

Evidence From Blood

Reading Preview

Key Concepts

- What can investigators do to detect blood?
- How is blood classified?
- What can investigators learn from patterns of blood at a crime scene?

Key Terms

- hemoglobin
- luminol
- antibody

Target Reading Skill

Comparing and Contrasting As you read, complete a graphic organizer like the one below for Type A, Type B, Type AB, and Type O blood.

Blood Type	Marker	Clumps With
Type A	A	Anti-A
Type B		

Discover Activity

What Can Blood Drops Reveal?



1. Place a large piece of white paper on a hard surface, such as a floor or desk.
2. Hold a dropper bottle of fake blood about 20 cm above the paper. Squeeze one drop of blood onto the paper.
3. Move the bottle to a height of 100 cm. Squeeze one drop of blood onto a different part of the paper.
4. Write a description of each drop in your notebook. How do the drops differ?

Think It Over

Predicting Jabar cuts himself while slicing a tomato. He leaves a trail of blood on the floor as he goes to get a bandage. What would the drops look like, and why?

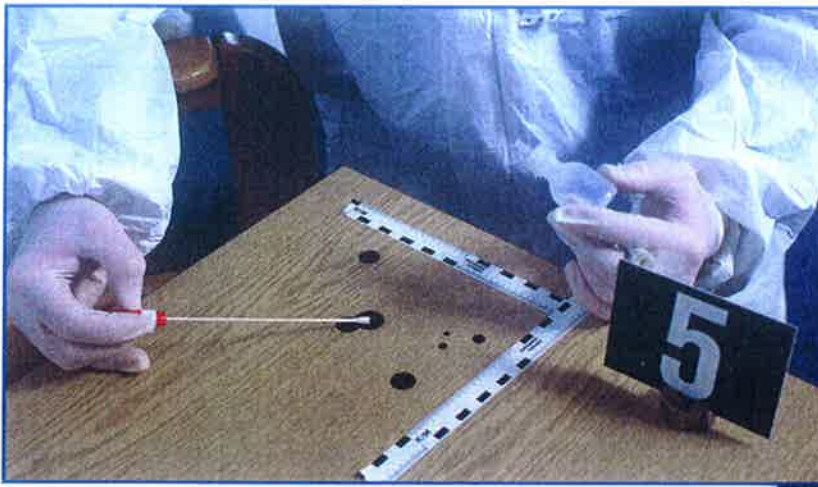
In a room of a farmhouse in Pennsylvania, a detective sweeps a bright light across a wood floor. In the dark room, the light sharpens the contrast between wood and blood that had soaked into the floor. The detective sees the outline of a small-boned man on the floor.

This detective is not collecting evidence from a crime scene. He is studying Civil War history. In July 1863, the house was a hospital. The man whose blood is on the floor was wounded at the Battle of Gettysburg. Given the large amount of blood, the detective suspects that surgeons operated in this room.

Even if there are only trace amounts of blood at a scene, the blood can be detected. This is true even when a person tries to clean away the blood or when the blood is old.

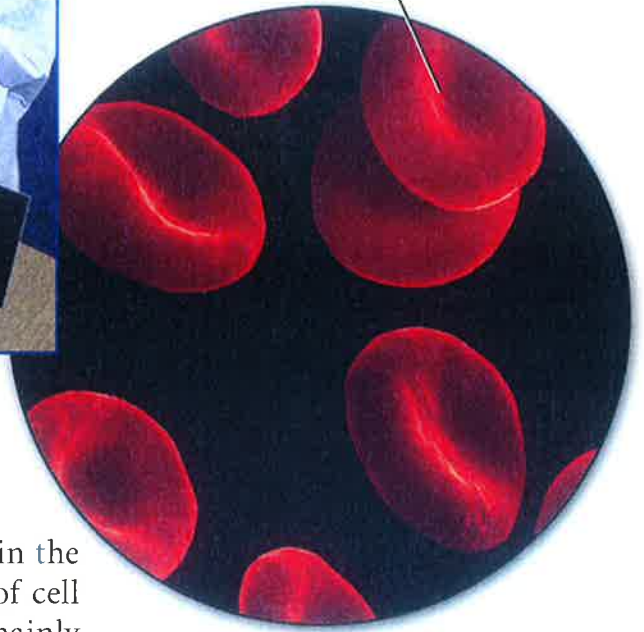


Two Confederate soldiers



CSI collecting blood sample

Red blood cells
magnified 5000 times



Searching for Blood

Blood is a water-based mixture, with cells suspended in the water. Figure 5 shows an enlarged view of one type of cell found in blood—red blood cells. These cells consist mainly of **hemoglobin** (HEE muh gloh bin), the molecule that carries oxygen to cells in the body. **Some chemicals produce light or change color in the presence of hemoglobin. The chemicals can be used to detect or test for blood at a crime scene.**

