



The scientific process starts with a question. When a scientific inquiry piques the interest of a high school or college student and answers can't be found in class or in a textbook, students can turn to HHMI's Ask a Scientist Website. There, working scientists field a wide range of biomedical questions.

FOR MORE INFORMATION on friction skin growth and development, visit www.ridgesandfurrows.homestead.com/friction_skin.html.

Do identical twins have identical fingerprints?

We've all heard stories of identical twins taking tests for each other and playing tricks on their teachers because they look so similar. They couldn't fool those trained scientists on *CSI*, though—their fingerprints would quickly reveal their true identity.

Our DNA provides the blueprint for forming most of our anatomy. However, every detail of every structural feature on our body is not encoded in that DNA instruction set. The environment in which we live—even within the womb—provides additional information that plays a role in our development. Identical twins develop from the same fertilized egg, and thus inherit the same DNA blueprint. Each twin embryo, however, develops in a unique microenvironment in the uterus. This location may affect the types of materials available, provide different sensory input and stimuli, and so forth, which creates variation in the final morphological structures of the body. It's similar to building two houses from the same general blueprint. If you follow the same set of instructions to build both houses, the two buildings may look the same at first glance, but the finer details (e.g., exact widths of boards used or patterns in the wood grains of the boards) may differ.

To determine if two people have identical fingerprints, you must analyze the patterns in close detail. Fingerprints are very complex patterns on the outer layer of our skin, called the epidermis. In general, fingerprints are grouped into a few major classes, including whorls, loops, and arches, depending on the macroscopic pattern formed by ridges in the epidermis. The ridges that create the whorls and loops may vary in their spacing or arrangement, and entire ridge systems may merge with one another (termed triradii), adding to the variation in fingerprint pattern. Even the properties of ridges themselves provide more detailed information as ridges can split or end, resulting in pattern alterations known as minutiae. In addition, ridges have numerous sweat pores scattered across them and their locations provide another level of complexity and variation to the overall fingerprint pattern.

Scientists hypothesize that ridge pattern formation results from changes in the number and positioning of cells in the dermis or lower layer of our skin. As dermal cell proliferation increases tension within this cell layer, cells begin to move away from the direction of the stress and create the perpendicular ridges seen in fingerprints. Additionally, the amnion in which a fetus develops contains various salts, waste products, and other useful nutrients and proteins. This fluid environment is constantly changing, and particles may not be uniformly present at all times and locations during development. All of this variation may alter cell growth or proliferation, which could then change tension within the dermis, and result in different ridge characteristics. Although the general pattern is coded in the DNA, these slight environmental changes may alter the finer details of ridge formation, like splits or ends in ridges.

Identical twins are likely to have similar fingerprints at some levels, but their prints are unique when examined in greater detail. Twins and other siblings are more likely to share the same fingerprint class than two random people. Identical twins may even share some ridge characteristics such as width or number. However, some of the finer details like sweat pore location and breaks in epidermal ridges may differ. Though microscopic, these differences provide enough information for automatic fingerprint scanners to decipher between identical twins.

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