Shadows and Projected Images

DaVinci gave a great deal of attention to the study of shadows. According to Isaacson he wrote more than fifteen thousand words on the topic. DaVinci felt that shadows were very important for making art. "Shadows are the means by which bodies display their form." (Isaacson, p266-277). Isaacson reports that DaVinci carried out many ingenious experiments coming up with multiple categories of shadows. These findings were applied to his paintings.

In his book The Shadow Club, Roberto Casati presents a history of the exploration of shadows over hundreds of years. They figured in the Greeks invention of geometry and in the evolving understanding of the moon and the planets. Carl Jung wrote extensively about the metaphorical shadow giving it a central role in his psychology.

Shadows then can be a rich phenomena to explore. They offer possibilities for developing some conception about the properties of light and they provide a way of having students play with different ways of drawing geometrical shapes.

In art students have multiple ways of exploring shadows. Different shapes and different kinds of arrangements of lighting can produce interesting aesthetic effects. After some open exploration students can design sculptures or installations that produce interesting shadows. In science students systematically investigate ways of making shadows that reveal properties of light. These explorations do not require special materials. In the outline below I draw upon my own experiences of having students explore shadows. In doing so I did not spend time on the possible connections to geometry although there are real possibilities for doing so. The art activities are suggestions that relate to what is happening in the science explorations.

Drawing shadows can be a way of coaxing students who are inhibited about drawing to try their hand. Moving from just tracing shadows they can try creating shadows of imaginary object.

Examples of Da Vinci work can be found on the internet. An interesting use of silhouettes is by Kara Walker which can be found on the internet.

Materials: Cardboard boxes, flashlights, Super bright LEDs, batteries wire, clear acetate sheets,

A Shadow Box: A special set up is suggested where a cardboard box is made into a mini lab. A rectangular portion of one end is cut out and a transparent plastic sheet tape over this hole. Tracing paper is attached to this plastic. At the other end a small hole

is made so that a LED light or flashlight is positioned to light up the box. Students place different objects in the box, moving them around to explore the shadows created.

The shadow box and detailed explanations of shadows can be found in the curriculum guide *Shadow Play* available at Kelvin,bernie zubrowski

ART	SCIENCE
Personal Silhouettes Using flashlights students can draw the shadows created of their head or other parts of their body. They can study the art work of Alice Walker who used silhouettes.	**Exploring Shadows Outdoors** Students can explore shadows in sunlight using chalk to draw outlines of their bodies and other shapes made from cardboard. A critical observation to be made is that the size of shadow doesn't change as objects are move further away from the ground
Shadow drawings	**A Shadow Box** There are several kinds of explorations that can be done with this box. 1. Three dimensional shapes are projected using modeling clay. 2. Two dimensional shapes are projected using index cards. 3. Wire is made into different shapes and shadows are created.
Light show Using flashlights or LEDs students can create interesting effects by shining light through different kinds of transparent containers and materials. After playing around with the materials, they can be challenged to put on a light show.	"**Shadows" of Transparent Objects** Glass and plastic bottles and containers are placed in the Shadow Box. These materials will result in bright spots and dark spots within the overall outline of the containers. It is an opportunity to introduce the property of refraction.
Shadow Puppet Theater Making human shaped puppets group of students can create a story projecting the shadow of the puppets on a wall. The Indonesian shadow puppetry can be studied. History of the camera obscura and its impact on painting in the Renaissance. Students can also study reproductions of the painting of DaVinci focusing on how he dealt with shadows in the paintings Lady with Ermine and Virgin of the Rocks.	**Shadows" of Thicker Transparent Objects** Water added to cylindrical bottles act like crude lenses. A comb is placed between the light source and the container. The combs give a pattern of rays which can be traced when the rays are bent by the container.

Exploring PIn Hole Cameras
The shadow box can be converted into a pin-hole camera. Where the light bulb was previously a piece of metal can be placed. This metal can have holes of increasing diameter. Students make drawings of different scenes that are projected on the screen at the other end of the hole inside the box.

Making a simple regular camera
Magnifying lenses or other lenses if available are placed over a hole in the box and the resulting images observed.