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Skeleton Handprint "X-Ray"

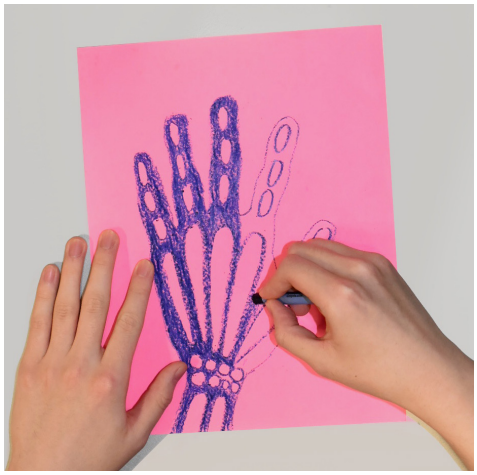
Materials

- *Colored construction paper*
- *Dark-colored crayons*
- *Oil*
- *Cotton swab*

1. Place your hand on the construction paper, along with about 2" of your arm. Trace the outline of your hand on the paper with a colored crayon.

2. Mark the interphalangeal digital creases (the finger joints) with a horizontal line. There should be two lines for every finger except the thumb, which has one.

3. Draw ovals for the phalanges, metacarpal bones, carpal bones, radius, and ulna. (See diagram on other side.) You can, instead, draw the bones as realistically as possible.



4. Using the crayon, color everything within the hand outline except the bones.

5. Dip the cotton swab into the oil and paint all the bones with it, staying within the outline of each bone.

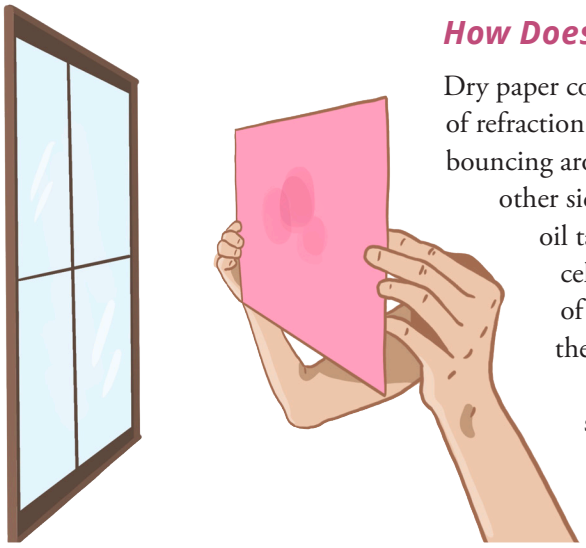
6. Tape the skeleton handprint art to a window. When sunlight hits the bones, the hand should look like a realistic x-ray scan!

Science Behind The Skeleton Handprint

Some Basic Facts about Light

Light is a type of energy called "electromagnetic radiation." In some ways light acts like particles, called "photons," and in some ways it acts like a wave. To explain our skeleton handprint, we use the wave theory of light. Light waves are created by a light source (like the sun or a light bulb) when the atoms inside it gain energy by heating up. The hotter the object gets, the more light waves it can give out.

When light hits a surface, energy can be **absorbed**, **reflected**, or **refracted**. When a light wave hits a substance with a different **density** from the first material it passes through, the light is refracted. The amount that a light wave changes speed and bends when it passes through a material is called the material's **"index of refraction."** Different substances, such as air, paper fibers, and oil, have different indexes of refraction. The bigger the difference between the indexes of refraction of two substances, the more refraction will occur in a material that combines them, and the more **opaque** the material will be. The smaller the difference between the indexes of refraction of two substances, the more **transparent** a material that combines them will be. In **translucent** materials, some light waves are refracted in the material, but other waves pass through the material, allowing a hazy image to be seen of objects on the other side of the material.



How Does Oil Make Paper Translucent?

Dry paper consists of tiny cellulose fibers and air, which have very different indexes of refraction. This means that light gets refracted a lot as it passes through the paper, bouncing around inside the paper and staying there rather than passing through to the other side. This makes the paper opaque. When you swab oil onto the paper, the oil takes the place of the air, filling the gaps between the paper fibers. Oil and cellulose fibers have similar indexes of refraction, which reduces the amount of light that is refracted and **diffused** inside the paper. More light can pass all the way through. As a result, the paper becomes translucent.

The transparency of paper after applying oil will depend on various factors such as the type and thickness of the paper, the quality and quantity of oil used, and the light source used to illuminate the paper. The thicker the paper is, the harder it is for oil to fill in gaps between the fibers, which results in less transparency.

Glossary

- ***Absorb:*** *Soak into the surface*
- ***Density:*** *The number of atoms per unit of volume in a substance*
- ***Diffuse:*** *Scatter*
- ***Index of refraction:*** *The amount that a light wave changes speed and bends when it passes through a substance*
- ***Opaque:*** *Hard to see through*
- ***Reflect:*** *Bounce off the surface*
- ***Refract:*** *Be slowed down or sped up, and therefore, bent*
- ***Transparent:*** *Easy to see through*
- ***Translucent:*** *Semitransparent*

Bones of the Hand