physical evidence may be used to answer questions about what happened, how the victim was killed, whether there was more than one person involved, and when the crime happened. The reconstruction uses the physical evidence as well as witness accounts and statements by those involved in the case.

Significance of Physical Evidence: Individual versus Class Evidence

The best evidence is anything that can be linked to a unique, single, specific source. This is called **individual evidence**. Examples are fingerprints, handwriting, DNA patterns, and sometimes physical matches, such as a piece of broken glass that fits exactly to another, like a jigsaw puzzle piece. Unfortunately, most evidence is **class evidence**; this means that the object has characteristics common to a group of similar objects, but not to one single object. Take blue jeans, for example: Although we can go to some length toward individualization by classifying them by maker, model, size, color shade, and surface treatment, there are still thousands of other pairs of jeans that are just the same. However, that need not be the end of it: If the jeans have been worn, they might have tears, stains, or even creases that individualize them.

individual evidence: material that can be related to a single source; individualization always involves a comparison

class evidence: material that can be associated only with a group of items that share properties or characteristics

ACTIVITY 2.1: Probability and Class Evidence

A young person was seen leaving a high school parking lot after having been near a car with a broken window; a purse was missing from the passenger seat. The suspect was identified as having light brown hair and wearing a white shirt, blue jeans, and dark-colored athletic shoes. In a school of 1,600 students, how common are these characteristics?

How many students would be expected to be wearing a white shirt on any given day? Let's say that in your class of 33 students, seven are wearing a white shirt. How many students in the whole school are likely to be wearing a white shirt?

$$\frac{7 \text{ wearing a white shirt}}{33 \text{ students in class}} = 0.21, \text{ or } 21 \text{ percent}$$

Next question: How many students is 21 percent of the whole student body?

$$0.21 \times 1{,}600 = 340$$

So if your class is representative of the whole school, then you would expect 340 students to be wearing a white shirt today. Is this good evidence? Could you do better?

Procedure Notes

This activity can be done as a whole class. Modify the numbers to reflect your class and your school. Look around at your students and decide what characteristics you want to emphasize, for instance, Nike shoes, gray sweatshirt, blond hair, or glasses. Ask the class if they feel they are representative of the whole school.

Procedure Notes

Have students list class characteristics that they could use to describe students in their school. Then determine how many such characteristics would be needed to narrow a suspect down to one or two students. Usually with four or five class characteristics, the number of suspects can be narrowed down to one or two students in the whole school!

ACTIVITY 2.1: Probability and Class Evidence continued

How many students would be wearing blue jeans? In your class, you count 12 wearing blue jeans.

$$\frac{\text{12 wearing blue jeans}}{\text{33 students in class}} = \text{0.36, or 36 percent}$$

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How many students in the school would be expected to be wearing blue jeans?

0.36 x 1,600 = 580 students

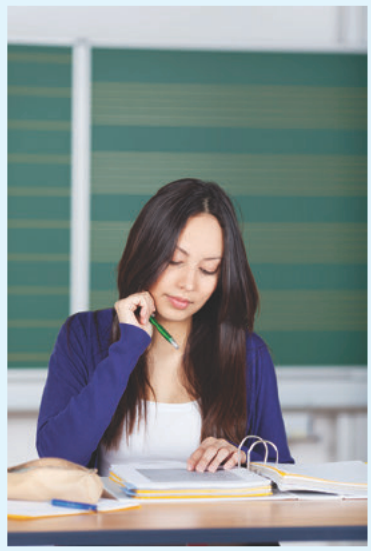
Is this good evidence? Why not ask how many students in the school are likely to be wearing a white shirt *and* blue jeans?

0.21 x 0.36 = 0.076, or 7.6 percent

Now multiply this by the number of students in school:

0.076 x 1,600 = 120 students

We have narrowed the field quite a bit by looking at just two general pieces of class evidence.



raoorn/Shutterstock.com

Now determine how many students would be likely to have light brown hair. In your class you count five students with light brown hair:

$$\frac{\text{5 with light brown hair}}{\text{33 students}} = \text{0.15, or 15 percent}$$

Class Discussion

Activity 2.2 serves to illustrate the distinction between class and individual evidence, and the circumstances whereby class evidence may be individualized. It is helpful to have stereomicroscopes available for use when necessary. The 12 activities described can be discussed in class. The teacher can also collect material and set up stations with different items for the students to examine and assess. Examples could include:

