



GASP Professional Development Project **Visual Arts**

Model Project: The Spinning Tops—A Hands-On Approach To Woodworking, Math And More

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Introduction

Project-based learning offers students the opportunity to connect with academics through a hands-on approach. Many students find this approach to be a very effective way of learning that reinforces what has been learned in the classroom as well as introduces academic subjects from a different angle. Through project-based learning academic detail can become very relevant as students are actively engaged with the content during the learning process. Project-based learning is not only about developing hand skills but is also about presenting information in a way that is easy to assimilate and likely to be retained. Project-based learning forms connections between different subject areas and the same project can be used to facilitate understanding at several grade levels.

The making of wooden spinning tops is a project-based visual arts project that offers students all of these opportunities as well as allowing them to develop craft, envision, observe and reflect. As students begin assembly of their tops they are introduced to concepts of inside and outside diameter, friction, compression, momentum and force. Through painting their tops students explore and gain understanding about the effects of color combinations and the effects of different hues of the same color. The finished tops give the students the opportunity to observe and understand concepts of stability, center of gravity, velocity and direction of forces. As the tops spin students can reflect, predict and describe the movements of the two differently shaped tops as well as describe the effects of the colors that were used to paint them.

Arts Area and Grade Level Focus

Visual Arts – Design, Construction and Painting, K-3rd grades and 6th -8th grades with appropriate scaling up or down

Connection To Elements of Art/Principles of Design

The Spinning Tops Project emphasizes **shape** and **form** through the process of constructing wooden tops, **color** through the design and painting of the tops and **movement, balance and proportion** through use and observation of the completed tops.

Connection To Core Curriculum and Content Standards

Mathematics

K-3rd Grades: Students learn to reason with shape and their attributes; model with mathematics, describe and compare measurable attributes; identify greater than and less than; analyze and compare shapes as two-dimensional or three-dimensional; and build shapes from components using geometric measurement.

6th-8th Grades: Students learn to identify and give verbal description of proportional relationships; construct and describe geometrical figures and describe the relationship between them; identify the formula for area and circumference of a circle; investigate chance processes and develop a probability model by collecting data; solve mathematical problems involving surface area and volume; know the formula for the volume of a cylinder; model with mathematics; and reason abstractly and quantitatively.

Physical Science

K-3rd Grades: Students learn how tools are used to apply force to make things move and how the motion of objects can be observed and measured.

6th-8th Grades: Students develop a hypothesis and perform an investigation; understand how levers confer mechanical advantage; describe velocity, its direction and speed; identify forces, their magnitude and effect; and explain effects of gravity, friction and rate of change in motion.

Social Studies/ History

K-3rd Grades: Students differentiate between things that happened a long time ago and things that happened yesterday.

6th-8th Grades: Students examine early civilizations of Egypt, Greece, Rome, China and India as well as the exchange of ideas in Medieval and Early Modern times.

Visual Arts

K-3rd Grades: Students create three-dimensional arrangements; experiment with color; discuss art objects from various places and times; identify elements of art in nature; replicate patterns in nature; and demonstrate skill in the manipulation and use of materials.

6th-8th Grades: Students describe how balance is used in art, describing symmetrical, asymmetrical, and radial; discuss works of art created in the classroom, their shape and form; and apply what is learned in visual arts across other subject areas.

Steps and Tips

The wooden rings of the spinning tops are held on to the center shaft by compression. Students arrange the rings in a specified order according to their outside diameter and then tap the center shaft into the center hole of the wooden ring using a hammer. The students create two shapes of tops, one with a high center of gravity and one with a low center of gravity. Students then explore color combinations as they paint their tops. As the finished tops are spun students talk about and explain their observations.

Step One: (15 minutes) Students are shown the two shapes of the tops that they will build, one with a high center of gravity and one with a low center of gravity. Students are also shown two shapes that occur in nature (an acorn and a conical shaped seashell) and talk about the similarities to the tops. They are given a demonstration of how the tops spin using a pull string and handle as well as twisting with the thumb and fingers. Students are given a brief history about the origin and early use of tops dating back over 5,000 years ago, using the *Spinning Tops History Handout* (see **Supporting Resources**). Students are given a description of the materials that have been used to make tops throughout history from the ceramic tops in the Middle East (3,500 B.C.), the wooden tops in Egypt (2,000 B.C.) and tops made of bone in Rome (27 B.C.). Students receive a box containing wooden rings of different sizes, two center shafts, a handle with a pull string and a pad to assist in assembly. Refer to the *Spinning Tops Construction Plans Handout* (see **Supporting Resources**) for details of sizes. Students arrange the wooden rings according to their numerical labeling.

