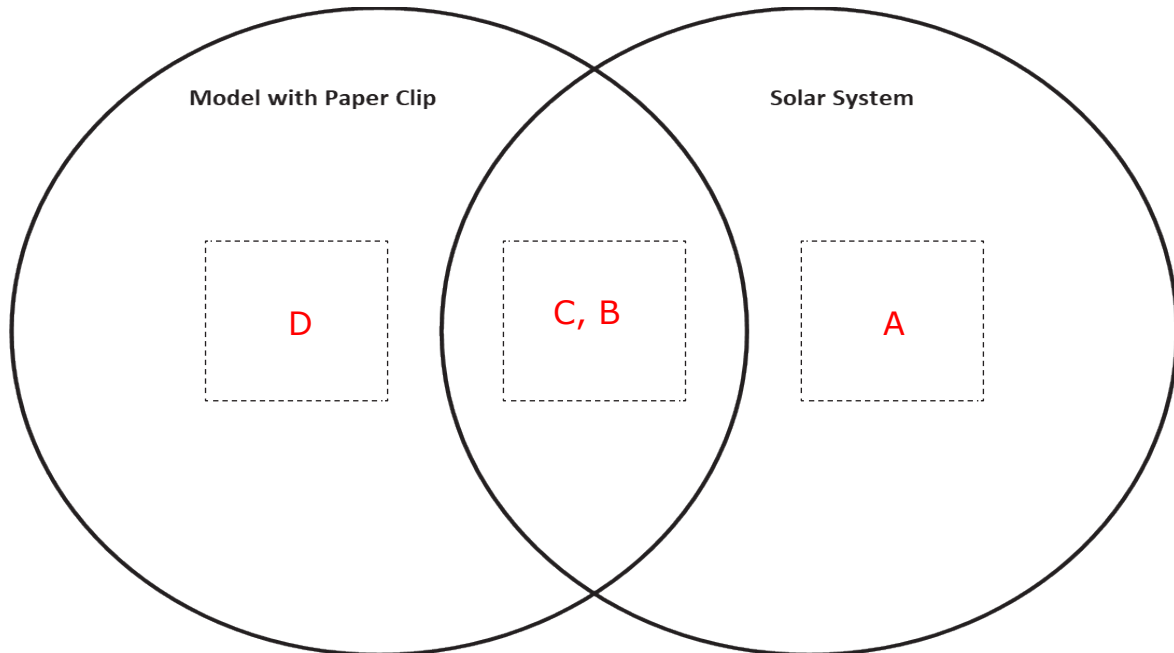
The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.

SEP6: Constructing Explanations and Designing Solutions

CCC2: Cause and Effect

5. Valeria and Justin need to analyze the relationship between the model with the paper clip and the motion of orbiting objects. They create a Venn diagram to help them understand this relationship.

Which statements apply to the paper clip model, the solar system, or both? Write the letter for **each** statement in the appropriate location in the Venn Diagram.



1 point for correctly placing all four statements

A. The force is only observed with very large objects.

B. The force is stronger when the objects are closer.

C. The force DOES NOT require the objects to be touching.

D. The force is only applied to magnetic objects.

Standards Alignment

Discipline: Earth and Space Science

NGSS Topic: Space Science

DCI: ESS1.B

The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.

SEP4: Analyzing and Interpreting Data

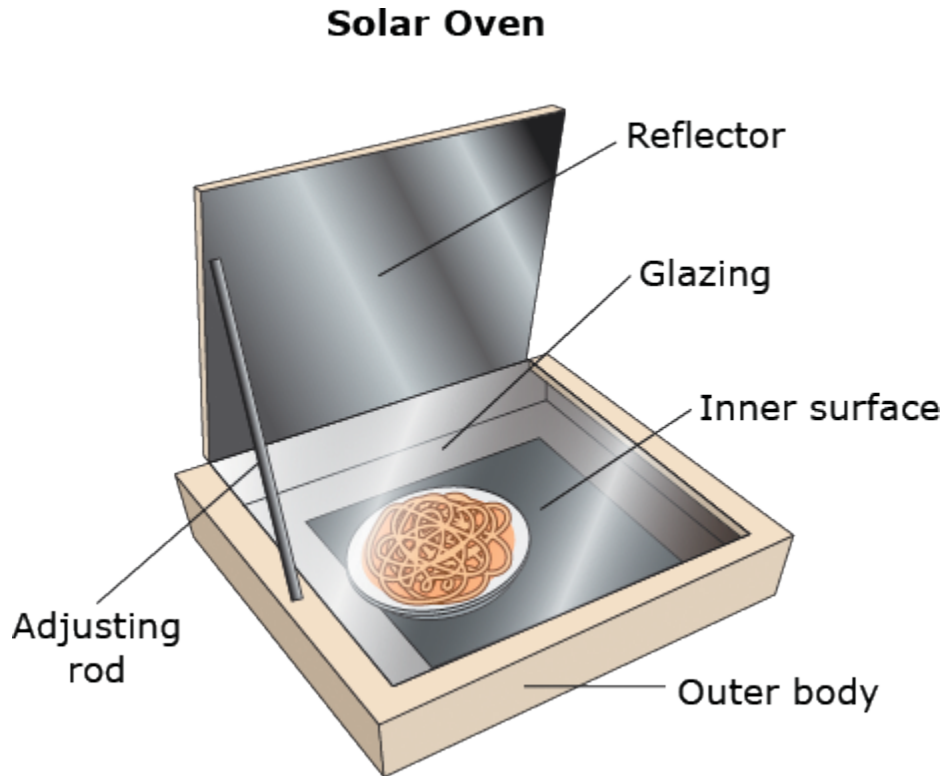
CCC1: Patterns

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Use the information from Solar Oven to answer **questions 6-9**.

