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#10434
GRAVITY:
HISTORY OF IDEAS

CLEARVUE/SVE, 1999
Grade Level: 9-12
24 Minutes
1 Instructional Graphic Included

CAPTIONED MEDIA PROGRAM RELATED RESOURCES

#2405 LET'S MOVE IT: NEWTON'S LAWS OF MOTION
#3137 HISTORY OF ASTRONOMY
#8355 SIR ISAAC NEWTON: THE GRAVITY OF GENIUS

Funding for the Captioned Media Program is provided by the U.S. Department of Education

GRAVITY: HISTORY OF IDEAS

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REPRODUCIBLE WORKSHEET(S) .....ENCLOSED

Intended for Junior and Senior High School Students

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INTRODUCTION

Gravity: History of Ideas follows the development of astronomy from the ancient Greeks to the seventeenth-century Europeans by characterizing some of the main people involved. It is the history of the development of the idea of universal gravity and begins with the earliest observations of the movement of objects in the heavens. It ends when the sun-centered model of the solar system was established and became generally accepted.

LEARNING OBJECTIVES

After completing the program and participating in discussion and activities, students will be able to:

- Gain a greater appreciation for the development of universal grav ity;
- Understand the history of ideas that has led to the present view of our place in the universe;
- Recognize the contributions of Aristotle;
- Acknowledge alternative views proposed about gravity;
- Observe how Galileo's achievements laid down a foundation for experimental science; and
- Identify Isaac Newton's laws of motion.

INTENDED AUDIENCE

This program is intended for junior (grades 7 through 9) and senior high school (grades 10 through 12) students.

PRESENTING THE PROGRAM

You may wish to follow this procedure in presenting the program.

1. Preview the program and familiarize yourself with this teacher's guide and the reproducible master(s). Review the learning objectives, discussion starters, and review questions.
2. Next, introduce students to the program, using the discussion starters to relate the upcoming information to what they already know.
3. Have students complete the program in its entirety the first time.
4. Check for understanding by discussing and reviewing the information and concepts presented in the program, using the review questions in this teacher's guide as an outline.
5. If time permits, allow students to complete the program a second time, pausing for discussion at points of interest.
6. Assign the enclosed reproducible worksheet(s) for guided and independent practice. Students may complete the activities alone, with a partner, or in a cooperative learning group. Choose the activities appropriate to your objectives and your students' level(s) of understanding. Be creative and integrate some activities of your own design that are based on concepts found in the program.

TARGET VOCABULARY

acceleration
Ancient Greece
astronomy
Babylonian astronomers
calendars
celestial equator
celestial object
heliocentric
horizon
inferior planets
months
moon
moons of Jupiter
phases of Venus

celestial sphere
circular motion
circular path
constellations
days
deferent
Earth-centered model
eccentricity
eclipses
ecliptic
epicycle
falling moon
geocentric
planets
retrograde motion
science method
seasons
star charts
stars
sun
sun-centered model
superior planets
timeline
varying speed
zenith

Discussion Starters

Begin a discussion about gravity, astronomy, and physics. Do students know when astronomers began watching celestial bodies move across the sky? Can they name any of the ancient philosophers and astronomers? What about Plato or Aristotle?

Tell students that the program they are about to watch illustrates the important astronomers and physicists who played an important role in the discovery of universal gravity. The video ends by describing the contributions of Galileo and Isaac Newton.

Review Questions and Activities

Use these discussion topics and questions to review the program material.

1. Why is Aristotle's view of the heavens called the "common-sense" view?

2. Why did Plato assume that the planets moved in a circular formation?

3. Why did Eudoxus have to use several spheres for each of the planets instead of just one?

4. List some of the objections that were raised about Aristarchus's suggestion that the sun was the center and the Earth orbited the sun.

5. What was the most important outcome of using Ptolemy's model of the planets?

6. Copernicus found that it was much easier to describe the retrograde motion of the outer planets by placing the sun at the center. What is retrograde motion and how did this model help in explaining it?

7. Why was Tycho Brahe interested in accurate measurements? What measurements did he make and how did he accomplish this?

8. Kepler used Brahe's measurements to work out something about the orbit of Mars. What did he find after 20 years of searching?

9. When Galileo pointed his improved telescope to the heavens, he found several things never seen before. What were they and how did they support the heliocentric model?

10. To understand the motion of the planets, Newton had to first understand how things went around in circles. What were the important things he was able to say about the paths of the planets from his knowledge of circular motion? Where did gravity fit into this picture?

11. Access one or more of the Web sites cited in the "Web Resources" section of this guide by going to your school or

library computer lab. As a group, go to one of the sites and explore the subject in more detail.

