
DNA Profiling

Learning Objectives

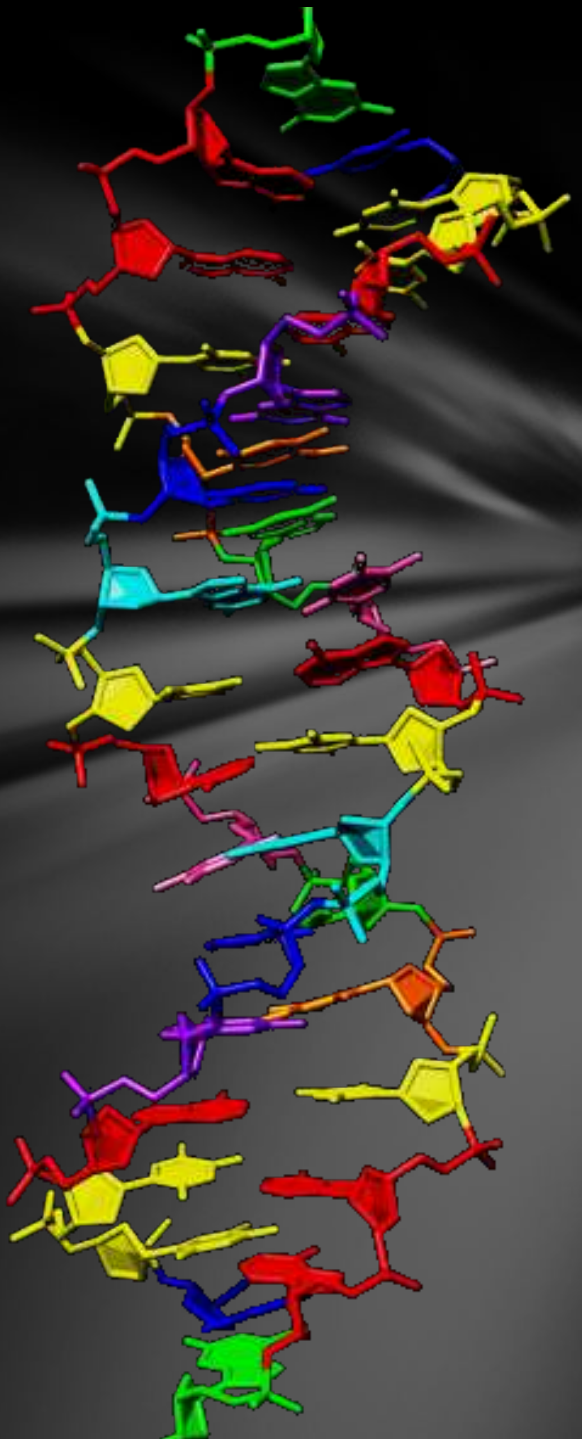
- Explain how DNA evidence is collected and analysis
- Explain how DNA evidence is compared for a match
- Explain how DNA evidence can be used to determine relations

Structure of DNA

Double helix - two coiled DNA strands

Genes - segments of DNA that code for proteins (height)

Alleles - a form of a gene that tells how it presents itself (tall or short)



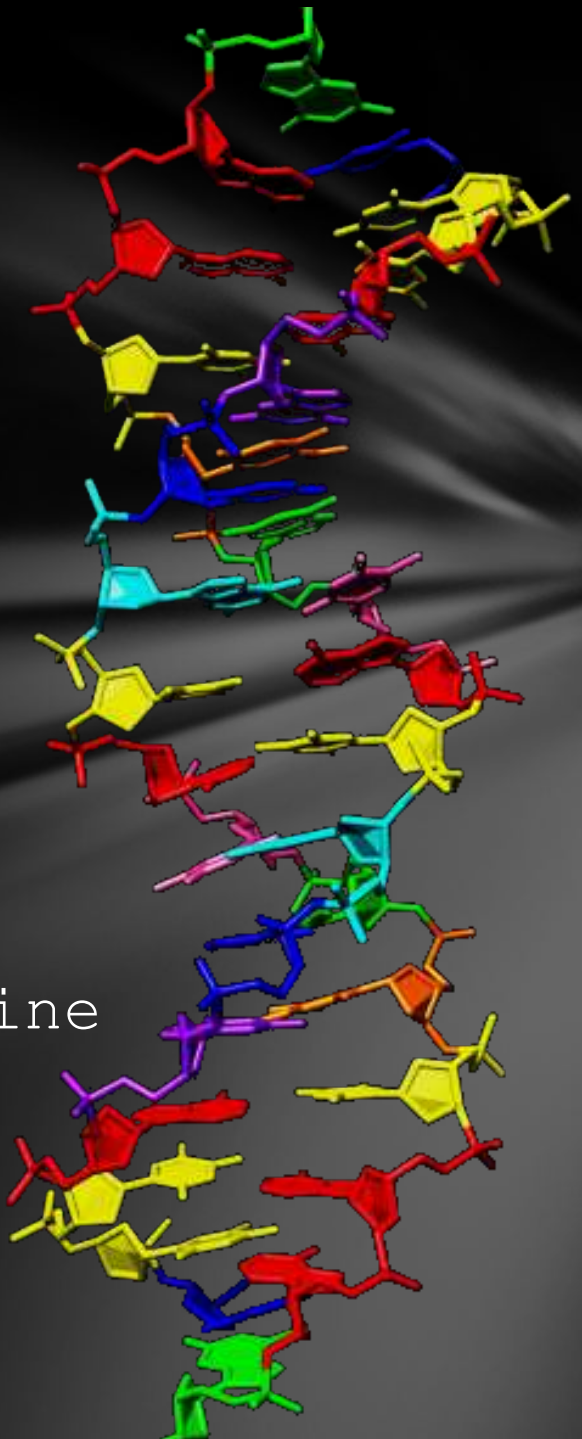
Structure of DNA

Composed of nucleotides

- deoxyribose sugar
- phosphate group
- nitrogenous base

Base Pairing:

