Maine Department of Education

GRADE 8

Maine Science Assessment

Released Items (2023)

New Meridian

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

Gravity Orbit

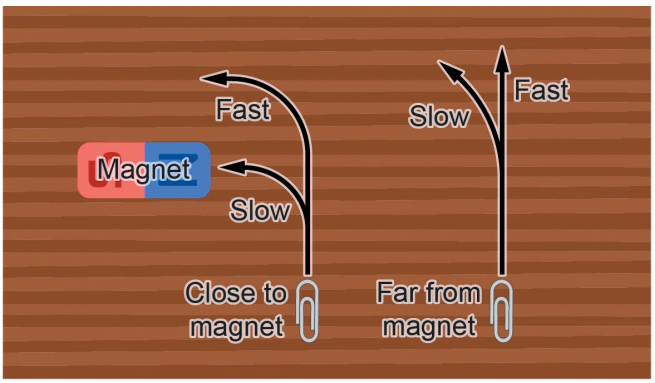
Valeria is completing a project for her science class. She wants to determine how the motion of objects in space are affected by gravity even though the objects are not touching.

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.



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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?

Ⓐ The mass of Earth is more than that of any other object in the table.

Ⓑ Earth orbits the Sun at a greater speed than any other object in the table.

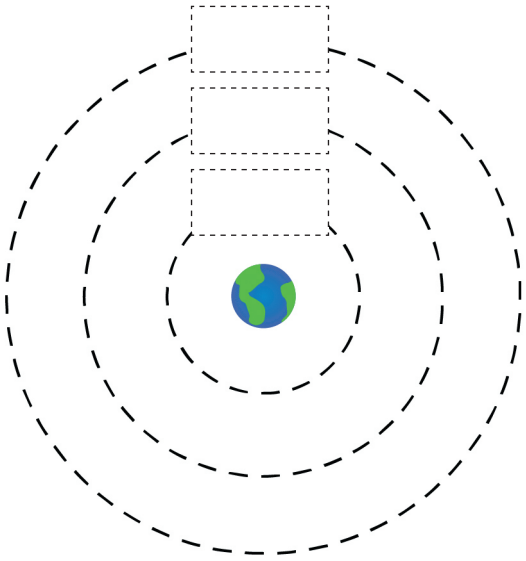
Ⓒ The distance between Earth and Moon is much less than any two other objects in the table.

Ⓓ The number of days it takes for Earth to orbit the Sun is less than any other object in the table.

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



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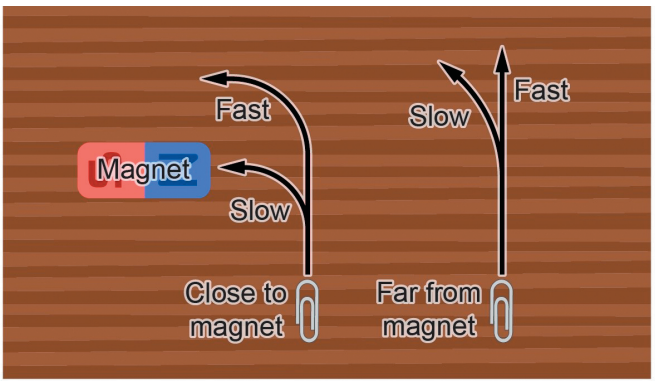