Finding Blood A CSI can use UV light to find blood at a crime scene. If this method fails, he can spray a chemical called luminol on surfaces where he suspects there is blood. **Luminol** emits a blue glow when it comes in contact with blood. The glow lasts about 30 seconds, which is long enough to photograph the evidence.

Luminol can be used to search large areas quickly. It can also detect the small traces of blood left behind when someone tries to clean up a crime scene. Luminol does have one drawback: Blood is not the only material that can cause luminol to glow. So a positive test with luminol may be a false alarm.

Testing Blood Stains that look like blood may not be blood. A CSI can run an initial test on a stain at the crime scene. She can use a moist cotton swab to take a sample of the stain. Then she rubs the swab against a strip that contains chemicals that change color in the presence of blood.

Some materials, such as horseradish, can produce the same results. But these materials are not found at most crime scenes. So a positive test is usually a reliable first test for blood. Another test must be done at the lab to confirm the results.

FIGURE 5

Collecting Blood to Test

The stains on the table look like blood. The CSI uses a swab to collect a sample. Only after she tests the sample can she be sure that the material is blood.

Inferring *What substance in blood gives blood its red color?*



Reading
Checkpoint





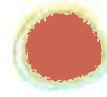







What does hemoglobin do in the body?

FIGURE 6

Typing Blood

When Anti-A antibodies are mixed with blood that has A molecules, the blood clumps.

Interpreting Data Which types of blood will clump when Anti-B antibodies are mixed with the blood?

Blood Type	Blood Sample	Antibodies	
		Anti-A	Anti-B
A			
B			
AB			
O			

Blue and yellow tints were used to highlight the clumps.

Skills Activity

Interpreting Data

Tests were done on four blood samples. Use these results to decide the possible blood type or types of each sample.

1. Blood clumps with Anti-A.
2. Blood does not clump with Anti-B.
3. Blood does not clump with Anti-A, but does with Anti-B.
4. Blood does not clump with Anti-A or Anti-B.

Classifying Blood

At the lab, scientists can test to see if blood is human. They may also do some quick, inexpensive tests to narrow the list of possible suspects. To understand how these tests work, you need to know more about blood.

ABO Blood Groups In the early 1900s, doctors were looking for a way to save patients who had lost large amounts of blood. They tried to transfer blood from a healthy donor to the patient. Most of the time, the transfer didn't work. One doctor, Karl Landsteiner, was able to figure out what happened.

He discovered that human blood can be classified into four major groups, or blood types. These types are A, B, AB, and O. The groups are named after marker molecules found on the surface of red blood cells. Some people have only A molecules. Some have only B molecules. People with type AB blood have both A and B molecules. People with type O blood have neither A nor B molecules.

Antibodies Marker molecules act as tags. They say, "These cells are part of your body." Or they say, "These cells are not part of your body." **Antibodies** are molecules that bind to marker molecules. Each antibody will bind to one specific molecule. **Scientists can use antibodies to classify blood.** Figure 6 shows what happens when Anti-A and Anti-B antibodies are mixed with different blood types.

Using Blood Types as Evidence Blood types are not like fingerprints. They cannot be used to identify a suspect. But they can point investigators in the right direction.

For example, police find a bloodstain on a suspect's shirt. "I cut myself while shaving," the suspect explains. But he has Type A blood, and the blood on the shirt is Type O. The police will wonder why the suspect lied to them. If the victim's blood is also Type O, the police will be even more suspicious.

Data on blood types can reduce the number of suspects. For example, a thief with Type A blood cuts herself while taking jewelry from a display case. Drops of her blood are found on the case. This evidence points directly to the thief. So suspects with blood types other than Type A can be eliminated.