- Adenine pairs with Thymine
- Cytosine pairs with Guanine

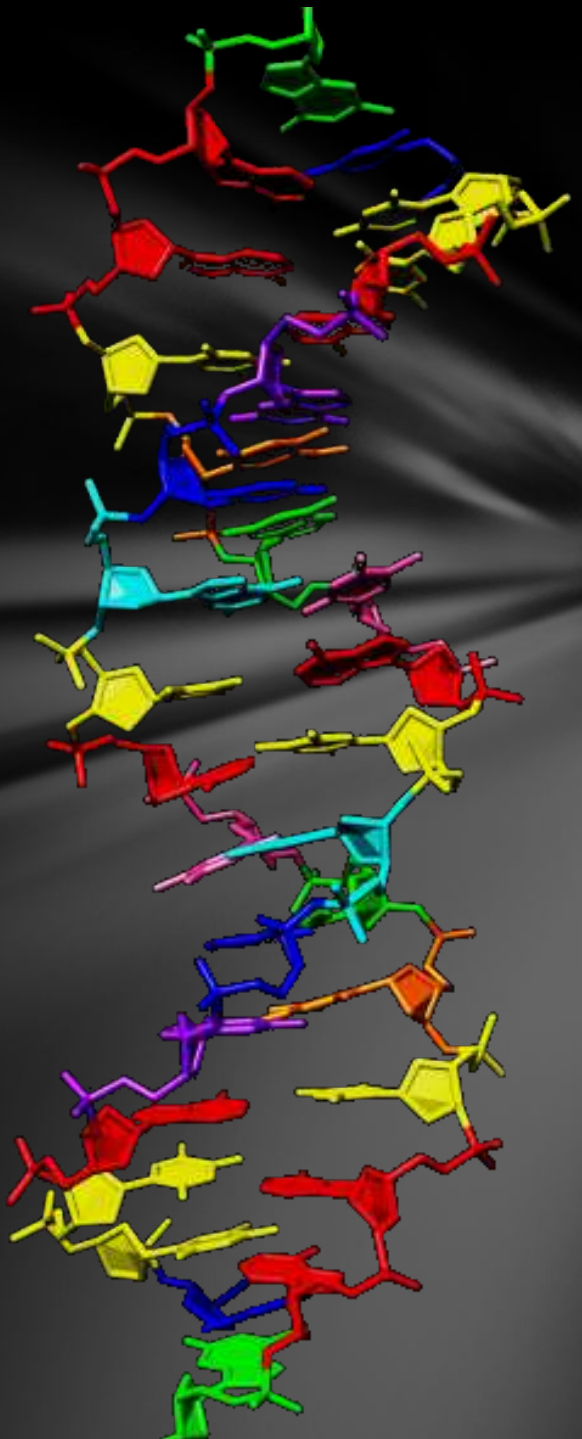


Function of DNA

DNA contains genetic material passed down from parents

Chromosomes are located in the nucleus

Found in **white blood cells, semen, saliva, urine, hair roots, teeth, bone, tissue.**



Comparing DNA Sequences

99.9% the human is identical for everyone

DNA profiling looks at 13 specific sequences that are highly variable and different for every person.

Why Do We Use DNA Profiling

To identify potential suspects

To exonerate an innocent person

To identify human remains

To establish paternity

To match organ donors

Handling Genetic Material

1. Use disposable gloves and collection instruments
2. Avoid physical contact, talking, sneezing, and coughing in the evidence area
3. Air-dry evidence and put it into new paper bags or envelopes
4. Dry or freeze the evidence
5. Keep evidence cool and dry during transportation and storage

Extraction and Amplification

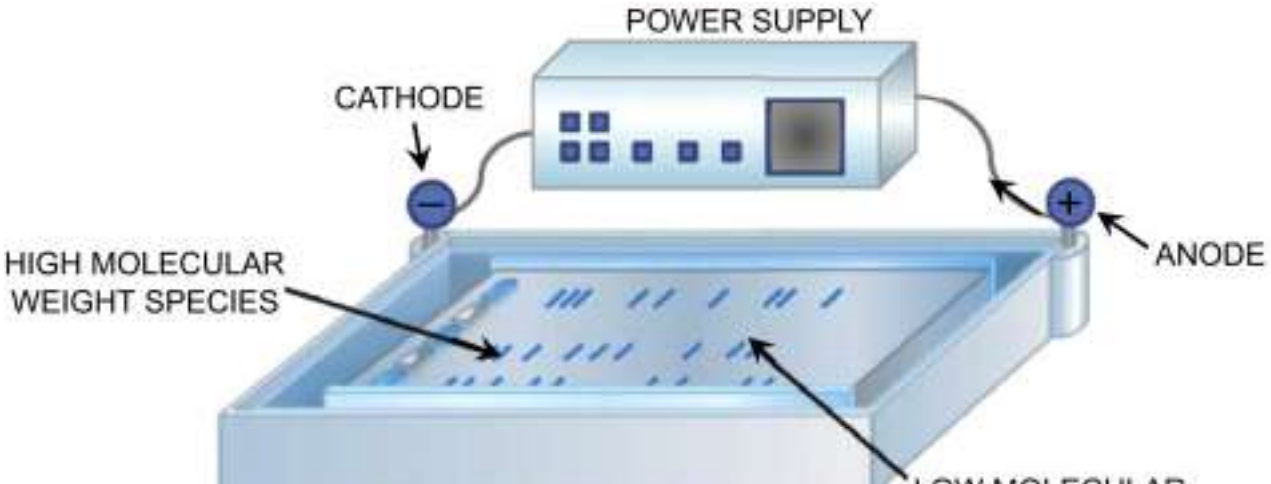
1. Cells are isolated from biological evidence such as blood, saliva, urine, semen, and hair
2. The cells are disrupted to release the DNA from proteins and other cell components
3. The DNA can be extracted from the cell nucleus
4. PCR may be used to make copies of a DNA segment if there was not much left behind.

Electrophoresis

An electric current separates molecules by size, small move farther, large move slower.

