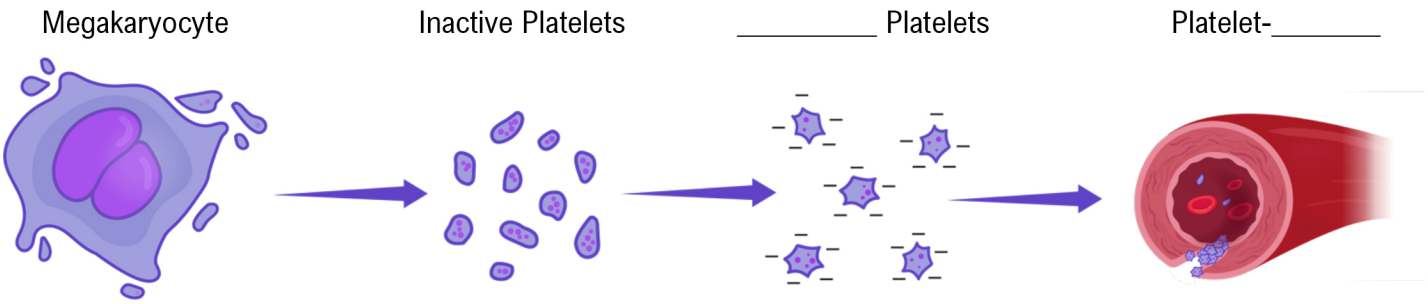
TOPIC: PLATELETS: HEMOSTASIS

Introduction to Platelets

- **Platelets (Thrombocytes)**: cell _____ that "plug" holes in damaged blood vessels, preventing blood loss.
  - Lack a nucleus but contain cytoplasmic _____ with proteins & chemicals involved in clotting.
  - Originate from large cells called _____ that *fragment* to form platelets.
  - Upon activation, platelets change shape & express some _____ charged surface proteins.



EXAMPLE

Which of the following formed elements is not technically considered to be a complete cell?

a) Erythrocytes.

b) Leukocytes.

c) Platelets.

d) They are all considered to be cells.

PRACTICE

Platelets are similar to erythrocytes in that both structures do not contain a _____. Platelets are similar to leukocytes in that both their primary functions involve _____ the body.

a) Plasma membrane; nourishing.

b) Plasma membrane; protecting.

c) Nucleus; nourishing.

d) Nucleus; protecting.

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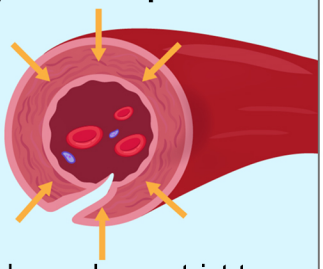
Overview of Hemostasis

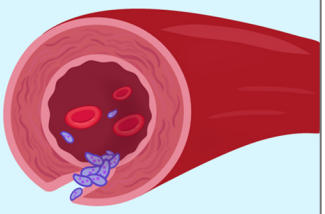
- **Hemostasis**: fast, local, & controlled process to *prevent* & *control* _____ after injury.
  - Under normal circumstances, blood does NOT clot because clotting factors are _____.
  - Upon blood vessel injury, hemostasis consists of ____ steps:

1) Vascular Spasm:



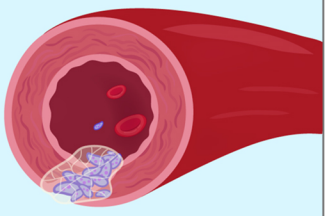
Blood vessels constrict to _____ blood flow.

2) Platelet Plug Formation:



Platelets aggregate to "_____" hole.

3) Coagulation (Blood Clotting):



Plug reinforced with _____.

- NOTE: after hemostasis is complete, ____ steps help complete the healing process (clot retraction & fibrinolysis).

EXAMPLE

When someone gets a wound, it is advised to "compress" and/or tightly wrap the wound. Why?

a) It causes clotting factors to become inactive.

b) It decreases the oxygen content in the blood that is being lost.

c) It increases the speed of platelet plug formation.

d) It enhances vascular spasm by decreasing blood vessel diameter, thereby reducing blood flow.