There are about 250 possible marker molecules for red blood cells. If scientists had a large blood sample and enough time, they might be able to use blood types to identify a suspect. But scientists now have a better option. They can do some quick, initial tests on blood. Then they can use the blood to do DNA tests, which you will read about in Lesson 3.

Go Online

 For: Links on blood type
 Visit: www.SciLinks.org
 Web Code: dan-1032



What problem was Karl Landsteiner trying to solve when he discovered the major blood types?

Math

Analyzing Data

Blood Type Distribution

Some blood cells have a marker molecule called the Rh factor. People who have this marker are Rh positive (Rh+). The rest are Rh negative (Rh-). The table shows the frequency of certain blood types in the United States. The data is based on A, B, and Rh markers only. Use the data to answer these questions.

- Interpreting Data** Which blood type is the most common? Which is the least common?
- Calculating** What percentage of people do not have the Rh factor?
- Inferring** Why are people with O- blood called "universal donors"?
- Predicting** A person is Rh negative. How does this fact affect her ability to receive donated blood?

Distribution of Blood Types in the U.S. Population

Type	Frequency of Blood Type	Can Receive Blood From	Can Donate Blood to
O+	37%	45%	84%
O-	7%	7%	100%
A+	35%	85%	37%
A-	6%	13%	44%
B+	9%	56%	12%
B-	2%	9%	15%
AB+	3%	100%	3%
AB-	1%	16%	4%