Smaller molecules will move the farthest

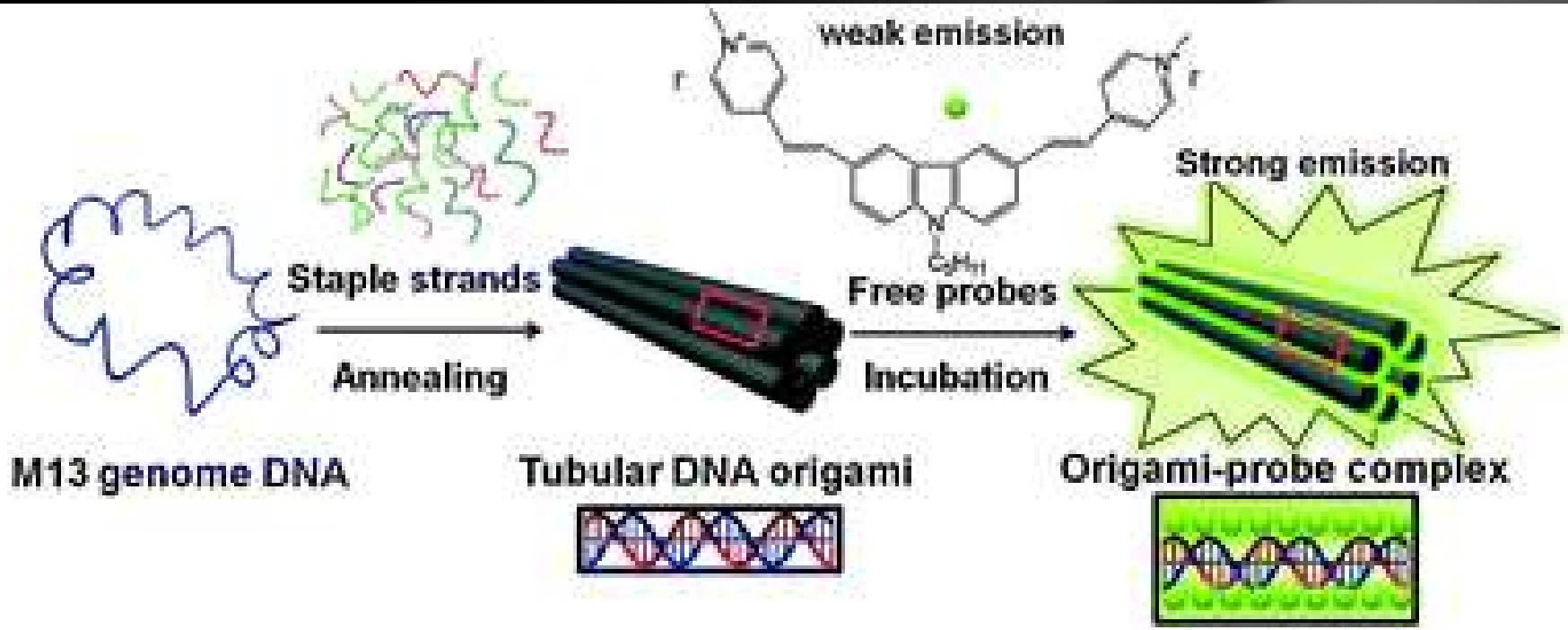
After developing, the fragments can be visualized for characterization



DNA Probes

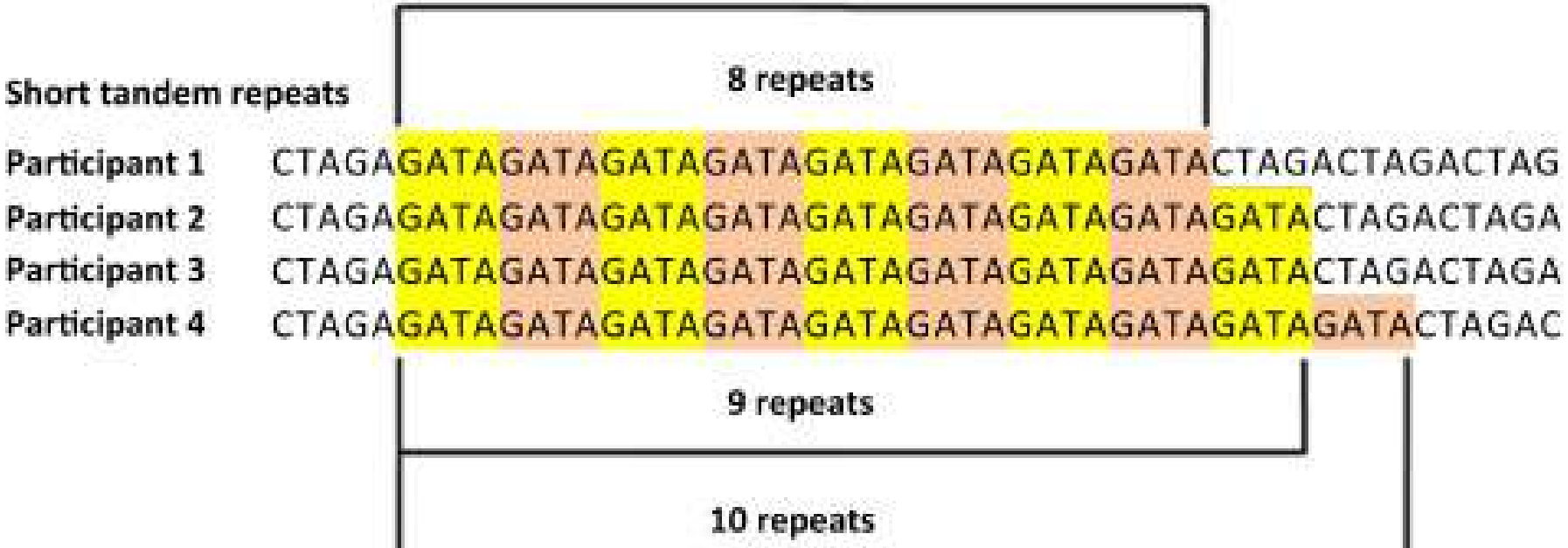
Complementary segment of synthetic DNA used to visualize the unique sequences in a person's DNA

In most criminal cases, 6-8 probes are used



Short Tandem Repeats (STR)

STR is another method of DNA typing. STRs contain two to five repeating bases in a DNA molecule. This method requires less time and a smaller sample size, and the DNA is less susceptible to degradation.



FBI's CODIS DNA Database Combined DNA Index System

FBI developed CODIS DNA database in 1998

Used for linking serial crimes and unsolved cases with repeat offenders in all 50 states

Requires >4 RFLP markers and/or 13 core STR markers

Blood and Serology

Learning Objectives

- I can explain the composition and function of blood
- I can determine blood type from a sample of blood.