Solar Oven

Winslow learns that a solar oven converts solar energy into thermal energy, which can be used to cook food. She places a bowl of uncooked pasta and water into a solar oven, as in the diagram below.



Winslow notices that after a few hours, the pasta remains uncooked inside the oven. She wonders which changes can be made to the solar oven to better cook the pasta, so plans to refine its design. Winslow bases her design on multiple criteria and constraints.

1. The design must be sturdy.
2. The design will work using only sunlight.
3. The outer body of the solar oven must act as an insulator.
4. The inner surface of the solar oven must absorb sufficient heat.
5. The reflector must allow the sunlight to reach the food item.
6. The adjusting rod must be moveable so that the reflector can be set according to the position of the sun.

6. Winslow wonders whether different reflectors in the oven might make a difference. She sets up an experiment to investigate different reflective materials. First, Winslow adds a certain volume of tap water into a cup and places it into the oven. Then she places an aluminum foil reflector on the solar cooker for 20 minutes. Winslow uses a thermometer to measure the initial and final temperatures of the water. She repeats this three times with the other reflector materials and records the results in the data table below.

Effects of Reflector Materials on Final Temperature of Water		
Material for the Reflector	Initial Temperature of the Water (°C)	Final Temperature of the Water After 20 Mins (°C)
aluminum foil	18	32
mirror	18	38
cardboard	18	25
white sheet	18	28

Part A

Which material is **best** suited for the reflector in the oven?

- (A) aluminum foil
- (B) mirror
- (C) cardboard
- (D) white sheet

1 point for both parts correct

Part B

Which evidence supports the answer to part A?

- (A) the volume of the water in the cup
- (B) the initial temperature of the water in the cup
- (C) the amount of time the cup was in the oven
- (D) the final temperature of the water in the cup

Standards Alignment

Discipline: Physical Science

NGSS Topic: Energy

DCI: PS3.B The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment

SEP4: Analyzing and Interpreting Data

CCC5: Energy and Matter

7. What is the purpose of each component of the solar oven? In the box for each component, write the letter for the purpose of that component. Answer options may be used more than once.

Reflector:

A

A. changes the angle of the incoming solar radiation to redirect thermal energy into the solar oven

Glazing:

B

B. insulates the solar oven to prevent thermal energy from escaping

Inner Surface:

C

C. absorbs and radiates thermal energy throughout the solar oven

Outer Body:

B

Adjusting Rod:

A

2 points for all correct, 1 point for 3-4 correct

Standards Alignment

Discipline: Physical Science

NGSS Topic: Energy

DCI: PS3.B

The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

SEP6: Constructing Explanations and Designing Solutions

CCC6: Systems and System Models

8. Winslow decides to investigate whether the wax paper is the most suitable material for the glazing of the solar oven. She once again adds a certain volume of tap water into a cup and places it into the oven. Then she adds the wax paper glazing material on the solar cooker for 20 minutes. She uses a thermometer to measure the initial and final temperatures of the water. She repeats this three times with the other glazing materials and records the results in a data table.

Effects of Glazing Materials on Final Temperature of Water		
Material for Glazing	Initial Temperature of the Water (°C)	Final Temperature of the Water After 20 Mins (°C)
wax paper	18	21
thin plastic film	18	23
mirror	18	20
thick plastic sheet	18	24

Which glazing materials are **most** effective in transferring thermal energy?

Number the materials in order from 1 to 4, where 1 is the **most** effective material and 4 is the **least** effective material.

- thin plastic film
- wax paper
- mirror
- thick plastic sheet

1 point for all four in the correct order

Standards Alignment

Discipline: Physical Science

NGSS Topic: Energy

DCI: PS3.B

The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

SEP4: Analyzing and Interpreting Data

CCC6: Systems and System Models

9. Winslow hopes to increase the oven’s efficiency. She decides to try painting the inner surface of the solar oven. She has three colors of paint: white, red, and black.

Which color paint should Winslow use? Explain using reasoning.

2 points possible, can earn partial credit
See next page for rubric

Standards Alignment

Discipline: Physical Science
NGSS Topic: Energy

DCI: PS3.B

The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

SEP6: Constructing Explanations and Designing Solutions

CCC6: Systems and System Models

Solar Oven Rubric

Points	Qualities of the Student Response
2	<p>The response identifies that black paint will absorb incoming solar radiation and therefore will get hot.</p> <p><u>Example student response:</u></p> <p>She should use black paint because the color black does not reflect light and therefore will get hotter than the other colors.</p> <p><u>Note:</u> A 2pt response may not include any errors or flawed logic.</p>
1	<p>The response demonstrates a partial understanding of the prompt:</p> <ul style="list-style-type: none">• Identifies the color black but does <u>not</u> include an explanation with reasoning.• Identifies the need for a color that would absorb heat without identifying any color.• Identifies the color black but provides an incomplete or insufficient explanation. (e.g., black attracts light, black conducts heat)
0	<p>The response demonstrates minimal understanding of the prompt. The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.</p> <ul style="list-style-type: none">• e.g., identifies a color other than black (“white because ___”)• e.g., identifies the color black but pairs it with an incorrect explanation (“black because it reflects light”)