Step Two: (30 minutes) Students receive a lightweight hammer and are instructed in the proper hand placement. Students are given a description of how the momentum of a swinging hammer is used to create driving force. Students tap a center shaft into the wooden rings following a numbered pattern to create their spinning tops. The wooden rings and center shaft are held together by compression. At this point the students are encouraged to spin their tops and observe how they work.

Step Three: (45 minutes) Students work in pairs sharing and combining colors as they paint and decorate their newly built tops. Students explore the color wheel through painting the tops either in various hues of one color that when the tops are spinning become a single version of that color or by painting the tops two different colors that when the tops are spinning combine to create a new color. The tops are set aside to dry.

Step Four: (30 minutes) Students receive a lesson in how to use the pull string with the handle and then practice spinning their completed tops. Students observe the patterns that the differently shaped tops produce as they spin. Students are encouraged to talk about the concept of an object's stability and the effect that high center of gravity or low center of gravity has on it. Students talk about the difference between rotational force and driving force. Students discuss the effects of mass and diameter on the length of time that an object will spin and the amount of energy needed to make it spin. Students will compare velocity and longevity of the spinning tops. Students will discuss the cumulative effects of these variables and then describe and predict the movement of the tops.

Tools and Materials

The following tools and materials can be purchased at Friedman's Home Improvement at www.friedmanshome.com or at The Home Depot at www.homedepot.com:

- 1/2 inch Birch plywood to make the wooden rings for the tops.
- 3/8 inch hardwood dowel stock to cut for center shafts.
- 3/4 inch by 3 inch Clear Fir lumber to make the handles.
- Light weight 9 ounce hammers. [Note: Although I show up with 25 hammers I have found that it is best to work in groups of six as the cumulative sound of 25 hammers tapping at the same time is a bit loud, therefore, 6 hammers are adequate.]

The following can all be purchased at Michaels at www.michaels.com:

- Flat-tipped paint brushes with medium length (between 3/8 inch and 5/8 inch) synthetic bristles that stay firmly in place and have short handles work well.
- Semi-gloss acrylic paints in 2 ounce bottles and a wide variety of colors and hues.
- Mixing trays to dispense the paint into that allow the students to work together as they paint.
- Low adhesion masking tape to put on the center shaft to keep it free of paint.
- 1/16 inch hemp cord cut to 20 inches in length and knotted on the ends for pull string.

Supporting Resources

- Spinning Tops History Handout
- Spinning Tops Construction Plans Handout [Note: Building plans with construction details for both high center of gravity and low center of gravity tops with handle details can also be obtained by contacting Chris de Firmian at cdefirmian@gmail.com.]
- For instructional videos on connecting woodworking to core curriculum math standards: www.buildingtoteach.com.
- For examples of project-based learning in the classroom: www.edutopia.org.

Project Objectives & Habits of Mind

The integration of building the spinning tops with concepts related to math, physical science and art gives the students the opportunity to connect with multiple subject areas through one project. The spinning tops project allows students to visually and physically understand concepts that are related to core curriculum standards. Students see and understand that small differences can have large effects.

Objective One: Students **develop craft** by learning to use tools (hammers) and materials (wooden rings and shafts) while assembling their tops. They learn to use paint brushes and colors while exploring color combinations as they paint and then spin their tops.

Objective Two: Students **envision** by developing skills in seeing and creating three-dimensional objects from two-dimensional pieces as they build their tops from flat wooden rings.

Objective Three: Students **reflect** on the concepts of stability, center of gravity, direction of forces, momentum and friction as they spin their tops. Students also reflect as they evaluate patterns and color combinations that they are using while painting their tops.

Making Learning Visible



Students building their tops from wooden rings and student with completed tops.



Painting tops with flat-tipped brush and acrylic paint and finished spinning tops

Tips for Scaling Project and Further Opportunities

This project is well suited for students in K-8th grades and can easily be expanded to engage high school students by having them make the spinning top kits for younger students as part of an expanded cross-age project. The pieces for the tops are made by using various size hole saws and a drill press as detailed in the *Spinning Tops Construction Plans Handout* (see **Supporting Resources**). Both the saws and drill are available at high schools where there are woodshop programs. Another cross-age opportunity is to engage college students in woodworking programs (locally in Mendocino County, for instance, from *The Fine Woodworking Program* at the College of the Redwoods), with students using lumber left over from furniture building projects to make the top parts. Further exploration into color could be explored by combining the different types of furniture grade lumber to create tops with a natural rather than painted finish.