Blood History

1659 – Antony Leeuwenhoek viewed blood cells under a microscope

1795 – First blood transfusion

1901 – Discovery of A, B, and O Blood types

1902 – Discovery of AB Blood type

1937 – First established blood bank

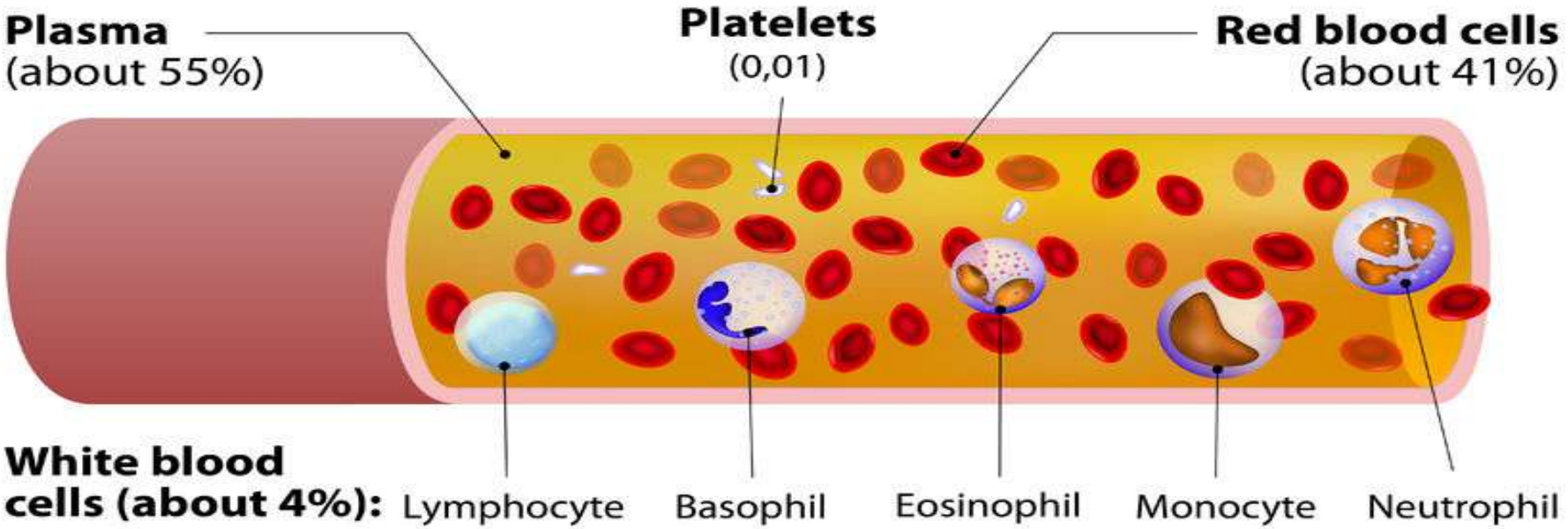
1940 – Discovery of Rh- and Rh+ protein

1959 – First recorded case of AIDs

What Makes Up Our Blood?

Red Blood Cells – aka erythrocytes

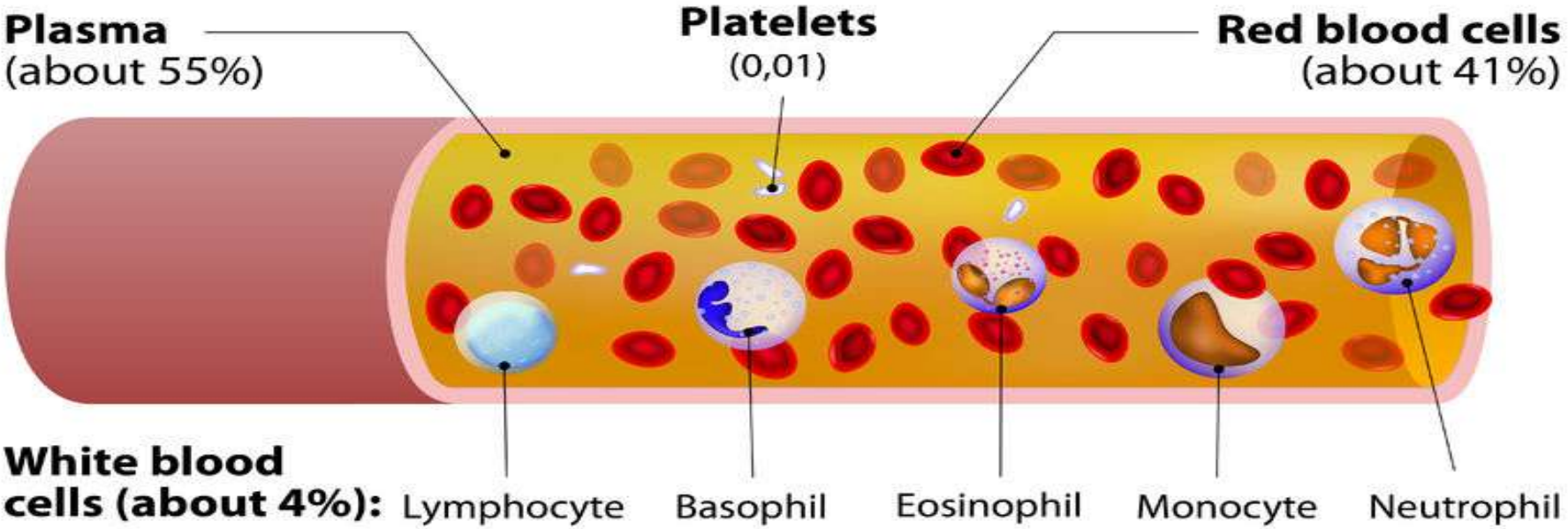
- Produced in bone marrow, no nucleus
- Hemoglobin carries oxygen and carbon dioxide through the body



What Makes Up Our Blood?

White Blood Cells – aka leukocytes

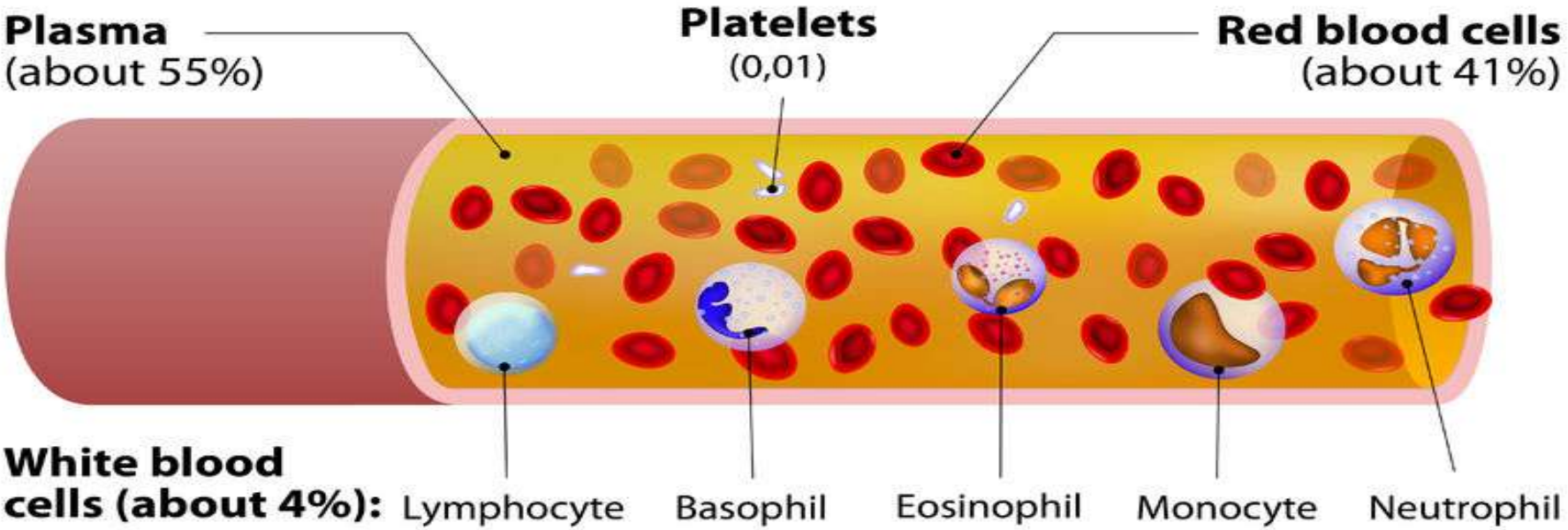
- Part of immune system which helps fight disease
- Contain a nucleus allowing it to replicate on its own



What Makes Up Our Blood?

