Shapes in Nature

Introduction:

This lesson introduces the idea that shapes occur throughout nature. In this lesson, students will primarily see unique shapes found within the geosphere. Students will get to see and touch minerals in their crystal form. They will see that crystals form many of the shapes they are learning about! They will see cubes, hexagonal prisms, tetrahedrons, rectangular prism, rhomboids, and even a dodecahedron (12 sides). Students will also practice making model crystals as well as explore a book showcasing more beautiful and unique shapes found in nature.

Standards:

K.G A. Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).

K.G B. Analyze, compare, create, and compose shapes.

1.G A. Reason with shapes and their attributes. 2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

2.G A. Reason with shapes and their attributes. 1. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.[12] Identify triangles, squares, rectangles, rhombuses, trapezoids, pentagons, hexagons, and cubes.

Learning Outcomes:

1. Students will have a greater understanding and recognition of 3-d shapes.
2. Students will understand that simple 3-d shapes come together to form more complex shapes.
3. Students will understand they can find simple and complex 3-d shapes in nature.

Materials Included in this box:

- **Lesson Plan**
- **Mineral samples**
- **Wooden block mineral shapes**
- **Mineral information cards**
- **3-d stick model kit**
- **Shapes in nature book**
- **Mineral poster**
- **Laminated images of minerals/shapes**

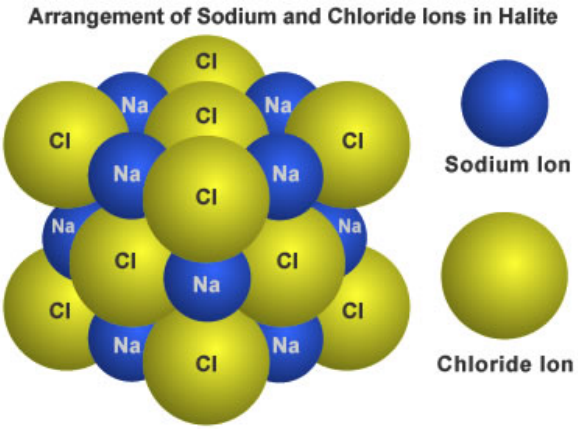
Teacher Background

Introduction

As we all know, 2-D and 3-D shapes occur all throughout the natural world! For example, many fruits and vegetables grow as spheres. For other shapes, like a cube, it is more difficult to think of a natural example. Most shapes in nature tend to be a complex blend of shapes together. But when we look closely, we can find some beautiful examples all around us!

Minerals form many different shapes (including cubes!). To understand why minerals are found in specific shapes we must first understand what makes a mineral, a mineral! In order for a material to be considered a mineral it must fit the following criteria:

1. Naturally Occurring
2. Solid
3. Inorganic
4. Definite Chemical composition
5. Crystalline



If a material meets those five criteria it can be called a mineral! The last two parts of the definition mean that a mineral must have a defined chemical formula and those atoms are arranged in an orderly fashion. A **defined chemical formula** means that the mineral always has a specific proportion of specific elements within its structure. For example, the chemical formula for the mineral Halite is NaCl. This means for every sodium (Na) atom there is one chloride atom attached (Cl). So it has a 1:1 proportion of those two elements. Another example of a defined chemical formula is Quartz which has a formula of SiO_2. This means for each silicon ion (Si) there are two oxygen ions (O).

Crystallinity means that the atoms that make up the mineral are arranged in an orderly way. Halite is considered crystalline because those two ions are arranged in a specific pattern or shape. Halite has a crystal shape that is cubic. You use, and eat, the mineral halite every day! Halite is actually table salt! Alternatively, a substance that is not considered crystalline has ions that are randomly arranged and is called amorphous. An example of an amorphous solid substance is glass.