1. A piece of twine or rope cut from its parent. (Class)
2. Small glass fragments compared to a large bottom or top section of a bottle (so they cannot be fitted together). (Class)
3. A bank robbery note and the pad it came from. (Class, unless the tear pattern can be matched or indented writing recognized)

ACTIVITY 2.1: Probability and Class Evidence continued

How many students in school would be likely to have light brown hair?

$$0.15 \times 1{,}600 = 240 \text{ students}$$

How many students would be likely to be wearing a white shirt *and* blue jeans *and* to have light brown hair?

$$0.21 \times 0.36 \times 0.15 \times 1{,}600 = 0.011, \text{ or } 1.1 \text{ percent}$$

So to determine how many students in the whole student body meet all those descriptors:

$$0.011 \times 1{,}600 = 18 \text{ students}$$

Statistically, you have narrowed the field of 1,600 possible suspects to just 18. Now let's calculate how four pieces of class evidence could affect the probability of nailing the suspect. If four students in your class are wearing dark-colored athletic shoes, then:

$$\frac{\text{4 with dark-colored athletic shoes}}{\text{33 students}} = 0.12, \text{ or } 12 \text{ percent}$$

How many students in school would be likely to be wearing dark-colored athletic shoes?

$$0.012 \times 1{,}600 = 190 \text{ students}$$

How many students in school are likely to be wearing a white shirt *and* blue jeans, *and* to have light brown hair, *and* to be wearing dark-colored athletic shoes?

$$0.21 \times 0.36 \times 0.15 \times 0.12 \times 1{,}600 = 2 \text{ students!}$$

A way to increase the probative value of class evidence is to find as many different types of objects as possible with which to link the suspect to the crime or the victim. (*Probative* means supplying proof or evidence.) So, soil and red paint on the jeans would each alone belong to a large class of material; but both occurring together might greatly increase the probability of linking those jeans with a certain crime, even though the evidence is still circumstantial.

You can see how the probative value continues to grow by simply considering class evidence. This type of statistical analysis is termed "the product rule," and it works only for independent events or observations. For example, if students were encouraged to wear the school colors of blue and white, then wearing blue jeans and a white shirt would be related and not independent.

Is class evidence useful? Yes, if there is a significant amount for a given case. It is also very useful in eliminating or exonerating certain suspects. For example, if a bloodstain is found to be type O, the most common type, people with type A, B, or AB can all be eliminated as possibilities.

In the preliminary hearings of the O. J. Simpson case, the prosecution gave evidence that blood found at the crime scene had been tested by

4. Three or more soda pop tabs compared to an empty can without the tab. (Class, probably)
5. A piece of paper, one of four carefully cut from a single piece and compared to the others. (Class, probably)
6. As above, but tear the pieces and compare. (Individual)
7. A section of newspaper compared to the other sections. (Class)
8. Cut a piece of duct tape and compare it to the parent roll (and/or a different roll), or tear off a piece. (Probably class if cut; individual if torn)
9. Pull a few strands of yarn from a sweater or fabric and compare them to the parent (if not obviously damaged) or a similar item. (Class)
10. Enlarge an inked fingerprint and compare it to several other prints. (Individual)
11. Break a hefty stick in two. Dab some "blood" on the one from the assault scene and compare it with the other end that was found in the suspect's woodpile. (Class, unless the break can be fitted together)
12. Tear a page from a book and crumple it up; place the closed book beside it. (Individual)

Your imagination is the limit in setting this up. The local junkyard may be a good place to visit and collect a number of samples to use in class.

Using stereomicroscopes can be fun for the students. Most students have used a microscope before but haven't had time to explore and enjoy the wonders of the microworld. Give them some time to look at their fingernails, scars, jewelry, a piece of clothing, and the like. The objective is to allow students time to discover how the stereomicroscope works. By the end of the year, students will know which type of microscope (compound or low-power stereo), which type of lighting (transmitted, reflected, or both), and what magnification to use for optimum results in various situations. The microscope is the forensic scientist's best friend.

ACTIVITY 2.1: Probability and Class Evidence continued

conventional blood grouping methods and matched Simpson's blood. One in 400 people share these blood characteristics. The defense argued that given the population of Los Angeles, this number of people would fill an entire football stadium; therefore, the blood evidence was useless. Is this true? If the blood evidence were the only evidence the prosecution had, the reasoning may have been correct. But if there were other types of class evidence implicating Simpson, should the significance of the blood evidence have been considered?

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O.J. Simpson

In the next activity, you will examine the concepts of class and individual evidence with a series of comparisons.

ACTIVITY 2.2: Can This Evidence Be Individualized?