Platelets – aka thrombocytes

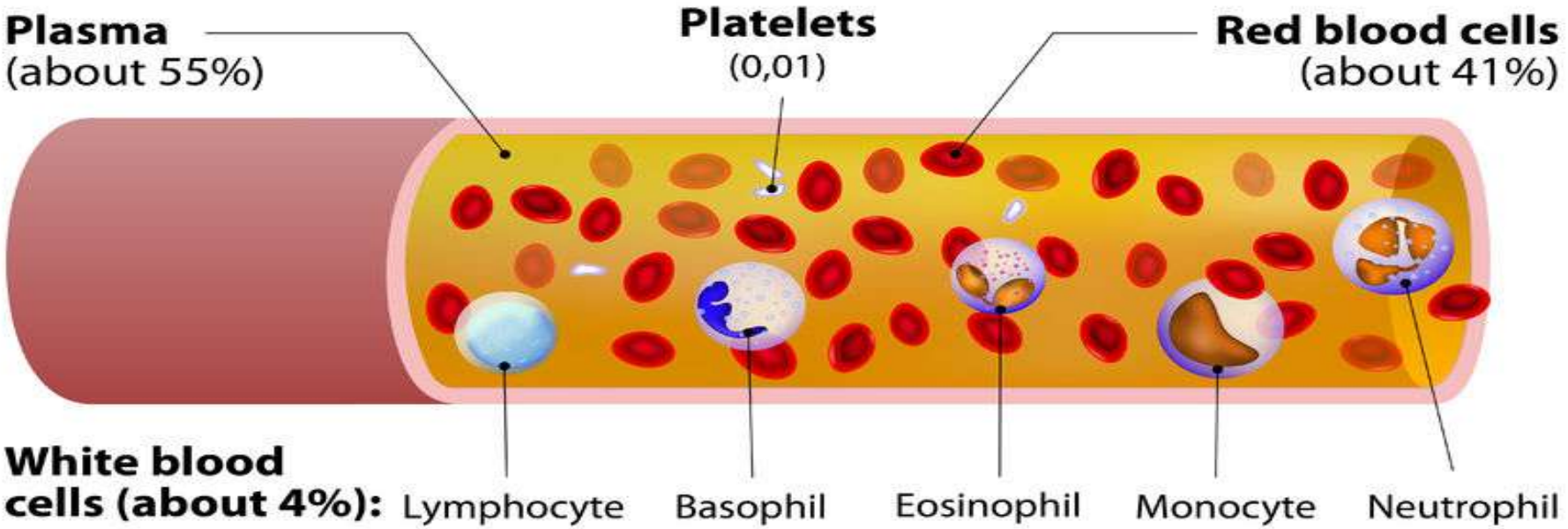
- Clotting factors caused by plasma
- Help to seal a wound preventing blood loss



What Makes Up Our Blood?

Plasma

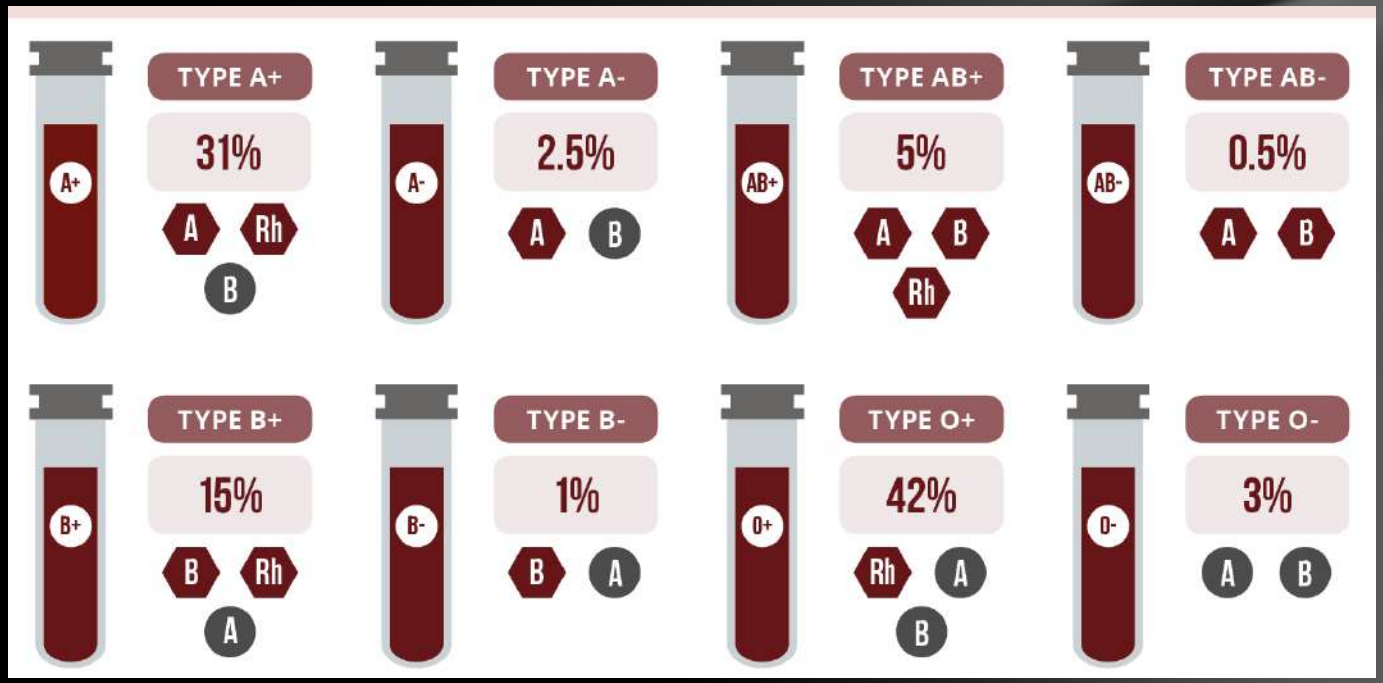
- Yellowish liquid portion of your blood
- Contains electrolytes, nutrients, vitamins, hormones, proteins (antigens, fibrogens, antibodies)