PRACTICE

Which physiological response causes a reduction in blood flow immediately after a blood vessel injury?

a) Migration of leukocytes to the site of the injury.

b) Platelet plug formation.

c) Vascular spasm.

d) Release of tissue plasminogen activator.

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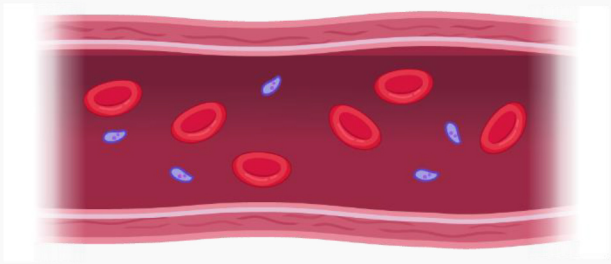
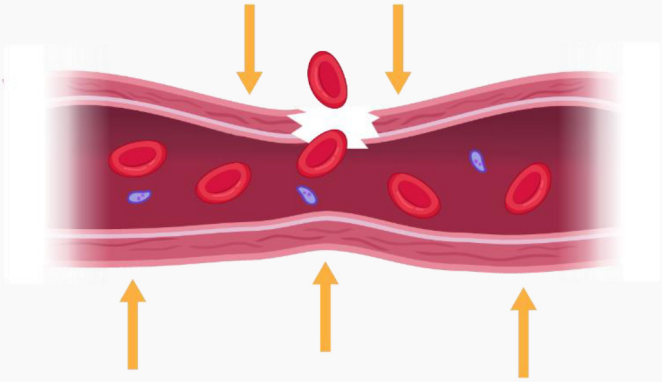
1) Vascular Spasm

◆ **Vascular Spasm**: immediate _____ of damaged blood vessel (*vasoconstriction*) to reduce blood loss.

- Initiated by chemicals released by damaged endothelial cells, smooth muscle, & activated platelets.
- Reduced blood loss "buys" sufficient _____ for the next 2 steps of hemostasis to occur.

Before Injury	After Injury: Vascular Spasm
	

EXAMPLE

Damaged endothelial cells release peptide hormones called endothelins, which help initiate vascular spasm. Considering this, what is the primary effect of endothelins?

a) Vasodilation.
b) Vasoconstriction.
c) Platelet aggregation.
d) Increased blood pressure.

PRACTICE

Which of the following statements about vascular spasm is false?

a) It occurs when smooth muscle cells surrounding the blood vessel relax, increasing the vessel's diameter.
b) It can help reduce blood flow immediately after a blood vessel is damaged, thereby reducing blood loss.
c) It is the first step of hemostasis, directly preceding platelet plug formation.
d) It is initiated by chemicals released by damaged endothelial cells, smooth muscle, & activated platelets.

