

Gravity

Grade-Level Expectations

The exercises in these instructional tasks address content related to the following science grade-level expectation(s):

ESS-M-C3 Relate Newton’s laws of gravity to the motions of celestial bodies and objects on Earth (GLE 39)

Contents

- These instructional tasks contain a set of document- or resource-based exercises about *Newton’s laws of gravity and the motions of celestial bodies*.
- Teachers may choose to use or modify the tasks as part of an instructional lesson or as a formative or summative assessment.
- The printable student version excludes teacher directions.

	Objective(s)
Scaffolding Exercise 1	· Build background information about gravity
Scaffolding Exercise 2	· Relate laws of gravity to objects that orbit the Earth
Culminating Exercise	· Analyze data from a gravity experiment to answer application questions
Scoring Rubric	
Scoring Notes	
Printable Student Version	

Scaffolding Exercise 1

Although you cannot feel it, there is a gravitational attraction between you and the person sitting next to you.	The gravitational force of the Earth on you is larger than the force you exert on the Earth.	Gravity keeps the planets in orbit around the sun.
Planets far away from the sun have less gravity.	Being on a space station can cause problems such as bone and muscle loss.	Gravity is a force.
The moon has no gravity.	Tides are caused by the rotation of the Earth and the gravitational effects of the Sun and Moon.	Gravity is stronger between the most distance objects.

Student Directions: Working in groups of two or three, discuss the statements on each of the cards and decide whether the statement is true or false. Research the ideas to prove or negate your initial thoughts. Formulate claims for each statement and support your claims using Newton's laws of gravity and other scientific knowledge.

A science class designed an experiment to determine if objects with different masses took the same amount of time to fall an equal distance. The class then calculated the acceleration of gravity on each of the objects. The data tables below show the results of the experiment and the calculations.

Data Table 1
Time for Objects to Fall a Given Distance
(Average of Class)

		Mass of Object (kg)		
		.5	1.0	2.0
Distance Dropped (m)	4	.91 sec	.90 sec	.91 sec
	6	1.10 sec	1.12 sec	1.11 sec
	8	1.28 sec	1.27 sec	1.28 sec

Data Table 2
Average Acceleration of the Objects

		Mass of Object (kg)		
		.5	1.0	2.0
Distance Dropped (m)	4	9.7 m/s ²	9.9 m/s ²	9.7 m/s ²
	6	9.9 m/s ²	9.6 m/s ²	9.7 m/s ²
	8	9.8 m/s ²	9.9 m/s ²	9.8 m/s ²

Part 1: Describe Newton's law(s) that apply to this experiment.

Part 2: Explain the findings of the experiment performed by the science class and provide evidence for your conclusion.

Part 3: Describe what would happen if two objects of the same mass but different volumes were dropped at the same time? Explain your answer.

Rubric

Key Elements:

- A. Response describes Newton's first and/or second law.
- B. Response correctly explains the findings of the experiments with evidence provided to support the findings.
- C. Response correctly describes what happens when two objects of different volume but the same mass are dropped at the same time.
- D. Response correctly explains what happens when two objects of different volume but the same mass are dropped at the same time.

4 Points

Response includes all four key elements.
Response contains no scientific errors.

3 Points

Response includes three of the four key elements.
Response may include scientific errors.

2 Points

Response includes two of the four key elements.
Response may include scientific errors.

1 Point

Response includes one of the four key elements.
Response may include scientific errors.

A well-developed response should demonstrate a correct and thorough understanding of analyzing data and drawing conclusions. The response should be clear, include specific details, show a higher level of reasoning skills where appropriate, and address the key elements of the task.

