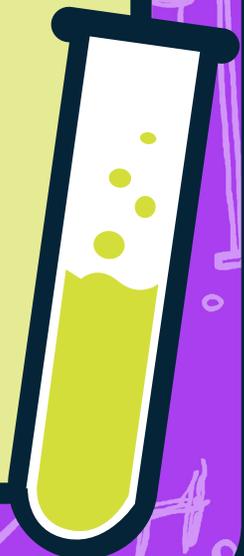


# UNLOCKING SCIENCE HANDSON!

## FOOTWEAR IMPRESSIONS

Footwear impressions are a valuable tool in forensic investigation. Footwear impressions have the potential to leave behind individual characteristics under the right conditions. There are two types of characteristics in investigation: class and individual. Class characteristics in shoes are group characteristics such as brand, size, design, or color. Individual characteristics in shoes are wear marks, cuts, gouges, and damage to the sole of the shoe. Individual characteristics in shoes are unique to the individual that wore the shoe. There is only a 1 octillion (1,000,000,000,000,000,000,000,000 or  $1 \times 10^{27}$ ) chance that two different people wearing the same shoe would have the exact same individual characteristics. That is basically a 0% chance. God made each person uniquely different in the way they walk, in their stride, and in their daily steps, including identical twins. If you walk with your toes out or in, bowlegged, or drag your heels, you leave behind different footprints.

**Extra Family Fun:** Create a criminal scenario where someone stole a sweet treat. Use the suspects shoe to make the footprints and then solve the mystery. Enjoy the treat together.

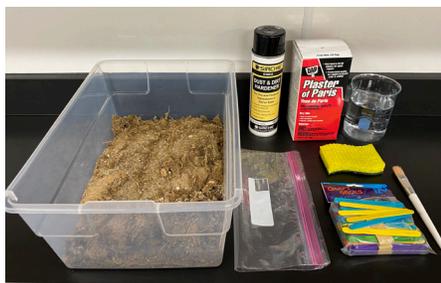


# Making a Cast

## Supplies

- 1 lb. plaster of Paris per impression\*
- 1 gallon plastic zipper bag per impression
- 1 pint (2 cups or about 500 mL) water per impression
- Aerosol hairspray
- Craft sticks
- Paint brush
- Scrub brush, old toothbrush, or sponge
- If indoors, a plastic shoe box or cardboard shoebox that your foot (with shoe on) will be able to step inside.
- Sand/Soil: damp play sand, damp beach sand, or soft clay/dirt mix are preferred. Potting soil contains too much debris to make good prints.

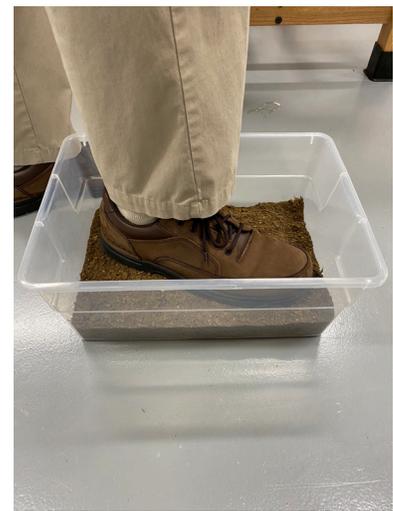
\*Use caution with plaster of Paris. Follow the directions for this activity and do not immerse any body parts (hands or feet) in the mixed plaster to take a mold as it can cause severe burning.



**Figure 1: Supplies**

## Procedure

- 1 **If outside**, clear a patch of ground of leaves and debris, leaving only the soil. **If inside**, fill your plastic/cardboard box about  $\frac{1}{2}$  full of soil and remove any debris like sticks, large rocks, or leaves.
- 2 Select one of your shoes with an interesting tread pattern on the bottom. Step (or walk through) the soil. Observe your shoe print. Is it clear and complete? If not, clear the area and follow the procedure until you have a satisfactory impression. See Figures 2 & 3.
- 3 Add 1 lb. (approximately) of plaster of Paris to a strong plastic zipper bag (1 gallon). The bag needs to be large enough to add sufficient water when ready to cast the impression.
- 4 Using the hairspray, hold the can approximately 1 foot way from the impression and lightly spray the impression in a side-to-side motion. Be careful to not spray too closely that you damage the impression. The hairspray will help to hold the soil particles together while you are pouring the casting material.
- 5 Add the water to the zipper bag (one pint or about 500 mL) and seal it. Holding the bag from the top



**Figure 2**



**Figure 3**

## MAKING A CAST CONTINUED

with your right hand, immediately begin to knead the bag with your left hand. Knead until there are no more lumps (approximately 1–2 minutes). You will now need to work quickly because the plaster of Paris will begin to set.

- 6 Open one corner of the bag. Start approximately 1 inch above one end of impression, slowly pour the casting material just above the impression. You do not want to pour the casting material directly onto the impression, but you want it to flow into the impression. This avoids damaging the details of the print. You should cover the entire impression as well as about a ½ to 1-inch overlap onto the soil around the perimeter. Discard the zipper bag and do not wash the plaster of Paris down your drain!
- 7 Break pieces of craft sticks into 2–3-inch pieces and place into the impression in all different directions to give it strength. Do not press the craft sticks so deep that it damages the impression, but simply lay on the surface and gently wiggle them into the plaster. You may notice the plaster becoming warm to the touch. Do not be alarmed, this is a normal reaction and it should not get so warm that it will burn you.
- 8 **If outside**, the plaster will need to cure (set) for a minimum of 30 minutes. After 30 minutes, gently press on the plaster with your finger. If it is hard to the touch, you will carefully pick up the impression, turn it over, and place on a board or shelf for 24 hours. Do not clean the impression at this point because further hardening needs to take place. **If you are inside**, simply leave the impression in the shoe box for 24 hours. It is best to not pick up the shoe-box since the movement has a tendency to crack the impression.
- 9 After 24 hours, you will be able to clean your impression. Begin by taking it outside. Using a small paint brush, remove any excess soil.
- 10 Using a hose or an outdoor sink, wash the impression with a gentle scrub brush, old toothbrush, or sponge to remove remaining soil. Don't rub too much or you will remove the details.