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2) Platelet Plug Formation

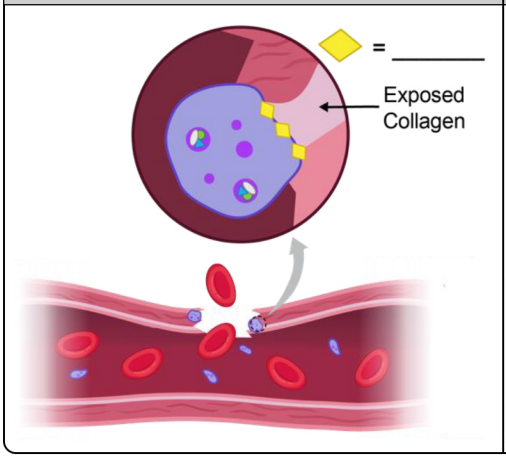
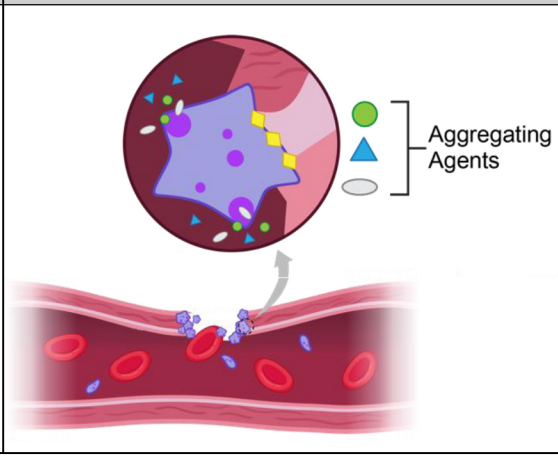
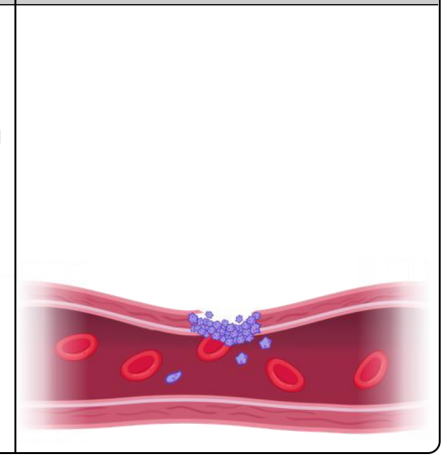
- **Platelet Plug Formation**: platelets aggregate to "_____" hole in a damaged blood vessel. Occurs in 3 steps:

  2a) **Adhesion**: *von Willebrand factor* (_____) protein "_____" it to exposed collagen.

  2b) **Activation & Degranulation**: "activated" platelets extend projections & release chemical-filled _____.

  - ADP, serotonin, & thromboxane A_2 (aggregating agents).

  2c) **Aggregation**: more platelets recruited to form an unstable plug, which can _____ blood loss.

2a) Adhesion	2b) Activation & Degranulation	2c) Aggregation
		

EXAMPLE

Which molecule acts as the glue between exposed collagen in damaged endothelial cells and platelets, initiating platelet plug formation?

a) Von Willebrand Factor.
b) ADP.
c) Serotonin.
d) Thromboxane A_2.

PRACTICE

Prostacyclin is a hormone that is normally active in the blood but becomes inactive when a blood vessel ruptures, and hemostasis begins. Considering this, which of the following is the most likely function of prostacyclin?

a) Causes platelets to aggregate.
b) Prevents platelets from aggregating.
c) Activates vWF.
d) Initiates coagulation.

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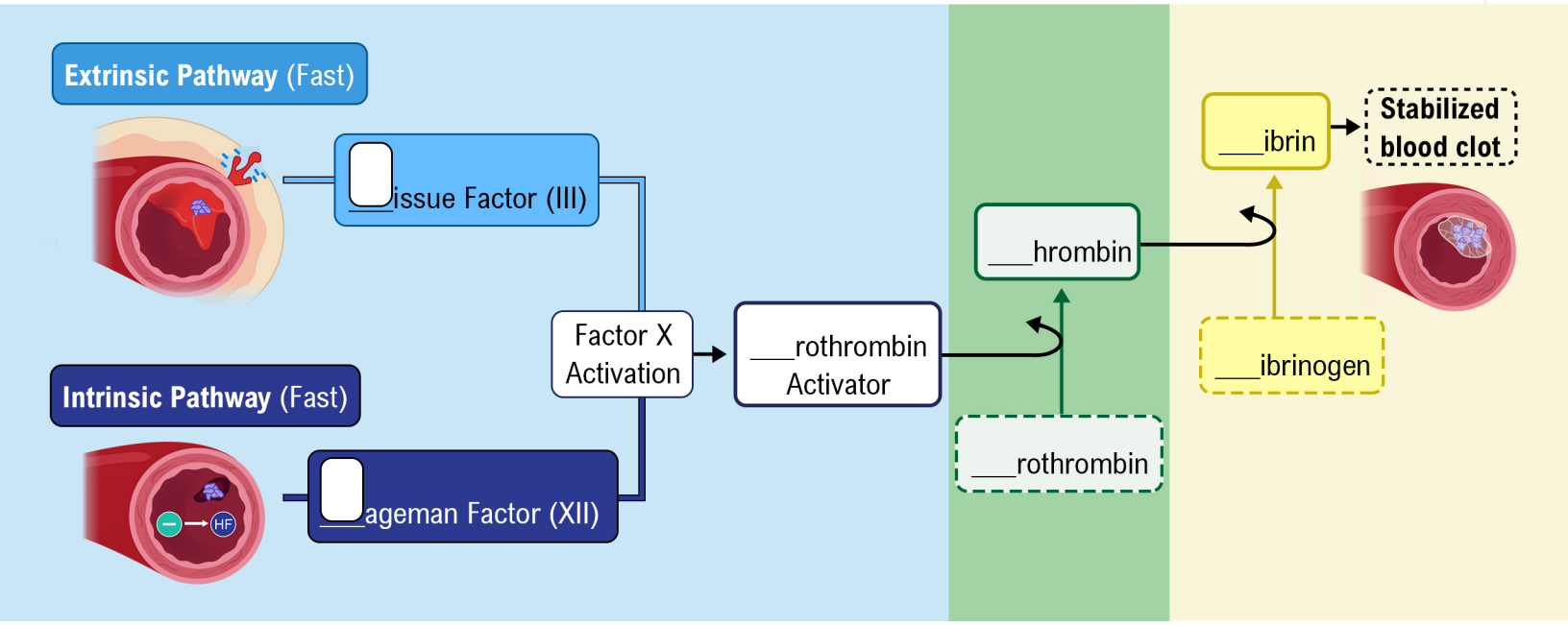
3) Coagulation (Blood Clotting)

