# Kaleidoscope

**Category:** Physics: Light & Optics

**Type:** Make & Take

## Rough Parts List:

| | |
|---|---|
| 1 | Paper towel tube |
| 1 | Sheet of transparency paper |
| 1 | Sheet of foil |
| 1 | Sheet of colored paper |
| 1 tsp. | Colorful, transparent and translucent beads |

## Tools List:

| |
|---|
| Scissors |
| Tape |
| Pen |
| Ruler |

**Video:** www.youtube.com/user/OaklandCSW

**Blog Link:** www.oaklanddiscovery.blogspot.com

## How To:

Use a pen to mark three dots 1 3/8” inches apart from each other starting from the long edge of the transparency sheet.

Fold the transparency sheet lengthwise into a triangular prism, using the dots as guidelines.

Trim any extra of the transparency sheet and tape ends together.

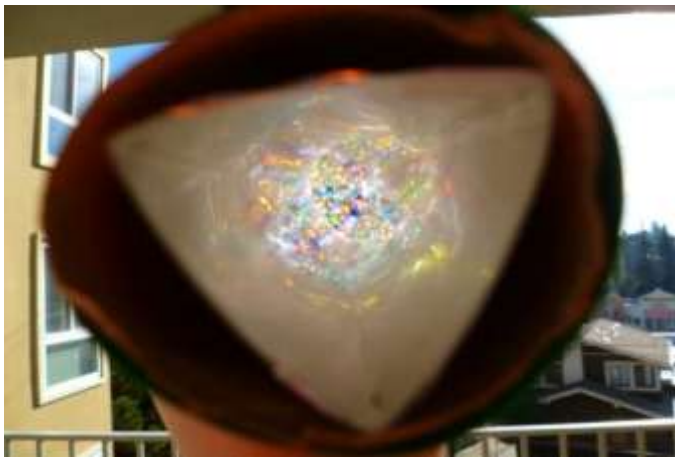
Fold foil around the outside of the triangular prism, shiny side facing inward. Tape in place. Try not to make any uncessesary wrinkles.

Insert the foil covered prism into the paper towel tube.

Make sure that it has maintained its triangular shape. Make adjustments as needed.

Use one end of the paper towel tube and a pen to trace two circles onto the leftover transparency sheet and cut them out.

Place colorful beads between the two transparancy pieces and tape the edges together.



Insert the bead packet into one end of the kaleidoscope and use tape to keep it in place.

***Make sure that the end you put up to your eye doesn't have any sharp edges!*** Hold your kaleidoscope up to your eye and look at a soft light source. Spin it around to see changing and colorful images!

## Fine Points:

→ Make sure to crease the transparency paper very sharply so it holds its triangular prism shape.
→ The triangle should fit loosely inside the paper towel tube; if it fits too snugly, the shape will become distorted and it won't reflect images as well.
→ Use a mixture of small and large transparent beads; the larger beads will allow the small beads to fall around as the kaleidoscope turns.

## Concepts Involved:

- Kaleidoscopes work because the mirrors inside reflect the incoming light multiple times.
- The triangular prism of mirrors inside the kaleidoscope is an equilateral triangle: three equal sides and three equal angles.

## Focus Questions:

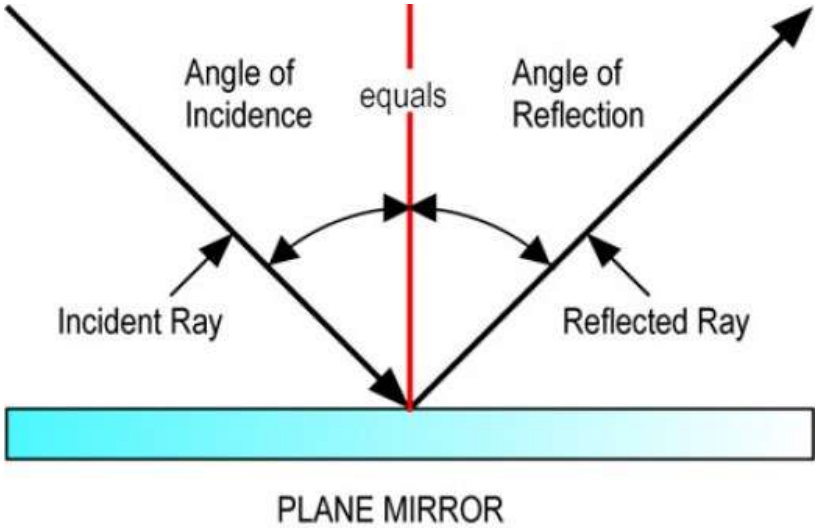
1. How many different reflections can you see through the kaleidoscope? Pick one bead and count how many times you see its image. Are all the images the same shapes and sizes?
2. Try looking through the kaleidoscope without the pouch of beads. What do you see? How does the world around you look?
3. What happens when you look through the kaleidoscope when there isn't very much light? How is it different from when there is a lot of light? Why do you think there is a difference?

## Elaboration:

Light comes from things that glow or shine. We can see because light gets in our eyes. When it's completely dark, such as in a cave or in a closet under a blanket at night, we can't see anything. Light coming from a source bounces off things in many directions. This is called *scattering.* This is why you can see the table while standing in any part of a room.

Light behaves differently when it encounters a mirror. Light rays bounce, or reflect, off mirrors in only one direction and at the same angle in which the light hit the mirror. This angle that light hits the mirror

is called the angle of incidence, and the angle that the light reflects from the mirror is called the angle of reflection.




http://the-pink-panther.hubpages.com/hub/Reflection-and-Refraction

Together, the transparency paper and foil reflect enough of the light that comes in the opening to act like a mirror. Since the transparency paper and foil are folded into a triangle with equal angles and equal side lengths, they form a prism shaped like an equilateral triangle. Each panel of the mirror is 60° from the others. Light can reflect from one to another many times, each time becoming a bit dimmer. The bits of light that end up in your eye form the wonderful image you see through the kaleidoscope.

If you remove the beads, you'll see the world around you kaleidoscope-ized. Looking at a single thing, such as a marble, will give information about how each image is formed. If you look carefully you can try to figure out how many times each image has reflected before it ended up in your eye.

## Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 3 Standard Set 2. Physical Sciences:
Light has a source and travels in a direction.
2.b Students know light is reflected from mirrors and other surfaces.

Grade 7 Standard Set 6. Physical Principles in Living Systems (Physical Sciences):
6.f Students know light can be reflected, refracted, transmitted, and absorbed by matter.
6.g Students know the angle of reflection of a light beam is equal to the angle of incidence.