Name ____TEACHER COPY_____Period _____ Date _____

Forensic Science

Chapter 8 – *Blood and Blood Spatter*

Directions: Fill in the information from the Classroom Chart or the Online Chart.

Forensic Science Standard and element:

SFS3. Students will analyze the use of toxicology, serology, and DNA technology in forensic investigations.

d.) Differentiate the forensic techniques used to distinguish human and animal blood.

e.) Analyze the physics of blood stain patterns.

1.) Put chart in Science Notebook behind the Charts section after it has been checked. ____yes ____no
2.) All parts were accurate and complete with no abbreviations. ____yes ____no
3.) Handwriting was neat. ____yes ____no
4.) Information was dark enough to be easily read, and chart was neat. ____yes ____no
(Part of Notebook Grade)

INTRODUCTION AND HISTORY

- Blood typing provides class evidence
- DNA profiling provides individual evidence
- A blood splatter pattern provides information
  - the truthfulness of an account by a witness or a suspect
  - the origin of the blood
  - the angle and velocity of impact
  - the type of weapon used
- Discovered in 1900 by **Karl Landsteiner**, an Austrian Biologist and physician who identified and characterized different blood types
- Identifies the presence or absence of particular proteins embedded in the cell
- Quicker and less expensive than DNA profiling
- Produces class evidence but can still link a suspect to a crime scene or exclude a suspect

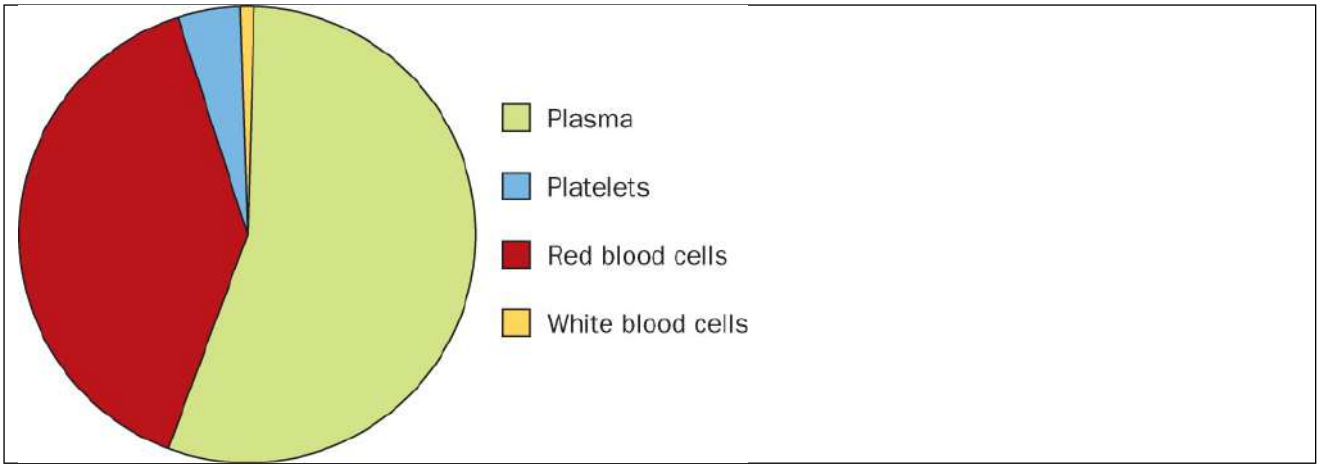
WHAT MAKES UP OUR BLOOD?

- **RED BLOOD CELLS (Erythrocytes) –** The most abundant cells in our blood; they are produced in the bone marrow and contain a protein called hemoglobin that carries oxygen to our cells and transports carbon dioxide to the lungs for us to exhale.
- **WHITE BLOOD CELLS (Leukocytes*)*** – They are part of the immune system and destroy infectious agents called pathogens.
- **PLASMA –** This is the yellowish liquid portion of blood that contains electrolytes, nutrients and vitamins, hormones, clotting factors, and proteins such as antibodies to fight infection.
- **PLATELETS (Thrombocytes) –** The clotting factors that are carried in the plasma; they clot together in a process called coagulation to seal a wound and prevent a loss of blood and they repair damaged blood vessels.