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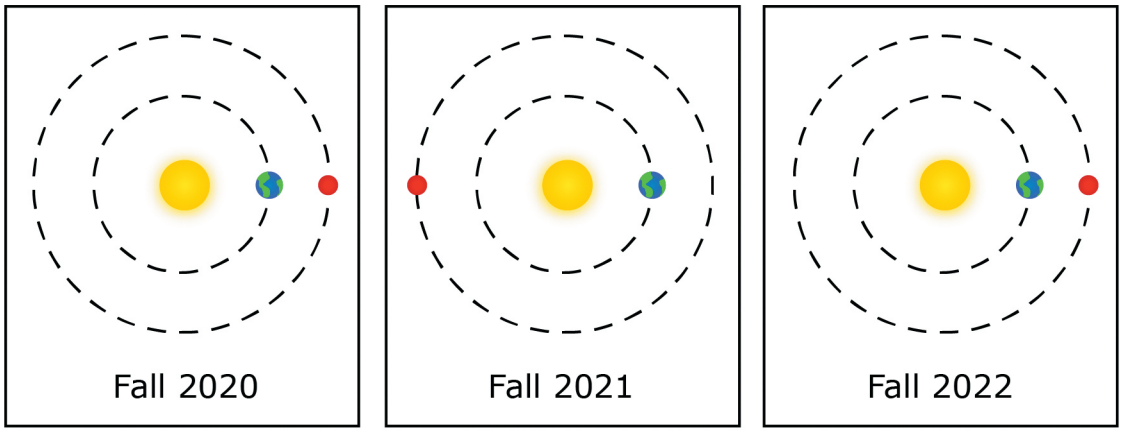
3. Valeria and Justin investigate the orbits of Mars and Earth around the Sun. They find diagrams that show the location of Earth and Mars in relation to the Sun during the same season on Earth over three years.



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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.

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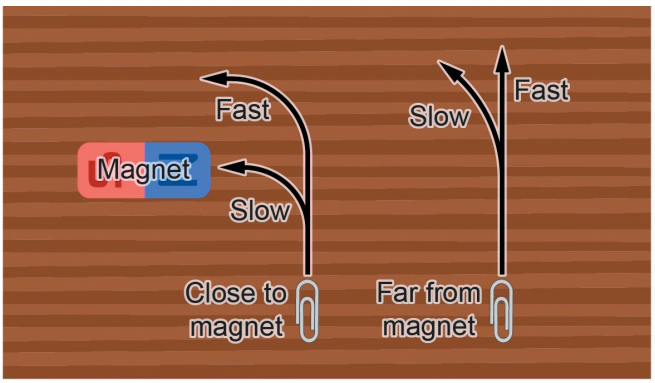

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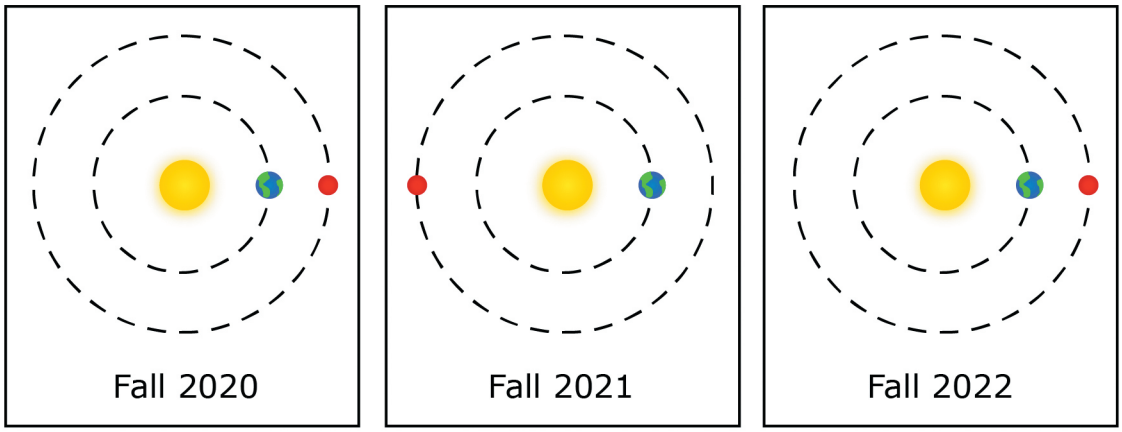

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What would happen to the orbit of Mars if the orbital speed of Mars changes significantly? Write the letter for the statement in the **Statement** box. Then, write the letter for each prediction in the **Predictions** boxes.

Statement:

Statements

A. The orbital speed of Mars increases.

B. The orbital speed of Mars decreases.

Predictions:

Possible Predictions

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

or

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.