A Mineral's Shape: Two Ways

If you happen upon a mineral in nature, one that is not contained within a rock, there are two factors that contribute to that mineral's overall shape. The first which we described earlier is crystallinity, or the arrangements of the atoms inside the mineral. Crystallinity is responsible for the shape a crystal grows. When a crystal grows unobstructed, we can see its true shape. Crystals can grow unobstructed in cavities in a rock or in magma that is just beginning to solidify. The shape a crystal takes during its growth is called the **crystal habit.**

There is one other way a crystal will end up in a particular shape and that is through mineral **cleavage.** Mineral cleavage occurs when a crystal breaks along planes of weakness. These occur along planes where the bonds in the crystal structure are weakest, and results in the mineral breaking along a flat/planar surface. Many minerals will have the same mineral cleavage as their habit, meaning they break apart along the same planar surfaces as the crystal habit. For example, halite has a crystal habit that is cubic and also has three 90^{o} cleavage planes (also cubic). Thus, if you take a halite crystal and break it, it will continue to break into smaller and smaller cubes.

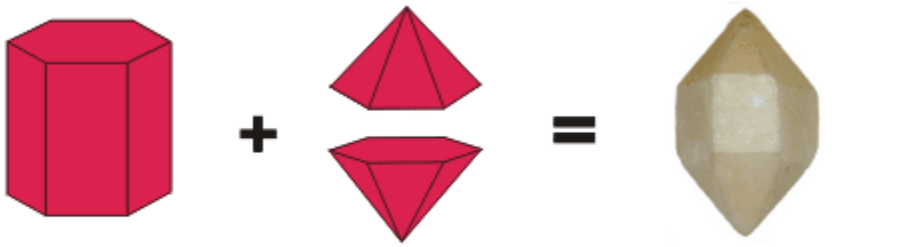
However, in some minerals these planes of weakness do not coincide with its habit faces. For example, the mineral fluorite has a crystal habit that is cubic. But the crystal has four cleavage planes which lends it to break apart into octahedrons.

Fluorite: Cubic Habit

Fluorite: Octahedron Cleavage

Complex Mineral Shapes

As with the fluorite octahedrons, you will see that many times in nature, shapes are combined together. Fluorite octahedrons are two pyramids that are joined together. Quartz crytals can have a habit that is the combination of a hexagonal prism truncated by a hexagonal pyramid on either end. Although in nature, quartz crystals are usually truncated on one end and have a hexagonal pyramid on just one end of the crystal. See the photo's below for examples of quartz crystals. One with two hexagonal pyramids and another with just one.



Many minerals are quite complex in their shape! Included in this lesson is a poster demonstrating different crystal habits - but these are just a few of the hundreds of possibilities. For the sake of this lesson, we will focus on the simpler and easier to identify shapes. But also included is a crystal that has 12 sides to it! A 12-sided shape is called a dodecahedron. The 12-sided mineral included in this kit is a garnet crystal, an example of which is pictured below.

Garnet crystal (var. andradite)

Lesson Instructions

1. Set up the minerals around the room. Place the mineral with its corresponding wooden shape and shape ID card.
2. Set up another station with the 3-D stick model and the additional shape ID cards.
3. You can also have the book available showing unique 2-D and 3-D shapes in nature.
4. Review the 3-d shapes with the students
5. Ask them to identify 3-d shapes around them (ex. rectangular prism = books, hexagonal prism = pencil, cylinder = cups)
6. Next ask if they can think of any 3-d shapes in nature. You can tell them to combine the shapes together.
7. If students don't say crystals, you can hold up a quartz crystal to help them. Some of the students may recognize quarts from jewelry or their own rock collections.
8. Discuss with the students some of the information about how a mineral will form some of the 3-d shapes they know.
9. Show the students the pictures that show how some minerals form perfect cubes!
10. Next, show the photos that show many minerals are a combination of different 3-D shapes.
11. See if the students can identify the different shapes in the photos. Explain how in nature, different 3-d shapes come together to form more complicated shapes.
12. Break the students into groups and have them go around the room to look at the minerals on the table.
13. You can challenge them by placing the shape ID card upside down and see if they can identify the shape of the crystal on their own (some crystals may not have exactly smooth sides… that is nature!).
14. Students should also take turns visiting the stick model station and practice making some crystal shapes.
15. Students can also look through the book provided.

Extensions for Grades 2-3:

Grade 2: Have the students identify the number of faces, vertices, and angles of the mineral samples.

Grade 3: Have the students measure different attributes of the mineral samples. Ex. Area of a face, angles, etc. The students can sort the minerals by shared attributes of their shapes (ex. Quadrilaterals, etc.)