- Coagulation _____ unstable platelet plug using protein _____ as a molecular "_____".
- Occurs via a VERY complex enzyme cascade but can be simplified into _____ phases:

- **Phase 1:** can occur via 1 of _____ different pathways; both lead to formation of *Prothrombin Activator*.
  - **Extrinsic Pathway:** initiated by factors _____ blood, specifically *Tissue Factor (III)*.
  - **Intrinsic Pathway:** initiated by factors _____ blood, specifically *Hageman Factor (XII)*.
- **Phase 2:** Prothrombin Activator converts Prothrombin → _____.
- **Phase 3:** Thrombin converts Fibrinogen → _____, which is *cross-linked* to stabilize platelet plug (clot).



NOTE: Ca^{2+} & Vitamin ____ play important roles in blood clotting.

EXAMPLE

Which phase 1 pathway of coagulation can be initiated by components that are not present in blood?

a) Extrinsic pathway.
b) Intrinsic pathway.
c) Neither extrinsic nor intrinsic pathway.
d) Both extrinsic and intrinsic pathways.

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PRACTICE

Which of the following is the most likely outcome if platelets could not release aggregating agents?

a) Platelets would not be able to bind to collagen within damaged endothelial cells.

b) Too many platelets would aggregate at the site of injury, causing blood clots that are too large.

c) Not enough platelets would aggregate at the site of the injury and an effective clot may not form.

d) There would be no effect.