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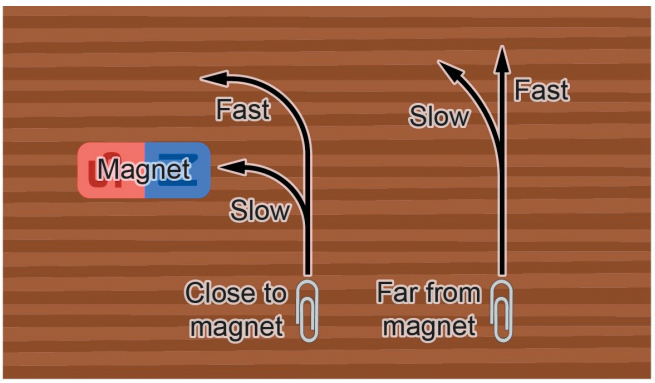

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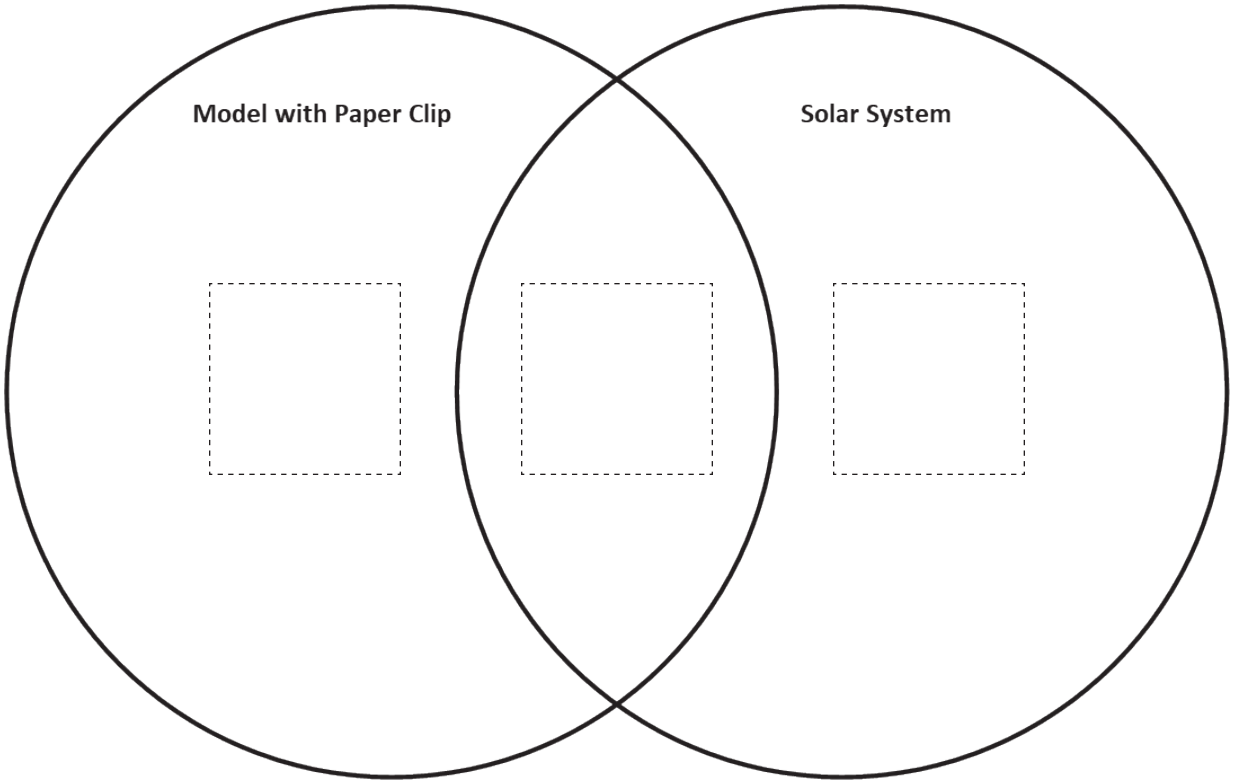
5. Valeria and Justin need to analyze the relationship between the model with the paper clip and the motion of orbiting objects. They create a Venn diagram to help them understand this relationship.