ANTIBODIES, ANTIGENS AND ENZYMES

- **Antibodies** are Y-shaped proteins secreted by white blood cells that attach to antigens to destroy them.
- **Antigens** are foreign molecules or cells that react to antibodies.
- **Enzymes** are complex proteins that catalyze different biochemical reactions
- Many enzymes and proteins have been found in the blood that are important for identification purposes

COMPOSITION OF THE BLOOD



BLOOD FACTS

- The average adult has about FIVE liters of blood inside of their body, which makes up 7-8% of their body *weight. (FIVE LITERS IS ABOUT **1.32** GALLONS)*
- Blood is living tissue that carries oxygen and nutrients to all parts of the body, and carries carbon dioxide and other waste products back to the lungs, kidneys and liver for disposal. It also fights against infection and helps heal wounds, so we can stay healthy.
- There are about one **billion** red blood cells in two to three drops of blood. For every **600** red blood cells, there are about **40** platelets and **one** white cell.

GENETICS OF BLOOD TYPE

- Your blood type is established before you are **BORN**, by specific **GENES** inherited from your parents.
- You inherit one gene from your **MOTHER** and one from your **FATHER.**
- These genes determine your blood type by causing proteins called **AGGLUTINOGENS** to exist on the surface of all of your red blood cells.

BLOOD TYPES AND POPULATION

O positive is the most common blood type. Not all ethnic groups have the same mix of these blood types. Hispanic people, for example, have a relatively high number of O's, while Asian people have a relatively high number of B's. The mix of the different blood types in the U.S. population is below on the chart.

	Caucasians	African American		Hispanic	Asian
O +	37%	47%		53%	39%
O -	8%	4%		4%	1%
A +	33%	24%		29%	27%
A -	7%	2%		2%	0.5%
B +	9%	18%		9%	25%
B -	2%	1%		1%	0.4%
AB +	3%	4%		2%	7%
AB -	1%	0.3%		0.2%	0.1%

WHAT ARE BLOOD TYPES and HOW COMMON ARE BLOOD TYPES?

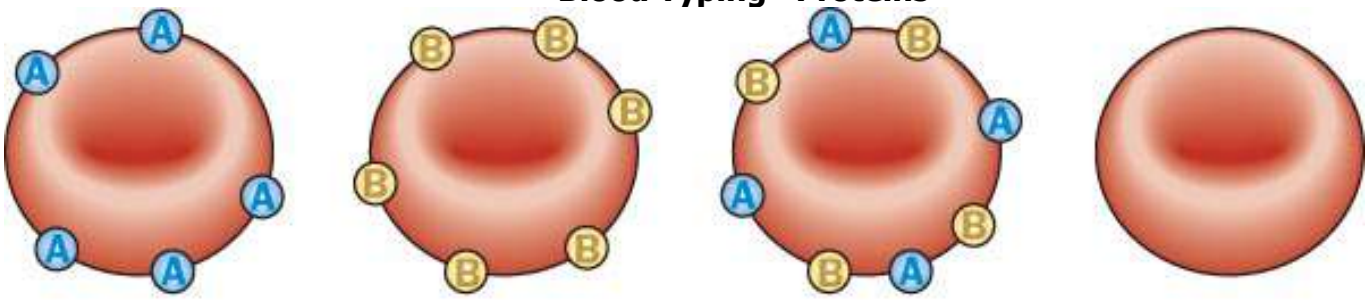
There are 3 alleles or genes for blood type: A, B, & O. Since we have 2 genes, there are 6 possible combinations.