How are Blood Types Determined

Your blood type is determined by the genes you inherited from your mother and father

Blood type of offspring can be predicted using a Punnett square



How are Blood Types Determined

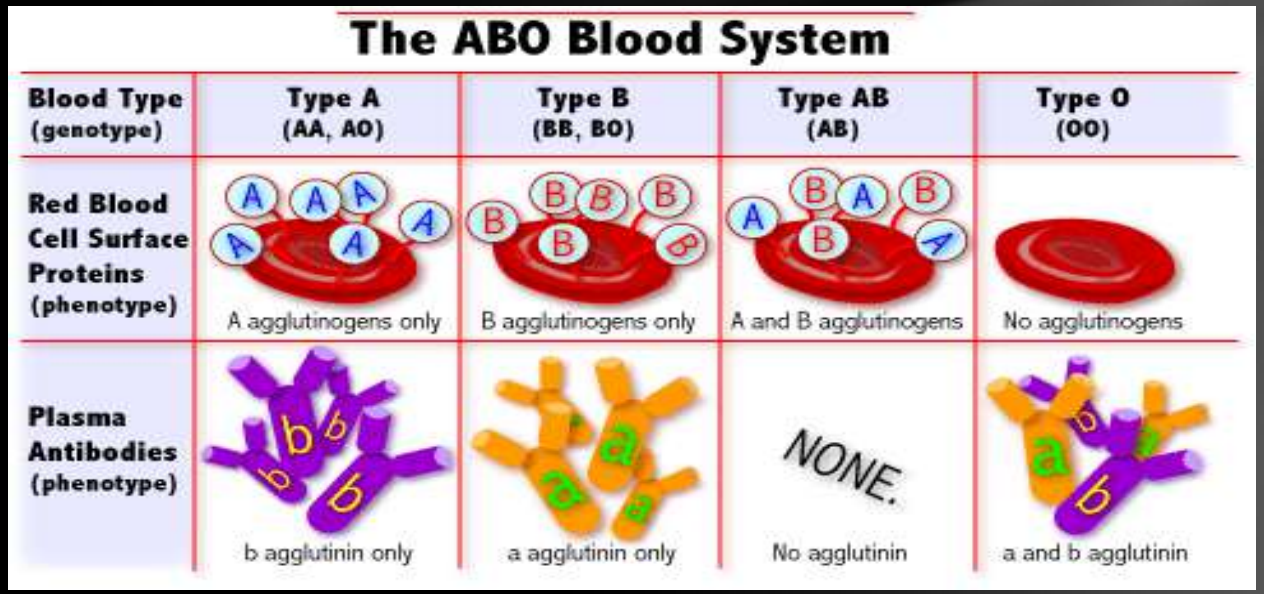
Predict the blood type of the offspring in the following scenarios

- A mother with AO and a father with AB
- A mother with Type O and a father with type B

How are Blood Types Determined

Blood type is determined by antigen on the blood cells

Plasma makes antibodies for any antigens not in your blood cells



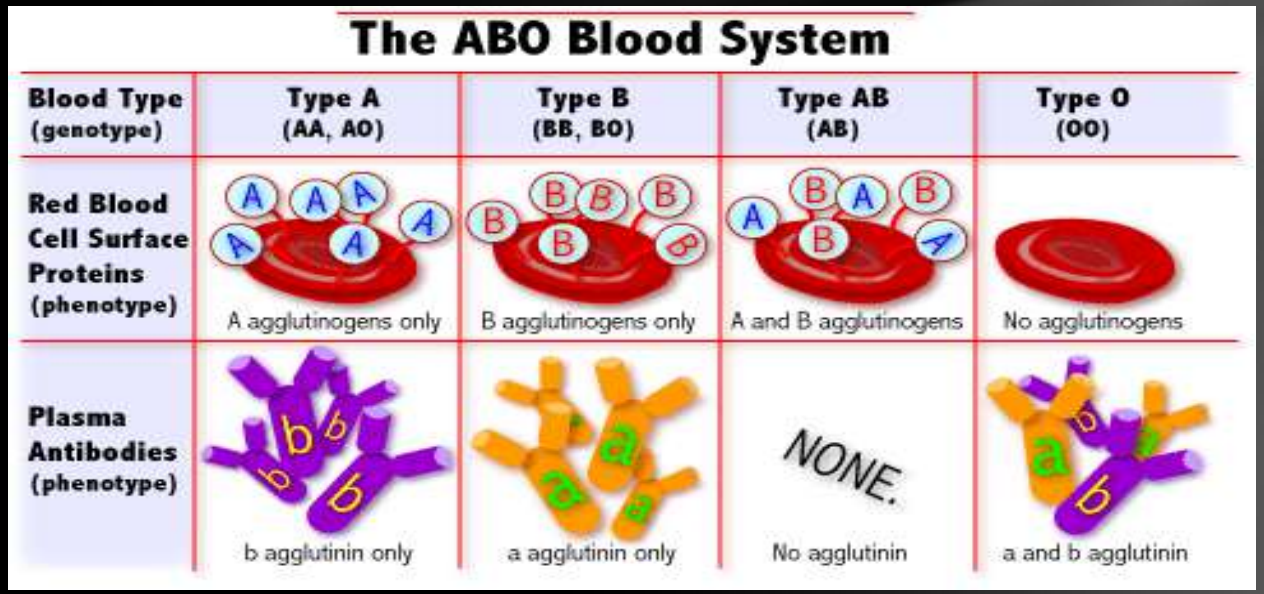
http://learn.genetics.utah.edu/units/basics/blood/types.cfm

How are Blood Types Determined

Tell whether each of the following transfusions are safe?

An AO donor to an AA recipient

An AB donor to a BO recipient



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Blood Typing

To determine a person's blood type, we add three different serums to blood samples and see if clumps form.

Clumps = Positive (+)
No Clumps = Negative (-)

Blood Type	Reactions w/ Anti-A Serum	Reactions w/ Anti-B Serum
A	+	-
B	-	+
AB	+	+
O	-	-

Rh Serum = Clumping = +

What blood type is the sample on the right?


Blood Spatter

Learning Objectives

- I can explain the composition and function of blood
- I can determine blood type from a sample of blood.
- I can examine stab wounds and blood splatter to reconstruct a crime.

