

## SNC2P Light and Applications of Optics

### Teacher Demonstration/Student Activity: Additive Colour Theory – Spinning Colour Tops

Topics	Timing
additive colour theory	preparation: 10–30 min demonstration: 15 min

#### Specific Expectations

##### SNC2P

- A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research
- A1.5 conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data
- A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions
- E3.5 use additive colour theory to predict the results of combining primary and secondary light colours
- E3.8 explain how the properties of light or colour are applied in the operation of an optical device (e.g., a reflecting telescope, stop lights, stage lights)

#### Introduction

A circular disc is made with two or more colours of the visible spectrum in equal area sectors. The disc is spun and a different colour appears.

#### Materials

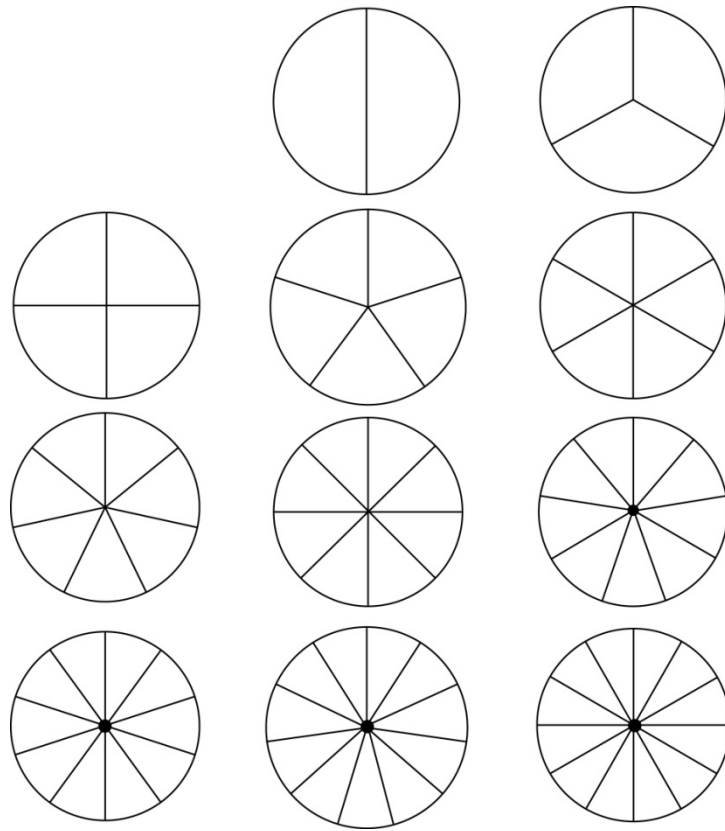
old CD or DVD	coloured markers or pencils
circle of white paper (of the same diameter as the CD)	glue
	marble

#### Safety Considerations

None

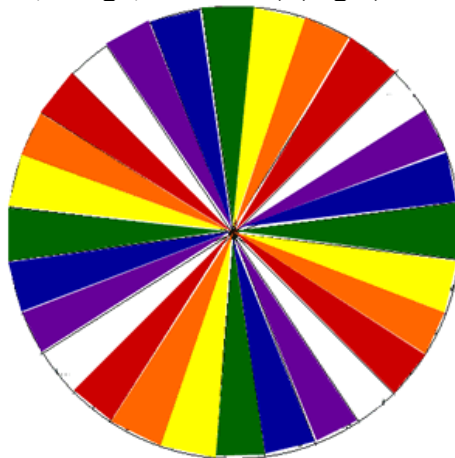
#### Procedure

1. Prepare the coloured discs ahead of time. Cut or poke a hole in the middle of the white paper circle.
2. Divide the paper into two to 12 sectors of equal size as shown in Fig.1.



**Fig.1** Divide the circle into equal sectors.

3. Use coloured markers or pencils to colour the sectors using a combination of various colours. It is a good idea to use an equal combination of the primary colors (red, green, and blue) or with an equal combination of the seven colours of the visible light spectrum (red, orange, yellow, green, blue, indigo, and violet) (Fig.2).



**Fig.2** Colour the sectors.

4. Glue the circular paper onto the CD or DVD.

5. Glue the marble to the hole in the CD or DVD, underneath and on the opposite side to the coloured sectors. Wait until the glue dries completely.

When the class begins, arrange the students into small groups of 2 or 3.

6. **Predict/Explain**

Ask students to predict, individually, what they will see when you spin the disc. Students should then explain their predictions to their group.

7. **Observe**

Spin the colour spinning wheel and invite students to note the colour changes.

8. **Explain**

Ask the small groups to reconvene and revise their explanations, if necessary. Challenge students to suggest a model to help explain their observations.

## **Disposal**

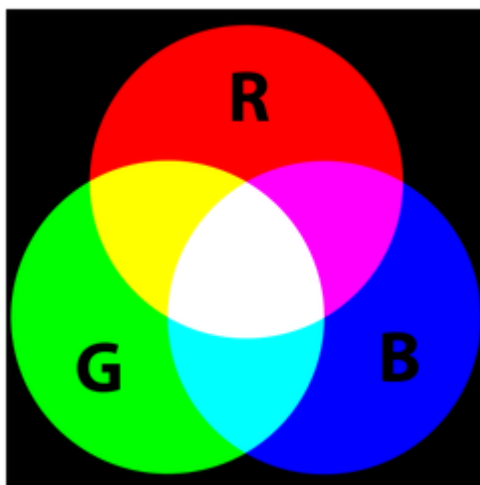
No special concerns

## **What happens?**

This demonstration has an interesting history and it is often referred to as Newton's Colour Wheel or Newton's Disc. As the disc spins, the colours blend together to form a new colour or hue.

## **How does it work?**

The light reflected from the colours is visually mixed together to cause the effect. Mixing red, green and blue will result in white (Fig.3).



**Fig.3** Additive colour theory

Fig.3 shows how coloured light adds together. Note that the eye adds three primary colours of light (red, blue, and green) to give white light. The eye also sees a combination of the secondary colours of light (yellow, magenta, and cyan) as white light.

### **Teaching Suggestions/Hints**

1. Prepared colour circles are available online. (See Additional Resources.)
2. Students will often confuse the addition of coloured light (in which the primary colours are red, green, and blue) with the mixing of coloured pigments or paints (in which the primary colours are magenta, cyan and yellow). You may need to clarify this distinction.
3. This demonstration can be extended to vary the combinations and proportions of colours. A Predict, Explain, Observe, and Explain (PEOE) framework works well in this case.

### **Next Steps**

Students could try different combinations and amounts of various colours. It is easy to connect this activity to the operation of colour liquid crystal displays (LCD). A colour LCD pixel must have three subpixels with red, green, and blue colour filters. By varying the voltage to each subpixel, a combination of coloured light creates a unique colour for that pixel. For example, if one had full voltage in the red, green and blue subpixels, one would see a white dot. A 10 × magnifier (or even a small drop of water) will allow students to see these pixels on a monitor screen.

### **Additional Resources**

1. Web site with detailed instructions and pictures of colour circles - <http://www.kidsmakestuff.com/articles/show/n4kg>:
2. Web site showing this demonstration - <http://www.youtube.com/watch?v=ZUIRH5ouBrY>