AA or AO = Type A
BB or BO = Type B
OO = Type O
AB = Type AB

TYPE	DISTRIBUTION	RATIOS
O +	1 person in 3	38.4%
O -	1 person in 15	7.7%
A +	1 person in 3	32.3%
A -	1 person in 16	6.5%
B +	1 person in 12	9.4%
B -	1 person in 67	1.7%
AB +	1 person in 29	3.2%
AB -	1 person in 167	0.7%

http://www.bloodbook.com/type-facts.html

Blood Typing—Proteins

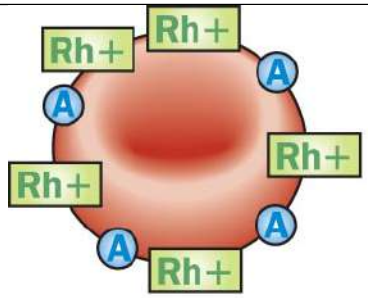


42% **12%** **3%** **43%**

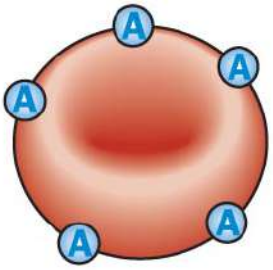
of the population in the United States

WHY ARE BLOOD TYPES POSITIVE OR NEGATIVE (Rh FACTORS)

- While studying Rhesus monkeys, a certain blood protein was discovered. This protein is also present in the blood of some people. Other people, however, do not have the protein.
- The presence of the protein, or lack of it, is referred to as the Rh (for Rhesus) factor.
- If your blood does contain the protein, your blood is said to be Rh **positive** (Rh+). If your blood does not contain the protein, your blood is said to be Rh **negative** (Rh-).
- 85% of the population has a protein called RH factor on their blood cells.



Protein A present
Rh protein present
Type A+



Protein A present
Rh protein absent
Type A−

BLOOD TRANSFUSIONS

A blood transfusion is a procedure in which blood is given to a patient through an intravenous (IV) line in one of the blood vessels. Blood transfusions are done to replace blood lost during surgery or a serious injury. A transfusion also may be done if a person's body can't make blood properly because of an illness.

Who can give you blood?
People with TYPE O blood are called Universal Donors, because they can give blood to any blood type.
People with TYPE AB blood are called Universal Recipients, because they can receive any blood type.
Rh + → Can receive + or -
Rh - → Can only receive -

BLOOD EVIDENCE

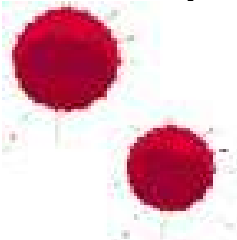
- **Blood samples** – Can be analyzed to determine **blood type** and **DNA,** which can be matched to possible suspects.
- **Blood droplets** – Can be analyzed to give clues to the location of a **crime,** movement of a **victim,** and type of **weapon.**
- **Blood spatter** – Can be analyzed to determine patterns that give investigators clues to how a crime might have happened.

Analysis of a splatter pattern can aid in determining the:
- direction blood traveled
- angle of impact
- point of origin of the blood
- velocity of the blood
- manner of death

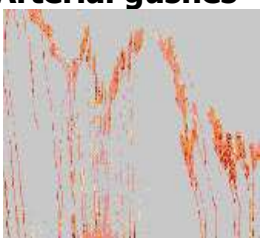
Blood Spatter Analysis
- **Satellite droplets**—
  - When blood falls from a height, or at a high velocity,
  - It overcomes its natural cohesiveness, and
  - Separates from the main droplet
- **Spiking patterns**—
  - Form around the droplet edges when blood falls onto a less-than-smooth surface
- **Directionality –**
  - The shape of an individual drop of blood provides clues to the direction from where the blood originated.
- **Lines of convergence** –
  - Two or more blood spatters can pinpoint the location of the blood source

BLOOD SPATTER ANALYSIS PATTERNS

a) **Passive drops**



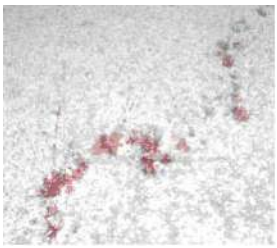
b) **Arterial gushes**



c) **Splashes**

d) **Smears**

e) **Trails**



f) **Pools**

- **Patterns can help investigators determine the type of weapon used**
- **What kind of a pattern is produced by a gun shot?**
- **What kind of a pattern is produced by a hammer blow?**