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.



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.

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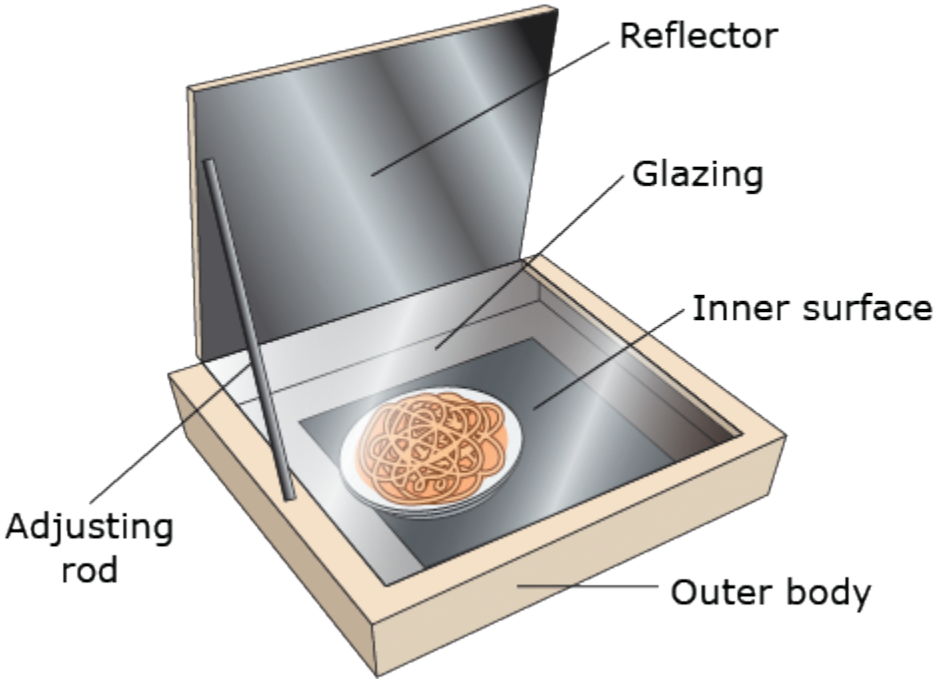
Use the information from Solar Oven to answer questions 6-9.

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.

Solar Oven



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?

Ⓐ aluminum foil

Ⓑ mirror

Ⓒ cardboard

Ⓓ white sheet

Part B

Which evidence supports the answer to part A?

Ⓐ the volume of the water in the cup

Ⓑ the initial temperature of the water in the cup

Ⓒ the amount of time the cup was in the oven

Ⓓ the final temperature of the water in the cup

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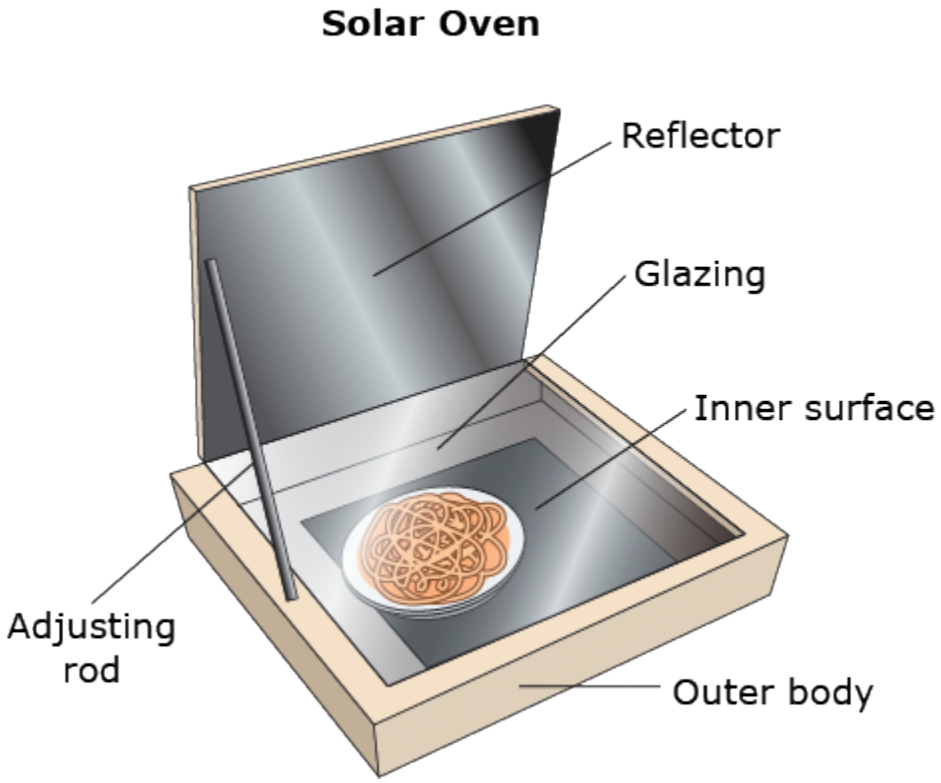