12. Assign the enclosed worksheet(s) to reinforce the skills students have learned from the program, the review questions, and the discussion activities.

WEB RESOURCES

The following World Wide Web sites may be helpful for both teachers and students in further researching gravity and physics. Additional WWW resources may be found using common search engines such as Excite, Yahoo!, HotBot, or Lycos. The World Wide Web is constantly evolving, so some of these sites may have changed locations or may no longer be available.

http://www.fearofphysics.com/
Skeptical physics students can enjoy interactive games with this site, which demonstrates the fun aspects of physics.

http://www.learner.org/exhibits/parkphysics/
Explore logical ways physics is used in virtually every kind of amusement park ride.

http://www.ncsu.edu/felder-public/kenny/home.html
Students can search articles, tips for writing physics papers, and links to other educational sites.

http://www.physicsclassroom.com/Default2.html
Students can use this high school physics tutorial to learn basic concepts and to check their progress through online quizzes.

http://www.physicscentral.com/resources/teacher.html
Study this useful evaluation of physics links, which allows teachers to easily find the resources to meet their classroom needs.

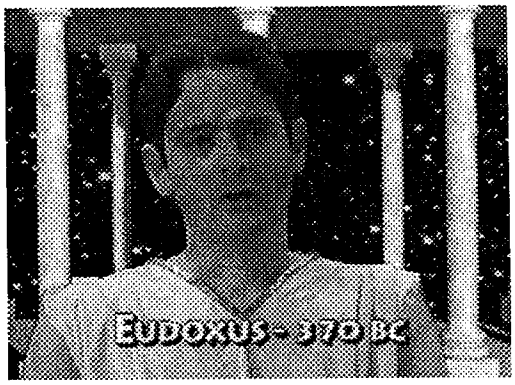
http://www.exploratorium.edu/learning_studio/cool/physics.html
Check out these educational physics sites geared to students and teachers. Many of the sites include interactive games and activities.

http://www.perry.k12.mi.us/edlinks.html#Science
Search this extensive list of Web resources and find interactive and informative sites about science.

http://www.cln.org/subjects/physics_cur.html
Locate useful resources that focus on specific topics in physics and more general resources.

Notes

Gravity:
History of Ideas



Credits

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Gravity: History of Ideas

To enhance your understanding of the history of gravity, choose one or more of the following options and address its questions and prompts.

1. Answer the following questions about each character in the video:

    a. How did he change the view that was previously held?

    b. How did others criticize his new view?

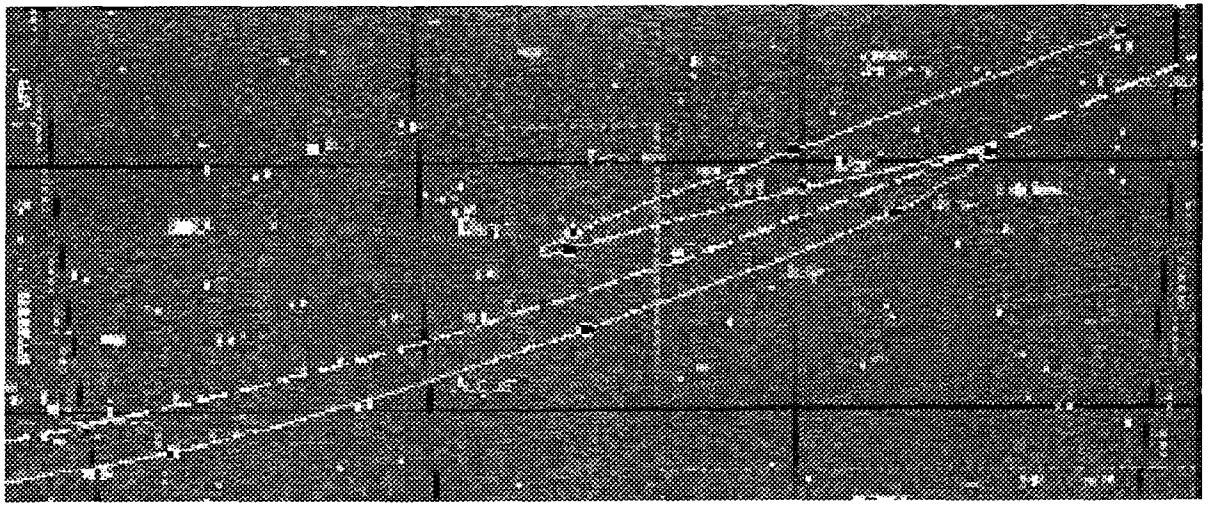
    Plato:
    Eudoxus:
    Aristotle:
    Aristarchus:
    Ptolemy:
    Copernicus:
    Brahe:
    Kepler:
    Galileo:
    Newton:

2. Set up your own "Stonehenge" or "Pipehenge" viewing frame at home to view the stars at night (a swing frame may do). Note the changes you see in the paths of objects in the sky. Can you locate some of the constellations and the South celestial pole? Name the ones overhead and the time they appear on the horizon. Use the newspaper or an almanac to find which planets should be visible at certain times. Locate them and name the constellation they are in. How does their position change over a month?