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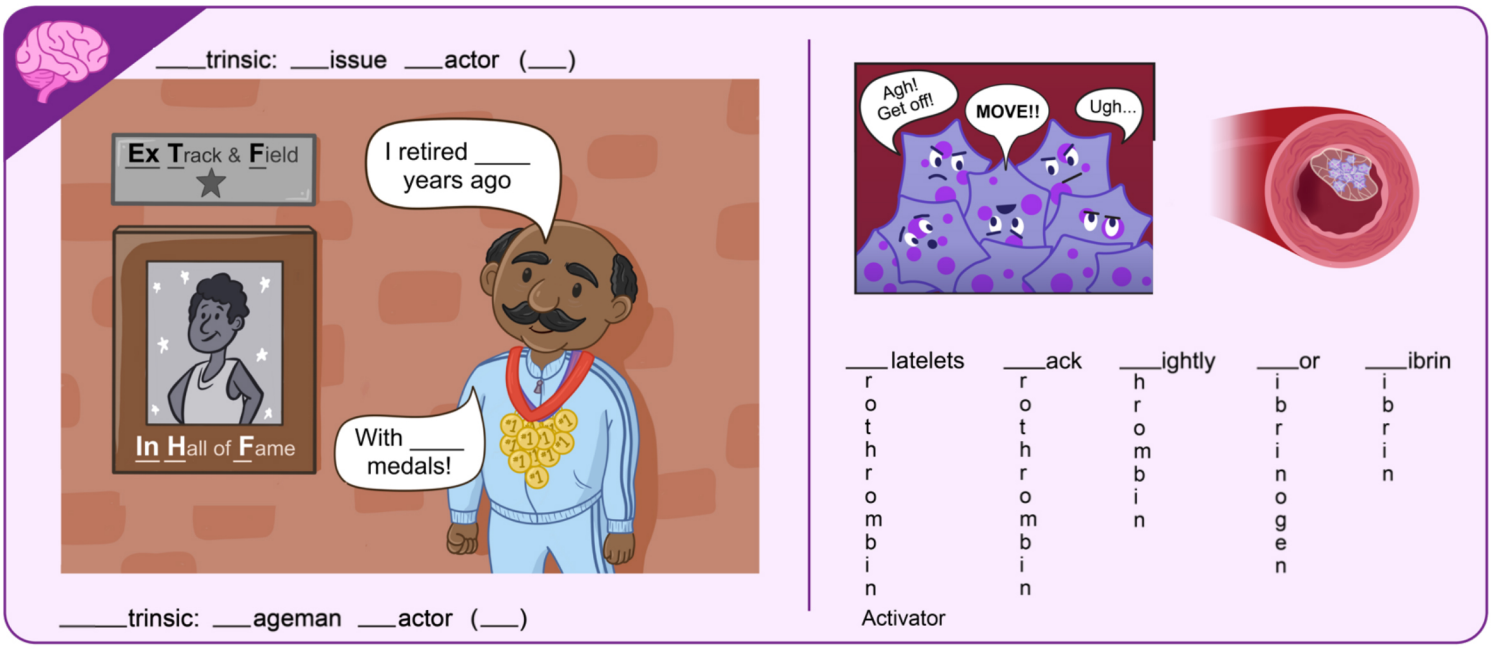
How To Remember Important Coagulation Components



PRACTICE

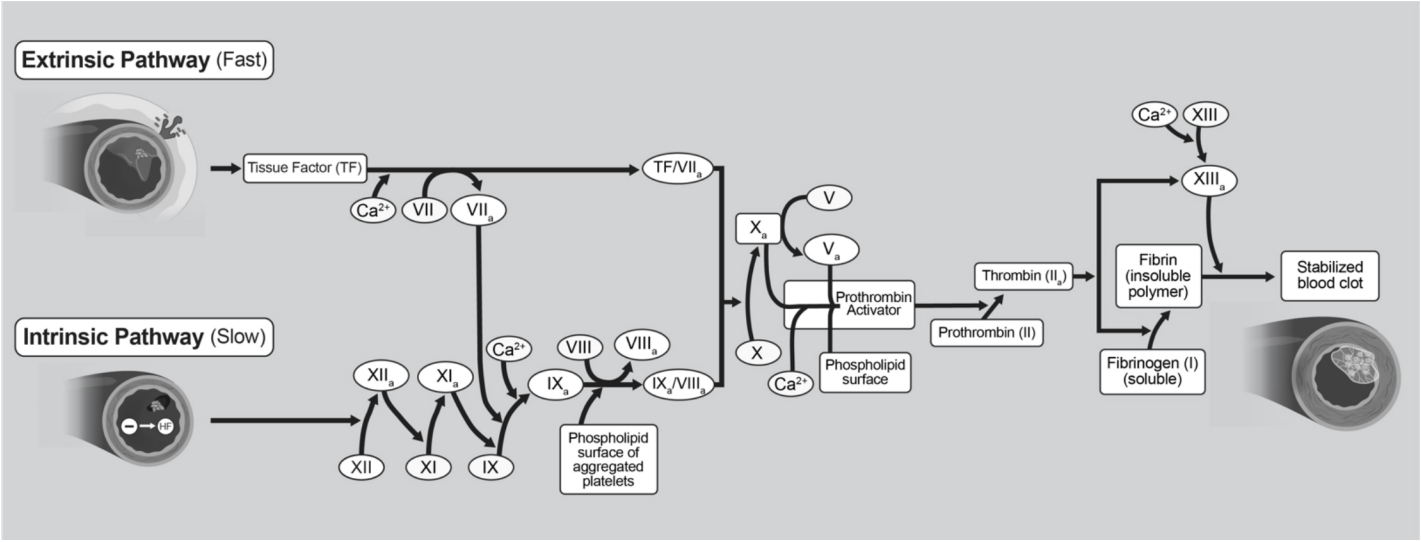
Which option correctly arranges/orders the components of the coagulation pathway?