## Activity: Comparing the Print

Compare the original shoe you wore to create the impression and your lifted impression side by side. Find 5 class characteristics and 5 individual characteristics (see Introduction). Record your information in the Impression Data Table below.

### Impression Data Table

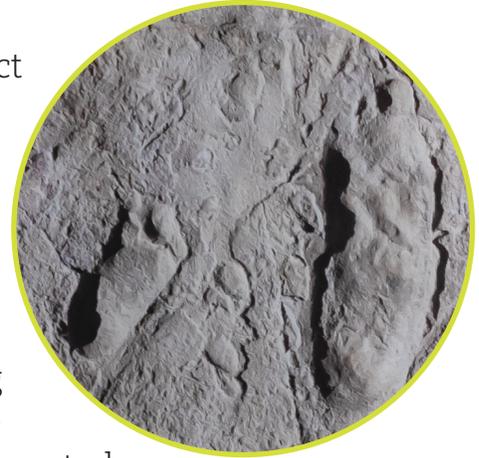
Class Characteristics	Individual Characteristics

## Analysis Questions and Discussion

- 1 Carefully examine the individual characteristics. Can you associate any of the unique wear marks, tears, or gouges in the bottom of your shoes with certain activities that you have participated in? *Discuss the characteristics as they appear on the bottom of the shoe.*
- 2 After you poured the plaster on the impression and it began to set, you may have noticed it got very warm to the touch? Why did this reaction occur? *The heat is generated by a chemical reaction that releases heat (an exothermic reaction). This is why you should never leave the plaster on your skin for a long time, as it can cause burns. plaster of Paris is made by heating gypsum. As gypsum is heated, the water content evaporates leaving behind a white powder. It is called plaster of Paris because there are large deposits of gypsum under the city of Paris which were used early in history for casting. The chemical name for plaster of Paris is calcium sulfate dihydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). Interestingly, when plaster turns from a liquid to a solid, it does not shrink but slightly expands. The plaster undergoes an exothermic reaction when water is added to the plaster powder. The water molecule and the calcium sulfate molecule form a new molecular structure generating heat. Heat is a sign that either a physical or chemical change is occurring.*
- 3 Conduct some research to find other uses for gypsum. *Gypsum is used in many building products, including the sheets of drywall that likely cover your walls. It is used as fertilizer, dough conditioner, in cosmetics, and many other ways.*
- 4 What do you think would happen if you tried to pour a cast in snow? *The heat would tend to melt the snow and ruin the impressions. To successfully pour a cast in compact wet snow, the plaster of Paris and the water must be as cold as possible. It is a good idea to lay out the plaster on a newspaper on top of the snow to let it cool and to use snow in the mixing water. You also want the consistency of the mixed plaster thicker than normal. If the mixture is too thin, it will seep between the snow/ice granules. You will also need to extend the curing time to one hour. Casting in loose snow is a little different. First, you will spray the impression with a liquid plastic spray to provide strength. Next, the impression must be layered with sifted dry plaster and sprayed with cold water. A screen is then impressed into the upper layer for strength. The final layer is applied by pouring a thick mixture of the plaster of Paris and water. The setting time is approximately 2 hours for loose snow impressions.*
- 5 God created humans with a unique gait, or walk, compared to other creatures. When humans walk, they point their feet slightly outwards. Stand up, walk, and look at your feet. Are they pointed outwards? This is because of the anatomical design in our pelvis. There have been fossilized footprints

## ANALYSIS QUESTIONS AND DISCUSSION CONTINUED

discovered that secular scientists claim is an extinct human ancestral ape. They are called the Laetoli footprints. Now, analyzing fossils is historical science not observational. The scientists were not there to observe the footprints being left behind, therefore they make assumptions about what they observe in the present. According to an evolutionary timeline, humans could not have been walking on the earth at the time the Laetoli footprints were made, so they equate the footprints to an extinct ancestral primate. Looking at the prints below, and knowing what we do about human gait, there is no question these are human footprints. Notice, the feet point slightly outward and there is a deep heel strike impression. Primates leave behind very different prints. First, they are knuckle walkers, leaving shallow heel impressions. Second, their pelvis and muscle structure are so different that a typical human bipedal (two feet) gait is impossible for them. On the rare occasion a primate does walk upright for a short distance, the footprints they leave behind are completely different from a human. So, any time you observe footprints, you can quickly determine if they are uniquely created humans made in the image of God.



- 6 God has given everyone a different gait, or walk. You can compare your gait with others by walking through a section of soil that will allow you to leave 3–4 prints. Examine the prints and record as many details as you can. Construct your own data table (research different gait patterns if you like) to record stride length (toe to heel), toe direction, is the print deeper on the inside (pronation) or outside (supination), and any other features you can identify. How could these features be used in crime scene investigation? *If there was a series of footprints, they could be used to estimate the height and weight of the individual and any unique gait features could be used to identify the individual.*

**“Ponder the path of your feet; then all your ways will be sure.” Psalm 4:26 (ESV)**