Dexter at a Crime Scene

Importance of Blood Spatter

Analysis of a spatter 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.

Collection of Blood Evidence

1. Search for blood evidence.
2. If any is discovered, process it determining:
   a. Whether the evidence is blood.
   b. Whether the blood is human.
   c. The blood type.
3. Interpret the findings:
   a. See if the blood type matches a suspect.
   b. If it does not, exclude that suspect.
   c. If it does, decide if DNA profiling is needed.

Passive Dropping: Height

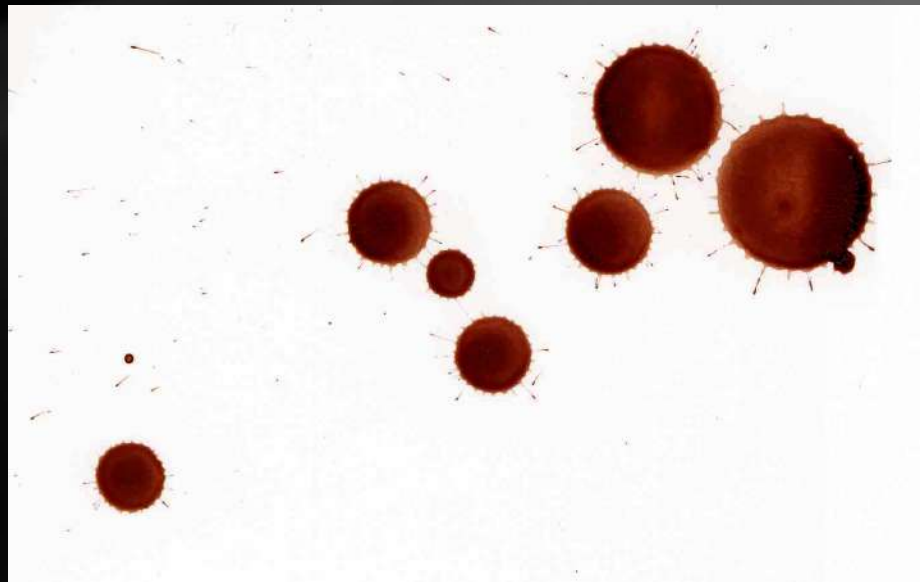
Blood falls due to gravity

Higher fall causes faster velocity reaching maximum velocity at five ft

Faster velocity causes larger drops

Match the blood drops to the drop height

8 in	33 in
22 in	53 in
25 in	78 in
28 in	



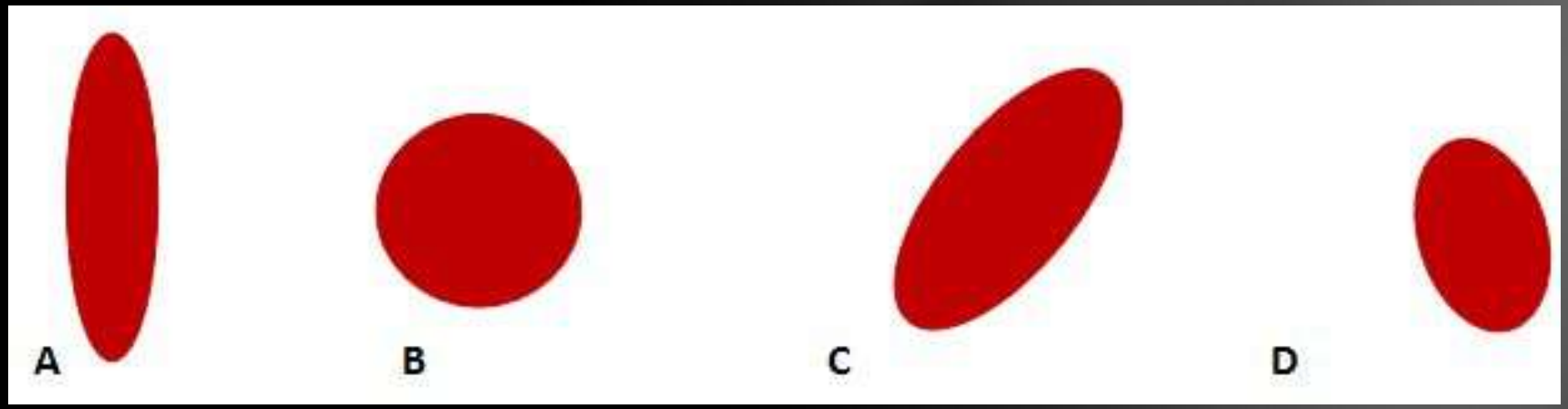
Passive Dropping: Impact Angle

Angle of Impact is calculated with the following equation

Make sure your calculator is in degrees

$$Angle\ of\ Impact = \sin^{-1}\left(\frac{width}{height}\right)$$

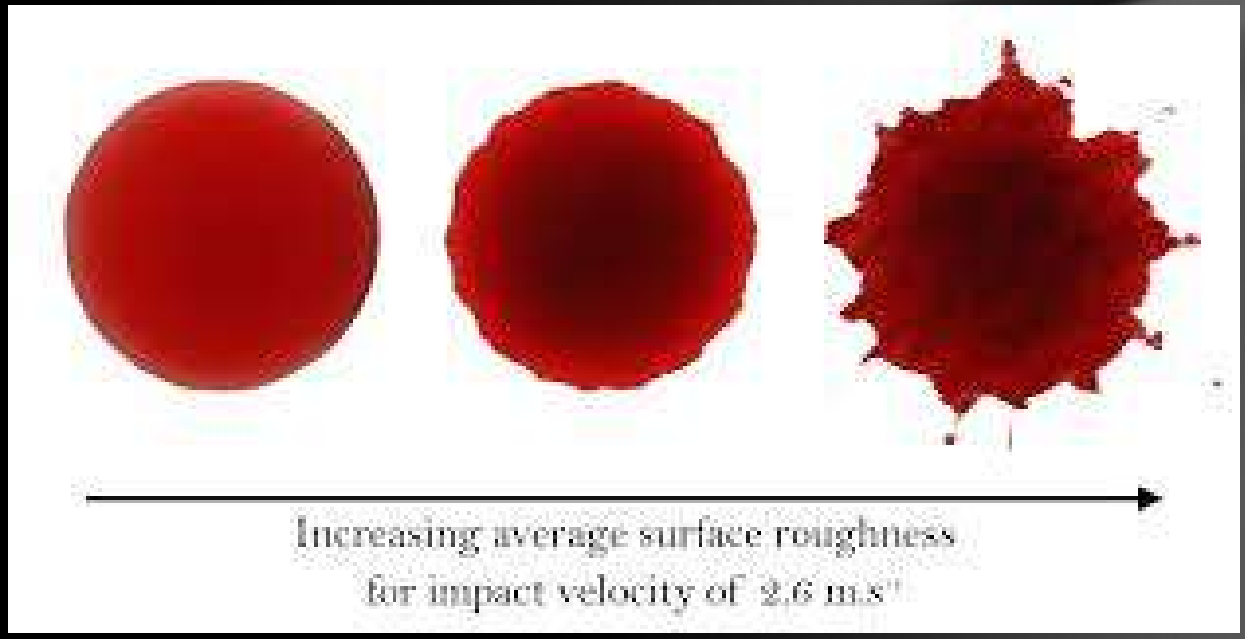
Calculate the impact angle of the drops below



Passive Dropping: Surface

Drops falling onto smooth, non-porous surfaces have smooth edges.