3. Use a pole as a sundial. Try to plot the position of the shadow and its position during the day. Remember to never look at the sun. You could make this into a long-term project and continue it for the year. You and your class would learn a lot and have a lot of questions to ask from this activity. For better results, place a mirror on a window sill to beam an image of the sun onto a wall in the room.

North

East



West

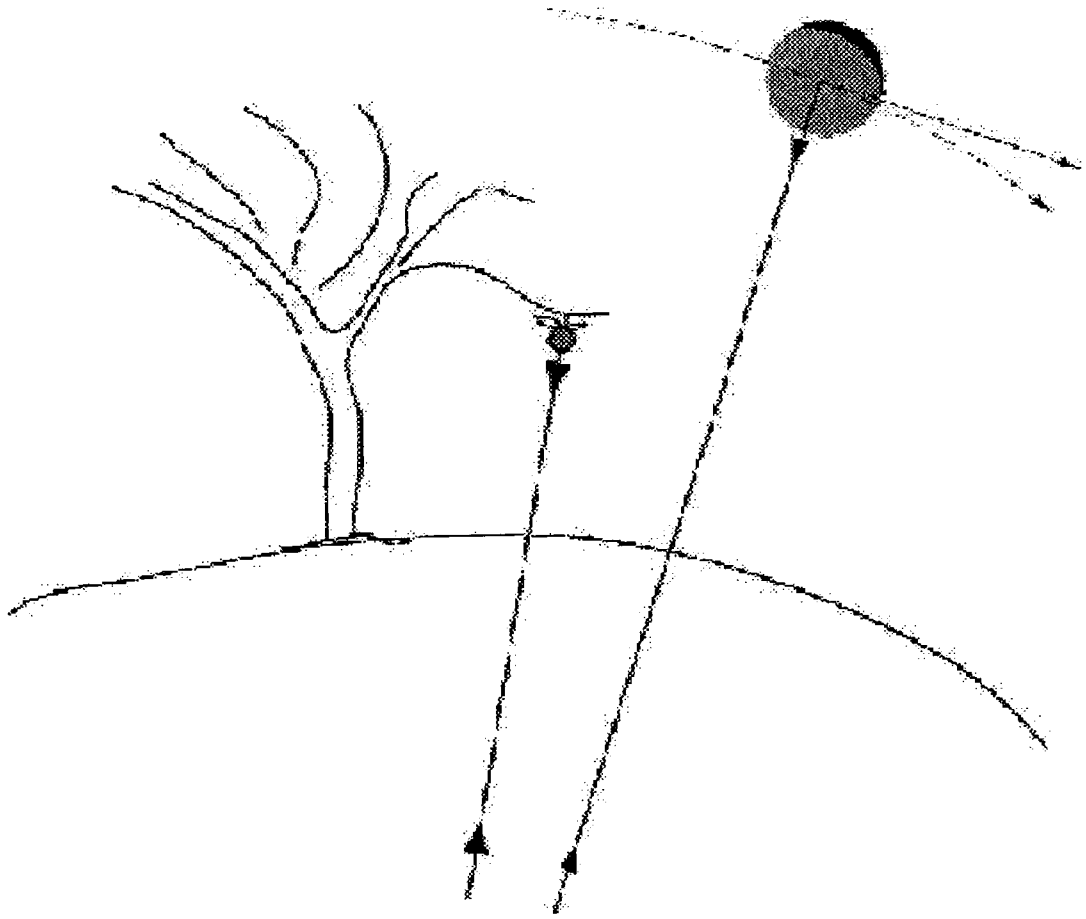
South

This is a part of the night sky showing the retrograde motion of Mars. There are several things to notice:

1. The star chart has to be viewed facing South with the chart above your head to the sky.

2. The position of Mars moves througout the stars slowly from west to east along the ecliptic.

3. Notice the change in the direction of movement of Mars from the middle of March to the end of May. This is its retrograde motion.



This is a diagram of Newton's apple and the moon. It doesn't matter if the story is true or not, as the idea is fundamental to our understanding. Make a list of as many things as you can that Newton was able to say about both the apple and the moon. How did he use the works of both Galileo and Kepler in establishing his law of universal gravity? Why is the term "universal" important?