a) Prothrombin Activator ➜ Thrombin ➜ Prothrombin ➜ Fibrinogen ➜ Fibrin.

b) Prothrombin Activator ➜ Prothrombin ➜ Thrombin ➜ Fibrinogen ➜ Fibrin.

c) Prothrombin ➜ Prothrombin Activator ➜ Thrombin ➜ Fibrinogen ➜ Fibrin.

d) Prothrombin Activator ➜ Prothrombin ➜ Thrombin ➜ Fibrin ➜ Fibrinogen.



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Clot Retraction & Fibrinolysis

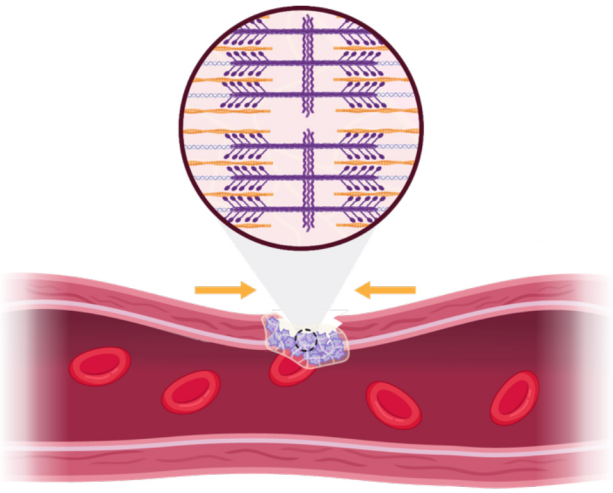
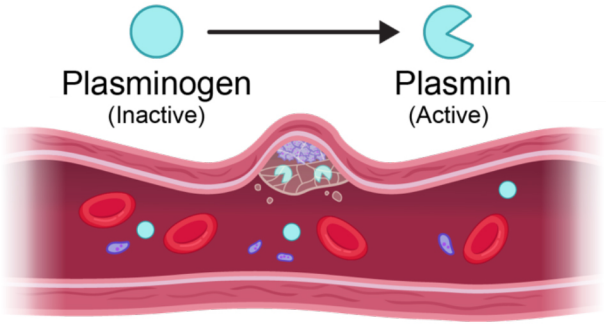
◆ Recall: after hemostasis, _____ more steps help complete the healing process:

4) Clot Retraction: platelet-induced process to further _____ clot & promote _____.

- Coagulated platelets in clot _____ to pull ruptured edges of blood vessel together.
- Platelets secrete *Platelet-Derived Growth Factor* (_____) to promote healing.

5) Fibrinolysis: process *after* blood vessel healing that breaks down fibrin to _____ unneeded clot.

- Plasminogen (inactive plasma protein) is converted to _____ (a fibrin-digesting enzyme).

4) _____ Retraction	5) Fibrinolysis
	

EXAMPLE

Which of the following issues might arise if fibrinolysis did not occur?

a) Decreased blood pressure.

b) Increased platelet count.

c) Increased hematocrit.

d) Buildup of blood clots.

PRACTICE

What would happen if plasminogen was activated before clot retraction?

a) Clot retraction would be completed even faster.

b) Fibrinolysis would occur too early & the healing process could be interrupted.

c) There would be no significant effect.