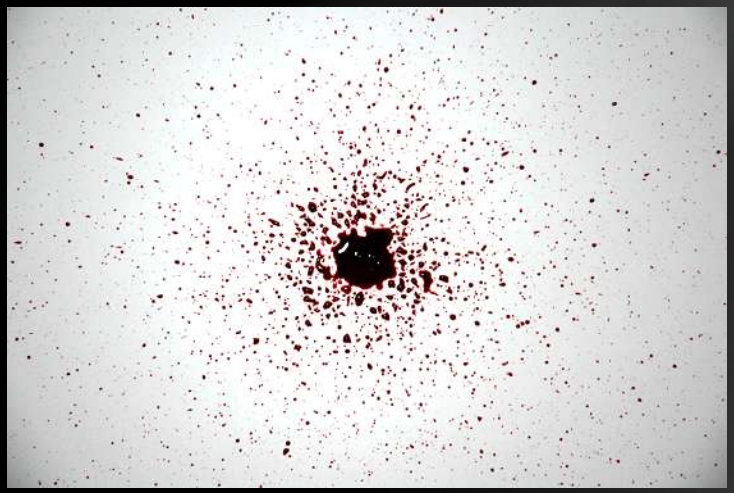
Drops falling onto rough surfaces produce spiny irregular stains and possibly satellite splatter



Blood Spatter Analysis

Drip Pattern

- A bloodstain pattern which results from blood dripping into blood



Blood Spatter Analysis

Flow Pattern

A change in the shape and direction of a bloodstain due to the influence of gravity or movement of the object

Blood Spatter Analysis

Pool

A bloodstain pattern created when a source of blood remains stationary over a surface causing an accumulation of blood

Blood Spatter Analysis

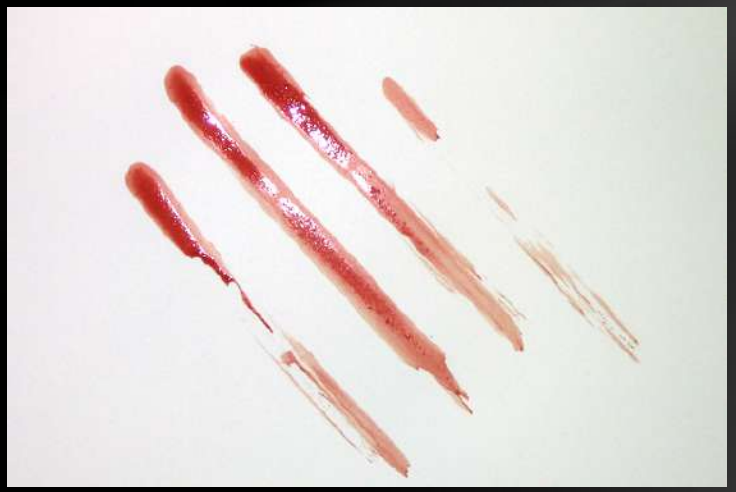
Transfer/Contact Pattern

- A bloodstain pattern created when a wet, bloody surface comes in contact with a second surface.
- Often leaves a pattern or recognizable image of the original surface

Blood Spatter Analysis

Swipe Pattern

- The transfer of blood from a moving source onto an unstained surface. Direction of travel may be determined by the feathered edge



Blood Spatter Analysis

Wipe Pattern

- A bloodstain pattern created when an object moves through an existing stain, removing and/or altering its appearance

Blood Spatter Analysis

Arterial Spurting

- Bloodstain pattern(s) resulting from blood exiting the body under pressure from a breached artery

Blood Spatter Analysis

Cast-off Pattern

- A bloodstain created when blood is released or thrown from a blood-bearing object
- Used to determine number of blows, position of victim and attacker, direction weapon was traveling, height of attacker

Blood Spatter Analysis

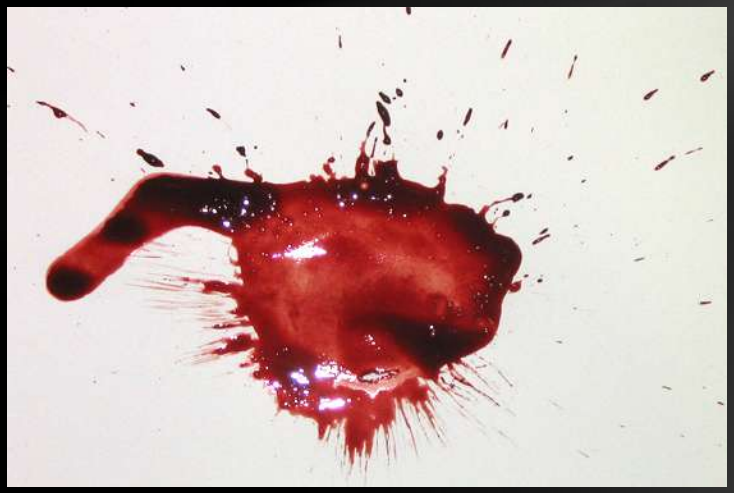
Extirpated Blood

Blood that is blown out of the nose, mouth, or a wound as a result of air pressure and/or air flow which is the propelling force.

Blood Spatter Analysis

Low Velocity Impact Spatter

- A bloodstain pattern that is caused by a low velocity impact/force to a blood source
- Up to 5 ft/s. Stains 4 mm or greater



Blood Spatter Analysis

Medium Velocity Impact Spatter

- A bloodstain pattern that is caused by a medium velocity impact/force to a blood source, typical beating
- 5-25 ft/s. Stains 1-4 mm in size

Blood Spatter Analysis

High Velocity Impact Spatter

- A bloodstain pattern that is caused by a high velocity impact/force to a blood source
- 100+ ft/s. Stains less than 1 mm in size