Scoring Notes

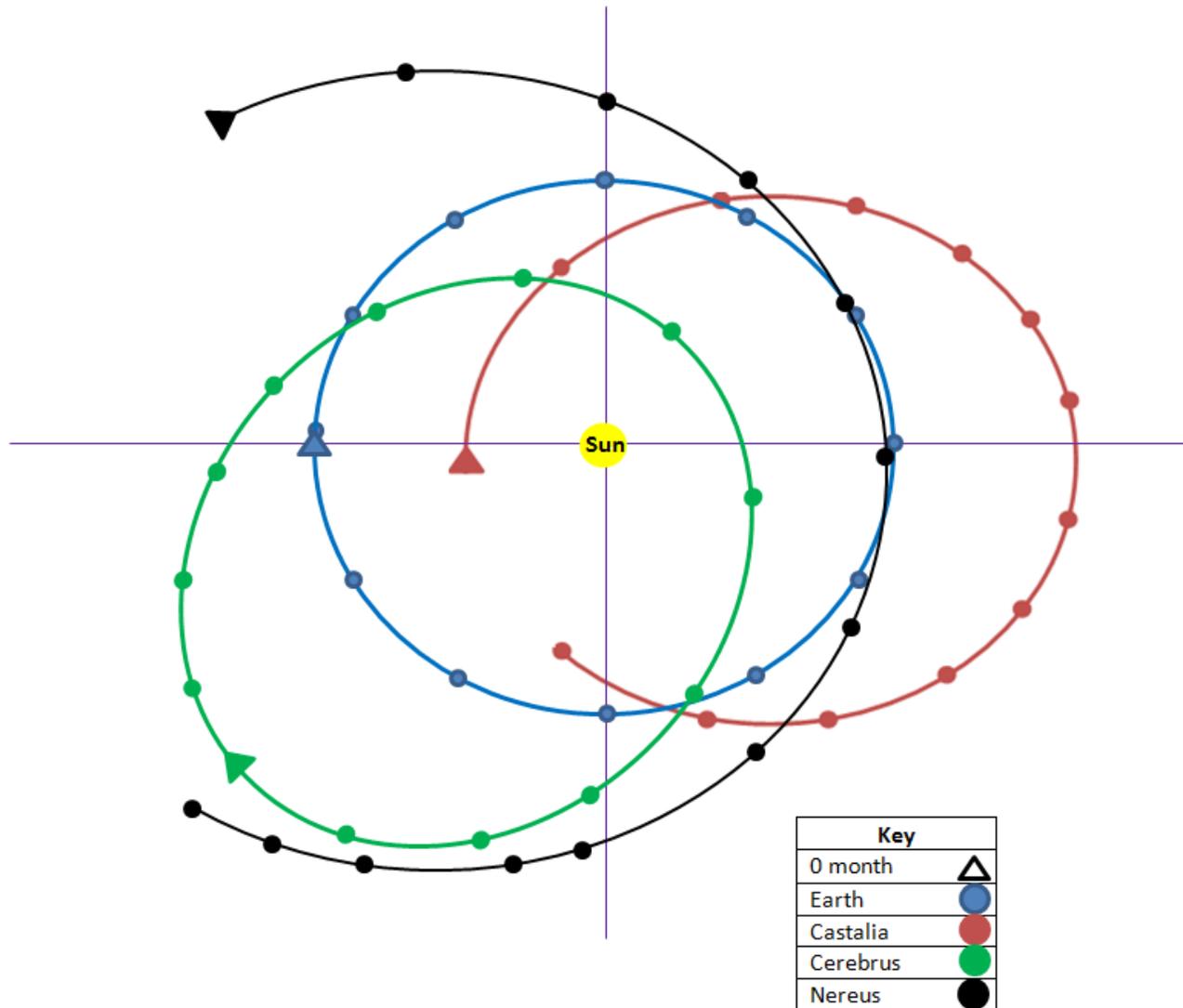
Student responses will not be an exact imitation of the responses below. These are given only as examples.

- A.** Response identifies Newton's first and/or second law
 - Newton's Law of Inertia (First Law)
 - An object in motion will stay in motion unless acted upon by another force
 - All objects resist change in their motion
 - Newton's Second Law
 - The acceleration of an object is affected by the mass of the object and the force exerted on it
 - The force of an object is equal to the mass of the object times the acceleration of the object
- B.** Response correctly explains the findings of the experiments with evidence provided to support the findings.
 - An object with greater mass will take approximately the same amount of time to fall than objects with lesser mass.
 - The acceleration of the objects is almost the same regardless of the mass.
 - Objects with a greater mass experience a greater gravitational force but are harder to accelerate because of their mass
 - Data from the table is cited as evidence
- C.** Response correctly describes what happens when two objects of different volumes but the same mass are dropped at the same time.
 - Objects will land at different times.
- D.** Response correctly explains what happens when two objects of different volume but the same mass are dropped at the same time.
 - Falling objects build up air resistance.
 - Objects with greater volumes (due to larger surface area) experience more air resistance.
 - Greater air resistance on an object will slow the object down as it falls.

**Printable
Student Version**

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Newton's first law of motion states that an object in motion will stay in motion unless an outside force acts upon it. The diagram above graphs the location of 3 asteroids and Earth over a period of 13 months. All of the celestial bodies are orbiting the Sun in a clockwise direction. Each filled-in circle represents a time lapse of one month. At first glance, it appears that the Earth could travel close enough to the asteroids to change their orbital path. Work with a partner to study the diagram more closely and determine whether this is true. Defend your reasoning.

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Part 1: Describe Newton's law(s) that apply to this experiment.

Part 2: Explain the findings of the experiment performed by the science class and provide evidence for your conclusion.

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