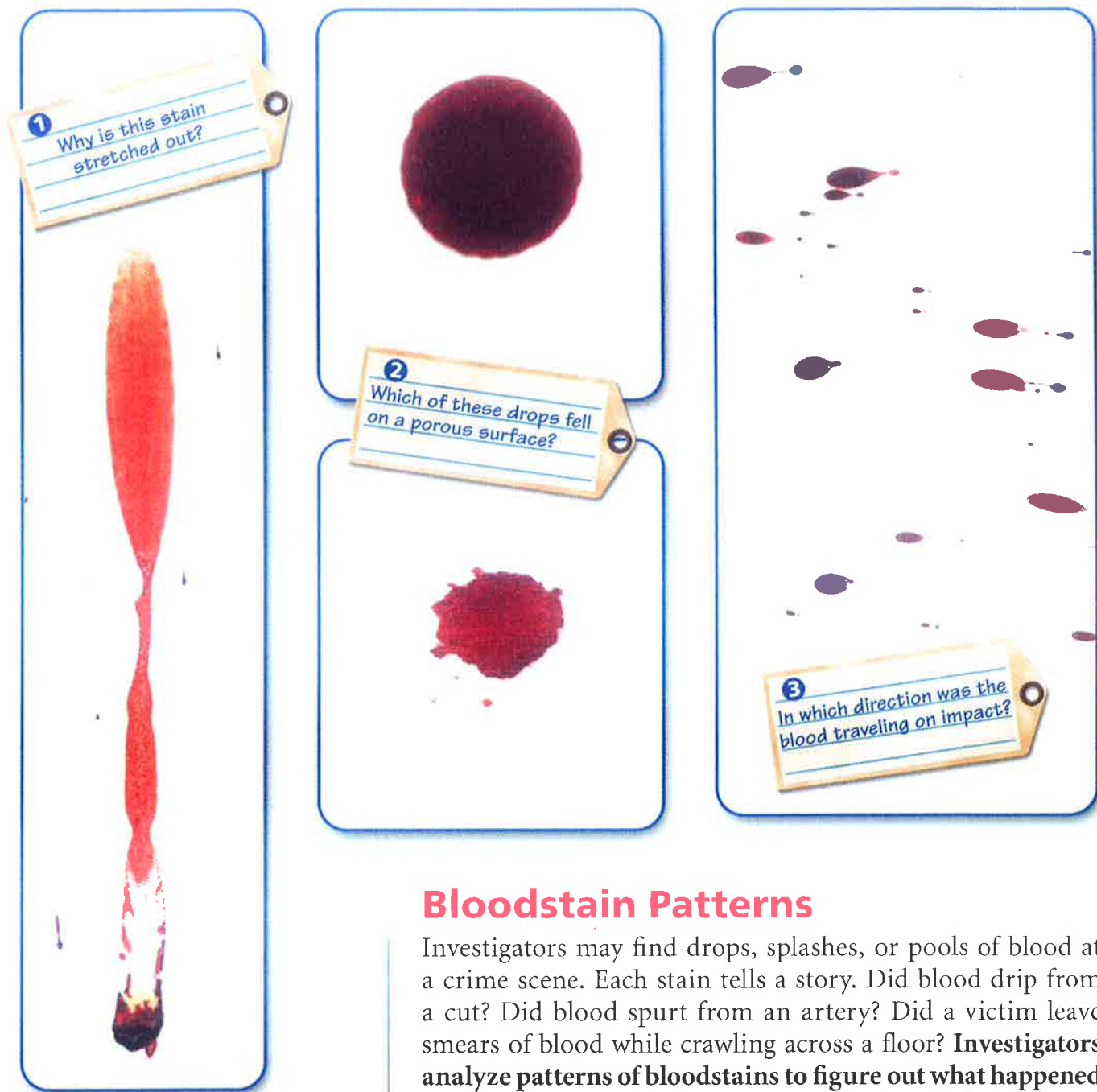


FIGURE 7
Analyzing Bloodstains
 The shape and size of bloodstains can provide important clues.
Applying Concepts After you read about bloodstain patterns, answer the questions in Figure 7.

Bloodstain Patterns

Investigators may find drops, splashes, or pools of blood at a crime scene. Each stain tells a story. Did blood drip from a cut? Did blood spurt from an artery? Did a victim leave smears of blood while crawling across a floor? **Investigators analyze patterns of bloodstains to figure out what happened at a crime scene.** The number and location of bloodstains is important. So is the shape of the bloodstains.

Distance and Angle of Impact Blood that falls a short distance usually leaves a round stain on a hard surface. If the surface is soft or porous, there is likely to be some spatter and the stain will have ragged edges.

A round stain also means that the blood hit the surface at a 90-degree angle. In other words, the source of the blood was perpendicular to the surface. Figure 7 shows what happens when blood hits a surface at an angle less than 90 degrees. The stain is stretched out and loses its round shape.

Size of Drops Blood that is sent flying through the air by a blow will break into smaller drops when it hits a surface. Investigators can estimate the force of the blow by the size of the drops. Generally, as the force increases, the size of the drops decreases.

Direction of Travel An analyst can also use the shape of bloodstains to figure out the location of an attack. He knows that the tip of a stain always points in the direction that the blood had been moving. If there are multiple stains on a surface, he can draw a line through the long axis of each stain. Then, he can follow the lines back to the point where they meet. This is the spot where the blood was released.


Analysts used to do all this work by hand. But now there are computer programs that can analyze the pattern of blood spatter. These programs can accurately plot the path that blood traveled from its source.

Absence of Stains There may be a space in the middle of a blood spatter pattern where there is no blood. This absence of blood can be an important clue. Investigators will suspect that there was an object in that location at the time of the attack. If investigators find the object, they are likely to find the rest of the blood pattern.



Forensic Science Video
Clues From Bloodstains

Lesson 2 Assessment

 **Target Reading Skill** **Comparing and Contrasting** Use the data in your graphic organizer to help you answer Question 2.

Reviewing Key Concepts

- a. **Explaining** How does hemoglobin make it possible to detect traces of blood?

b. **Applying Concepts** What are two advantages of using luminol to detect blood? What is one drawback?
- a. **Naming** What two molecules can be used to determine a blood type?

b. **Comparing and Contrasting** How are Type A and Type AB blood alike? How are they different?

c. **Drawing Conclusions** Blood found at a crime scene and a suspect's blood are both Type B. Can this evidence be used to identify the suspect? Why or why not?

- a. **Reviewing** What properties can an investigator use to analyze bloodstains?

b. **Inferring** A CSI finds a round drop of blood on a floor. What might the CSI infer about the source of the blood?

c. **Relating Cause and Effect** What could cause an empty space in the middle of blood spatter?

In the Community

Blood Donors The American Red Cross keeps a supply of donated blood for emergencies. Interview a Red Cross representative to find out about blood donation in your community. Ask questions such as these: What blood types do they need most? Are there times during the year when the blood supply is low? Who can be a blood donor?