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Motion

Physics is the science that explores how energy acts on matter. Everything in the universe that we can experience with our senses is made of matter and energy. The Bible recognized this fact in Genesis 1:1–3. After God created earth (matter), He said, “Let there be light [energy].”

Matter has weight and occupies space. Energy can put matter in motion or change it in some way. Physics is sometimes described as the study of matter in motion, but physics is far more than that because physics includes exploring not only motion, but also sound, heat, light, electricity, magnetism, and nuclear energy.

Physics goes far back in time. Aristotle, an ancient Greek scientist, lived more than 2,000 years ago. The Greeks made an effort to gain knowledge through observation and reasoning. However, they seldom did experiments, which are observations that can be repeated under

PROBLEM

1. How do modern scientists test new ideas?
2. What discovery helped clocks keep better time?
3. How did Galileo slow the motion of falling balls?

Can You Propose Solutions?

controlled conditions. Without experiments, they could not repeat what they observed to test their conclusions.

For instance, suppose they saw a leaf fall from a tree and later saw an apple fall from the same tree. They might speculate as to why the apple appeared to fall more quickly than the leaf, but they would not think to pick up an apple and a leaf and drop them together.

In addition, measurement is essential to good science. Scientists must be able to measure quantities such as weight, distance, time, temperature, electric current, and light intensity. Ancient people had few accurate scientific instruments, so they could not easily measure what they observed. Ancient scientists could only state what they discovered as general conclusions rather than precise scientific principles.

For example, they might see a heavily loaded cart roll down a hill and conclude that it gained speed. From one moment to the next it rolled faster and faster. However, they had no accurate clocks, so they could not time the cart and measure its actual speed.

The first person to make real progress in understanding physics was Galileo, a scientist who lived in Italy almost 500 years ago. Like

the Greeks, he had a brilliant and inquiring mind. In addition to thinking and observing, he was willing to experiment. Experiments are a great way to collect scientific information and test new discoveries.

Galileo entered the University of Pisa in 1581 to study medicine. Europe at that time was coming out of a period known as the Middle Ages. The Middle Ages were sometimes called the Dark Ages in Europe because learning had been in a deep decline. Most people—including leaders of countries—could neither read nor write.

In these dark days, scholars held in high regard the confident writings of Aristotle and other Greeks who lived almost 2,000 years earlier. People of the 1500s turned to ancient books as final authority on scientific matters. They saw no reason to question Aristotle's books or test his statements.

During his first year at the university, Galileo discovered an important principle that ancient Greeks had completely overlooked.

Students at Pisa began their day by going to chapel. One morning Galileo knelt and said his prayers in the dark chapel. He arose to watch a lamplighter light the candles in a lamp which was hanging 30 feet from the high ceiling.

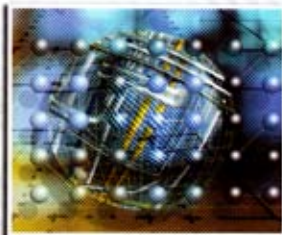
Lighting the candles caused the lamp to move in a slow back and forth motion. As its motion died down, it seemed to take as long to make a small swing as a large one. Galileo timed the chandelier swing with his pulse.

Galileo returned to his room to try other pendulums. Experiments showed that the time for a complete swing was the same whether the arc was a small one or a large one.

Galileo's discovery is known as the principle of the pendulum. A principle is a law of science. In this case, Galileo had found that two pendulums of the same length would swing at the same rate regardless of how wide or shallow



Aristotle taught his students to learn through observation and reasoning.



EXPLORING THE WORLD OF PHYSICS

Physics is a branch of science that many people consider to be too complicated to understand. In this exciting addition to the "Exploring" series, John Hudson Tiner puts this myth to rest as he explains the fascinating world of physics in a way that students from elementary to high school can comprehend.

Did you know that a feather and a lump of lead will fall at the same rate in a vacuum? Learn about the history of physics from Aristotle to Galileo to Isaac Newton to the latest advances. Discover how the laws of motion and gravity affect everything from the normal activities of everyday life to launching rockets into space. Learn about the effects of inertia firsthand during fun and informative experiments.

Exploring the World of Physics is a great tool for students of all ages who want to have a deeper understanding of the important and interesting ways that physics affects our lives and is complete with illustrations, chapter questions, and an index.

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