KALEIDOSCOPES AND DESIGN TECHNOLOGY IN GRADE 4

Barbara A. McMillan

This article is for enthusiasts of kaleidoscopes and teachers of the grade 4 science curriculum who might be more interested in having children design and develop kaleidoscopes for the light cluster than a periscope or other optical device that transmits and reflects light (SLO 4.2.14).

The kaleidoscope is a "magical" instrument that produces changing patterns of unexpected beauty. It was invented in 1813, one hundred eighty-eight years ago, by Sir David Brewster, a natural scientist from Scotland. His invention is known today as the teleidoscope. Unlike kaleidoscopes manufactured with an attached object chamber, the teleidoscope makes a pattern out of the object or objects at which it is pointed. In addition to the teleidoscope, there are three common types of kaleidoscopes. These are the cell scope, the wheel scope, and the sphere scope. Each is distinguished by the object chamber or end piece. The cell scope has an enclosed container at the end of the optical system that is filled either with tumbling objects or objects floating in a liquid. The wheel scope, like its name suggests, has a wheel attached to the end of the optical system that can be turned. The wheel is usually greater in diameter than the body of the scope. It can be made of stained glass, crystal, found objects that are mounted on a disk, or hand-drawn and photographic images that are glued to a disk. A glass marble or crystal sphere is the viewing object that is placed at the end of the body of a sphere scope.

Irrespective of the kind, all kaleidoscopes have four component parts, namely: the eye piece; the body that contains the reflective surfaces; the optical, or mirror system; and the object chamber. The eyepiece can be as simple as a circular- or triangular-shaped opening or as complex as cut glass or a ground lens. The body in its plainest form is a cardboard cylinder without ornamentation. Elaborate flared, curved, and tapered cylinders of rigid plastic, metal, wood, ceramics, fabric or blown glass are common shapes and materials used by contemporary makers of kaleidoscopes. The optical system has traditionally been a two- or three-mirror system. It's not uncommon to now find acetate, metal, foil and mylar in place of glass mirrors. The two-mirror system is V-shaped, and the three mirror system is any form of triangular prism. The angle of the "V" determines the pattern of replication with a 90° angle producing fewer images than smaller, acute angles. This is nicely illustrated on John Haug's web site http://www.pclink.com/jhaug/howto.html#angle with a mirror angle chart and samples of 60°, 36° and 15° angles. Unlike the two-mirror system that produces a single, symmetrical, circular, snowflake-like image, the three-mirror system produces a faceted pattern that fills the field of view (see http://www.kaleido.com/systemgd.htm for beautiful illustrations of these differences). Cell and wheel scopes have object chambers, often interchangeable, at the end of the body. Objects in the chamber freely tumble, changing the image, as the entire body and affixed chamber are rotated or as the chamber (wheel) is turned around a fixed body. The contents of the chamber can be any number of objects chosen for their colour, shape, texture, weight and transparency. Objects like coloured beads, trinkets, glitter, glass and metal fragments, confetti, sequins, flower petals, and insect wings are commonly used.

The kaleidoscopes most often recommended for construction by children are the two or three-mirror teleidoscope (see the following web sites: http://www.pclink.com/jhaug/howto.html#build; http://www.amazable.com/cgi-bin/projects.asp?mode=getrec&rec=5) and the cell scope (see the following web sites: http://www.xited.co.uk/dandt/keleidoscope/index.htm; http://www.thebizpost.com/kids/activities/kaleidoscope.html). These are made using box board, cardboard tubes, potato chip containers, or PVC pipe. The nice thing about the teleidoscope is that the degree of the angles of the optical system can be changed and the effects explored before the reflective surfaces are taped permanently in place.

If, however, you are looking for a design that is simpler in construction yet provides stunning images, it is suggested that you try the wheel kaleidoscope (see the following web sites: http://www.synergylearning.org/connect/articles/d10.html; http://sln.fi.edu/tfi/activity/math/math-2.html). Substitute materials that you believe would be safe for the children in your class, keeping in mind that the most reflective surfaces for the optical system will create the sharpest images. I have built three mirror systems glued to the inside of matte board that has been shaped into in a 30°, 75°, 75° hollow prism. The object containers are white tag board disks onto which magazine illustrations are glued, images are painted, drawn, or rubber stamped, or flat objects affixed. Each disk has a small hole centrally placed. A pushpin inserted through this hole is used to hold the disk to the end of the kaleidoscope at the top of the 30° angle. Looking through the opposite and open end of the kaleidoscope, the disk is then gently rotated by hand producing wonderful images.

If you decide to have your students design and build such instruments, the following resources should be among those that you would want to have on hand or have viewed prior to initiating the project. Four copies of the Boswell book and one copy of each of Baker's books are in the Winnipeg Public Library system (call number given). There is also an interesting web site with kaleidoscope applets that your students might enjoy (http://aleph0.clarku.edu/~djoyce/java/Kaleido.html).

Books

1. Cozy Baker. (1987). *Through the Kaleidoscope – and Beyond*. 688.72 BAK
2. Cozy Baker. (1999). *Kaleidoscopes: Wonder of Wonders*. 688.72 BAK
3. Carolyn Bennett with Jack Romig. (1994). *The Kids' Book of Kaleidoscopes*. Workman Publishing Company; ISBN: 1563056380
4. Thom Boswell. (1992). *The Kaleidoscope Book*. 688.72 KAL
5. Cassandra Eason. (1992). *The Kaleidoscope Book and Kit*. Sterling Publishing Company, Inc., ISBN: 080695695X
6. Gary Newlin. (1995). *Simple Kaleidoscopes: 24 Spectacular Scopes to Make*. Sterling Publishing Company, Inc., ISBN 080693154X
7. Gary Newlin. (1996). *Simple Kaleidoscopes: 16 Spectacular Scopes to Make*. Sterling Publishing Company, Inc., ISBN 0806931558

Web Sites

1. http://www.exploratorium.edu/snacks/duck_into_kaleidoscope.html (directions for making a kaleidoscope in which children can stand)
2. http://www.discribe.ca/tartans/famscots/brewsterd.html (biographic information on Sir David Brewster)
3. http://www.kaleido.com/ (check out the thorough F.A.Q.s About Kaleidoscopes and the Featured Scopes and Artists, this online catalogue has wonderful illustrations of contemporary kaleidoscopes)
4. http://members.spree.com/thearts/scopemuseum/default.htm (Virtual Kaleidoscope Museum, only the first floor is active, and it contains images of just about every kind of modern kaleidoscope imaginable)
5. http://www-ah.st-and.ac.uk/mgstud/reflect/david.html (biographic information on Sir David Brewster)