1. A torn T-shirt was found in the backseat of a suspect's car. A piece of torn cloth was found at the scene of the crime. Can it be individualized to the T-shirt? Explain.

2. A pistol was found in a theatre where a man was shot. A suspect known to have owned a Derringer like this one was apprehended. Would this gun be considered individual or class evidence?

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3. Pieces of a broken bottle were found at the scene of an assault. The bottom of a bottle was found in a suspect's car. Can the pieces of the bottle be uniquely associated (individualized) with what was found in the suspect's car? Explain.

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Answers

1. Tear a piece of cloth from a T-shirt. Set the piece out with the shirt and add another piece of the same color and type of fabric from a different source. Students should be able to individualize one piece, while identifying the other as class evidence. Ask them whether the color makes a difference. White is a more common color for a T-shirt, so a red shirt, for example, would have more probative value. Even better than color would be a matching imprint.
2. The gun is class evidence unless it was one of a kind and specifically linked to its owner (who happened to be, say, John Wilkes Booth).
3. Break a bottle so that the pieces are large enough to fit together as individual evidence, like pieces in a jigsaw puzzle. Wrap the bottle in layers of newspaper before using a hammer or pipe.

4. Some blond hairs were found on the gloves of a suspected kidnapper who has brown hair. Would they be considered class or individual evidence?


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5. A bloody knife has been found in the backyard of a murder suspect. Under what circumstances could it be individualized? Or will it remain class evidence?


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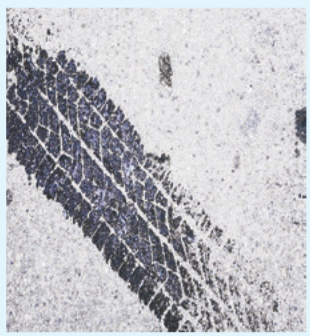
6. Are tire impressions such as these individual or class evidence? Explain.


Konstantin/Shutterstock.com

7. Can it be determined whether these bullets and casings were fired from the same gun? How can bullets be individualized to a gun? Explain.

8. Some powder was found in a plastic bag in a suspect's pocket. Some similar powder was found on the victim. Can the first powder be individualized to the second powder? Explain. If the two powders were determined to be chemically identical, does that prove they came from the same source?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9. A pair of latex gloves was found at the scene of a robbery. A box of the same brand of latex gloves was found at a suspect's home. Can the gloves be individualized to the box? Explain.


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4. Even if the victim had blond hair, the hair is class evidence.
5. Fingerprints on the handle would specifically identify the culprit. Blood analysis could tie it to the victim.
6. Millions of tires are manufactured with the same imprint. What may make a tire unique is the wear pattern coupled with imperfections or damage (cuts, nails, pebbles in a groove, etc.).
7. If you know a hunter, policeman, or proprietor of a local shooting range, collect several spent bullets and shell casings of the same caliber. Bullets can be individualized by striations on the outside, and spent shell casings can be individualized, to some degree, by the firing pin marks.
8. Use baking soda or some other powder; place some in a baggie and another sample in a vial. Even though the two samples are the same powder chemically, there is nothing unusual about them, and there is no way to prove that the powder in the vial came from the same source as the powder in the bag. It is, therefore, class evidence.
9. Take two latex gloves out of a box and set them next to the box. There is no way to individualize the gloves to that particular box.

10. No, because it could have come from any cigarette package, however fingerprints or DNA found on the cigarette may be individualized to a specific person.
11. Without the matchbook, the single match is class evidence. But by comparing the match's characteristics (such as dimensions, color, head, composition, tear pattern, and the like) with those from the suspect's matchbook and perhaps a dozen randomly collected matchbooks, it could be individualized. This is a good experiment to do with the stereomicroscope.
12. Soil composition and characteristics vary considerably, even in small areas. If everything matched and it could be shown that there were no other similar samples wherever the suspect had been, perhaps it could be individualized enough to provide strong evidence. Better would be a matched impression with a shoe print from the scene. That would put the suspect there, but not necessarily in the house.

ACTIVITY 2.2: Can This Evidence Be Individualized? continued

10. A cigarette butt was found at the scene of a crime. Is it individual evidence? Explain.

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11. A match was found at the scene of a suspicious house fire. A suspect was found carrying a book of matches, several of which were missing. Is the single match class or individual evidence? Explain.

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12. A suspect in a B & E (breaking and entering) had shoes that were caked with soil. Is the soil class evidence, or could it be considered individual evidence? Explain.

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