

PSI:

PHYSICAL SCIENCE INVESTIGATION



Teacher's Lesson Description

Title	One Good Turn
Brief Description of the Videos	In these videos, Dante demonstrates a spinning bicycle wheel and its ability change the movement of an object. This spinning bicycle wheel is similar to a top and a gyroscope. Students will use scientific inquiry to ask questions, test hypotheses, analyze data, communicate results and identify questions for further investigations as they design the perfect top.
Time Needed	Two class periods.
Ohio Science Benchmarks Addressed	<ul style="list-style-type: none">• Grade 6-8 SI Benchmarks A & B• Grade 6-8 SW Benchmarks A & B• Grade 6-8 ST Benchmarks A & B• Grade 6-8 PS Benchmark B•
Ohio Grade Level Indicators Addressed	<ul style="list-style-type: none">• Grade 6 SI Indicator 1, 2 & 3• Grade 7 SI Indicator 1, 2, 3, & 4• Grade 6 SW Indicator 4• Grade 7 SW Indicator 3• Grade 8 SW Indicator 1• Grade 6 ST Indicators 1, 4, & 5• Grade 7 ST Indicators 1, 3, & 4• Grade 8 ST Indicators 3 & 4• Grade 8 PS Indicator 3

	<ul style="list-style-type: none"> •
<p>Concepts Developed</p>	<p>Scientific inquiry is the development of a questioning system that allows students to make sense of the world around them. Inquiry includes the processes of observation, inference and prediction. When conducting an experiment, the observations made may lead to new questions.</p> <p>Scientific explanations for some concepts (the gyroscope) may seem difficult but beginning explorations in similar concepts can give students the skills needed to later tackle these more difficult concepts.</p>
<p>Lesson Rationale</p>	<p>The Earth is a large top. It spins on its axis and this creates the concept of day and night. Students will explore the concept of spinning on an axis as they use inquiry methods to will explore the affect of mass, velocity, diameter and mass location on the spinning of a top.</p>
<p>Background Knowledge for Teachers</p>	<p>Scientific inquiry describes how scientists go about finding answers to questions about the natural world. It begins when a question is asked and continues as you look for the answers. The goal of scientific inquiry is to understand and explain the natural world. Scientific observations are a large part of inquiry. They involve using your senses to describe the world. Observations are often made during experiments. Sometimes measurements are taken and added to your observations. These eventually lead to a prediction about what has been observed and measured.</p> <p>Earth has two major movements. Rotation on its axis is one. Earth spins from west to east. Earth's axis is an imaginary line that runs from its North Pole, through its center, to its South Pole. Each complete spin around the axis, or rotation, takes about 24 hours. Also, for its second movement, Earth revolves, or circles, around the sun. The combination of the Earth's tilt and its revolution around the sun produces Earth's seasons.</p> <p>A top is a toy that can be spun on an axis, balancing on a point. Holding the axis firmly while pulling a string produces this spinning motion. An internal weight then rotates, producing an overall circular motion. The action of a top relies on the gyroscopic effect for its operation. Typically the top will at first wobble until the shape of the tip and its interaction with the surface force it upright. After spinning upright for an extended period, the angular momentum, and</p>

	<p>therefore the gyroscopic effect will gradually lessen, leading to ever increasing precession, finally causing the top to topple in a frequently violent last thrash.</p>
<p>Classroom Procedures</p>	<p>This lesson is designed to be an exploration using scientific inquiry. Students view the video, make observations, pose and formulate testable questions that they will investigate.</p> <ul style="list-style-type: none"> • Have student share their written observations from the video. Tell the student that they are going formulate testable questions to explore (What if...is a good way to pose these questions.) • List the students “what if” questions. As a class, determine which questions are testable. (single independent variables) • Divide students into groups of 3 or 4 (depending on available materials and space). • Each group will explore a different independent variable. TEACHER NOTE: Using a question template will identify the independent and dependent variable for students i.e. DOES (INDEPENDENT VARIABLE) AFFECT (DEPENDENT VARIABLE) • Example: DOES (the weight being close to the center axis) AFFECT (the length of spin time)? • Possible independent variables are the overall mass of the top, the diameter of the top, the velocity of the spinning, the distribution of the weight from the axis, etc. • Student groups will share their testable question and formulate a hypothesis statement. • The group will write and execute their experiment. • Each group will orally explain what they did and the results they obtained. • Teacher led discussion about how a top is similar to the Earth.

	<p>Possible discussion questions: What things affected the spin of the top? What made the spin of the top longer? Shorter? How is this similar to the rotation of the Earth?</p>
Materials Needed	<p>Tops Skewers Tag board Pennies for weights String</p>
Science Connections	
Additional Web Resources	<p>Gyroscope Web Links</p> <p>Self-balancing Scooters http://tlb.org/scooter.html</p> <p>How Segway Scooters Work http://science.howstuffworks.com/ginger1.htm</p> <p>Engineering Week “Roomerang” http://www.eweek.org/site/DiscoverE/PDFs/middle/Here%20It%20Comes%20Again.pdf</p> <p>Exploratorium Activities with the Bicycle Gyroscope http://www.exploratorium.edu/snacks/bicycle_wheel_gyro/</p> <p>Uses of Gyroscopes http://www.gyroscopes.org/uses.asp</p> <p>Yo-yo’s and the Science of Spin http://www.sciencenetlinks.net/lessons_printable.cfm?DocID=456</p> <p>Spin Around – A YouTube Science Video http://www.youtube.com/watch?v=XT261O7jXh4&feature=related</p>

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Ohio Science Standards Abbreviations:

ES – Earth/Space Science

SI – Scientific Inquiry

LS – Life Sciences

ST – Science and Technology

PS – Physical Sciences

SW – Scientific Ways of Knowing