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7. What is the purpose of each component of the solar oven? In the box for each component, write the letter for the purpose of that component. Answer options may be used more than once.

Reflector: [ ]

Glazing: [ ]

Inner Surface: [ ]

Outer Body: [ ]

Adjusting Rod: [ ]

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

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

C. absorbs and radiates thermal energy throughout the solar oven

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

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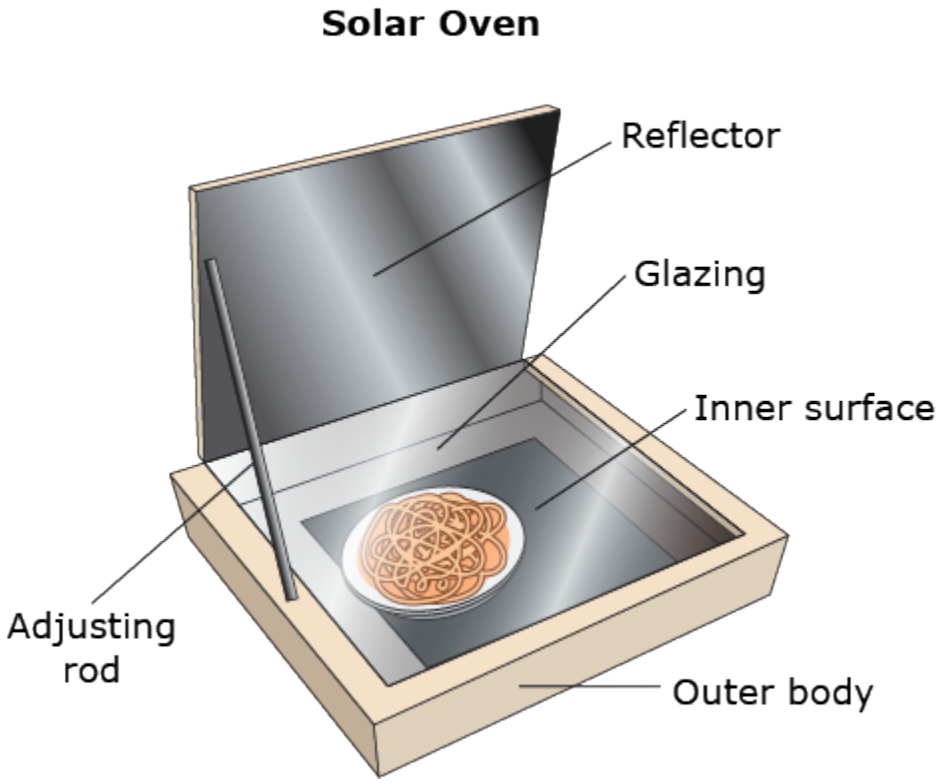

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6. The adjusting rod must be moveable so that the reflector can be set according to the position of the sun.

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.

_____

_____

_____

_____

_____