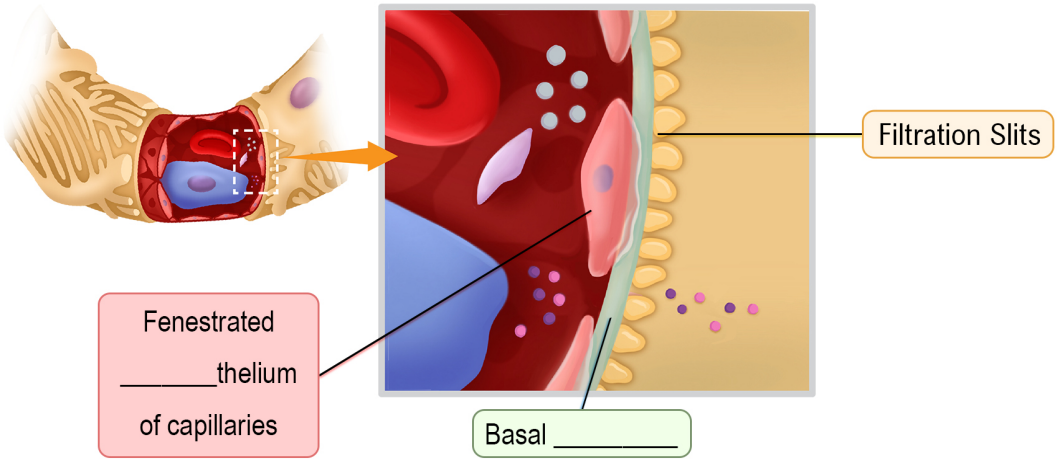
TOPIC: RENAL PHYSIOLOGY STEP 1 - GLOMERULAR FILTRATION

The Filtration Membrane

- **Filtration Membrane**: Membrane between the capillaries and the capsular space.
- Allows passage of water and any solutes _____ than plasma proteins. Has _____ layers:

Fenestrated Endothelium of Glomerular Capillaries	Basal Lamina	Filtration Slits of Podocytes
Fenestrations allow blood components _____ blood cells and platelets to pass through.	Thin layer of extracellular matrix _____ between other two layers. Has negative charge; _____ negatively charged plasma proteins (ex: albumin, globulin).	'Foot processes' wrap around the glomerular capillaries and interlace to form filtration _____.
Gaps are large: _____ nm.	Gaps are approx. _____ nm.	Gaps are approx. _____ nm.

- The filtrate in the capsular space contains water, ions, nutrients, and waste products.



EXAMPLE

Which of the following would NOT be able to pass through the fenestrated endothelium of the glomerular capillaries?

a) Ions.
b) Water molecules.
c) Red blood cells.
d) Glucose.

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PRACTICE

The _____ is the *finest* layer of the filtration membrane.

a) Fenestrated endothelium of the glomerular capillaries.

b) Basal lamina.

c) Filtration slits of the podocytes.

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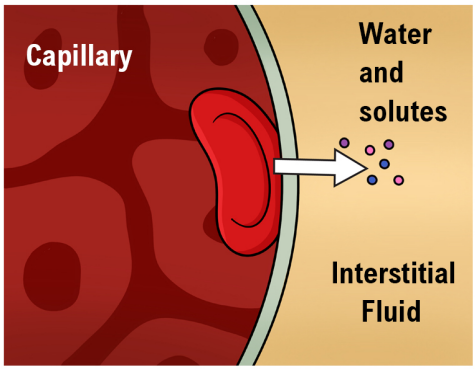
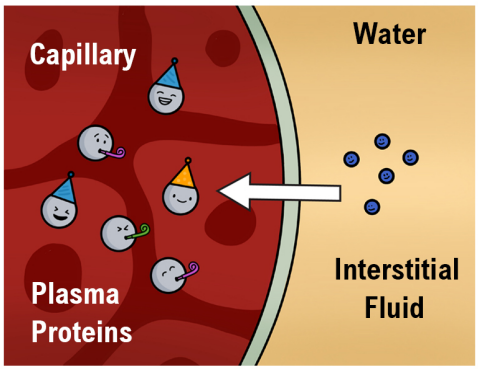
Overview of Filtration Pressures

- *Recall*: There are _____ main forces that drive fluid movement in a capillary bed:
  1. **Hydrostatic Pressure:** Force of a fluid on the _____ of its container. Usually _____ to blood pressure.
     - Pushes water and solutes _____ of the capillary.
  2. **Colloid Osmotic Pressure (COP):** Pressure created by _____ (primarily albumin) in the plasma.
     - Proteins create osmotic gradient that pulls water _____ the capillaries.
- **Net Filtration Pressure (NFP):** Determines _____ of fluid movement between capillaries and interstitial fluid.

Hydrostatic Pressure



Colloid Osmotic Pressure



EXAMPLE

Water moves out of the capillary if _____ is higher than _____.

a) Colloid osmotic pressure; hydrostatic pressure

b) Hydrostatic pressure; colloid osmotic pressure

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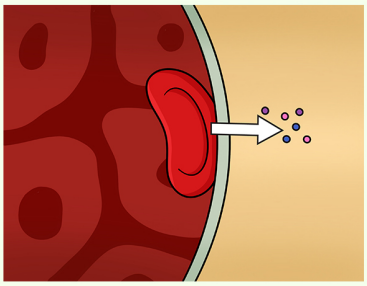
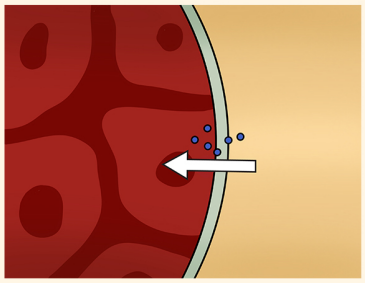
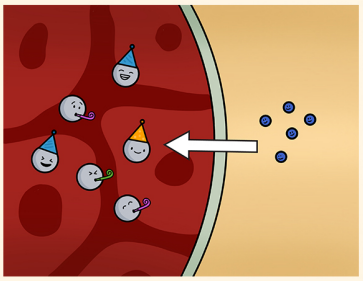
Glomerular Filtration Pressure

◆ Glomerular filtration pressure (GFP) is determined by _____ factors:

	Glomerular Hydrostatic Pressure (GHP)	Capsular Hydrostatic Pressure (CHP)	Glomerular Colloid Osmotic Pressure (GCOP)
Principle	Hydrostatic Pressure.	Hydrostatic Pressure.	Colloid Osmotic Pressure.
Description	Determined by _____ blood pressure. High resistance causes blood to push on walls of glomerular capillaries.	Filtrate in _____ space builds up its own hydrostatic pressure.	High concentration of plasma proteins (ex: albumin) in capillaries creates _____ gradient.
Movement	_____ filtration: Pushes fluid through filtration membrane.	_____ filtration: Pushes fluid back into capillaries.	Opposes filtration: Osmotic gradient draws water _____ capillaries.
Force	_____ mm Hg	_____ mm Hg	_____ mm Hg
			

◆ Glomerular filtration pressure is about 10 mm Hg – _____ movement through the filtration membrane.

EXAMPLE

Solve for net filtration pressure using the following equation: NFP = GHP – (CHP + GCOP).

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PRACTICE

In the process of filtrate formation, which of the following factors creates an osmotic gradient?

a) Systemic blood pressure.

b) A high concentration of negative ions in the capillaries.

c) A high concentration of plasma proteins in the capillaries.

d) A low concentration of water in the capsular space.

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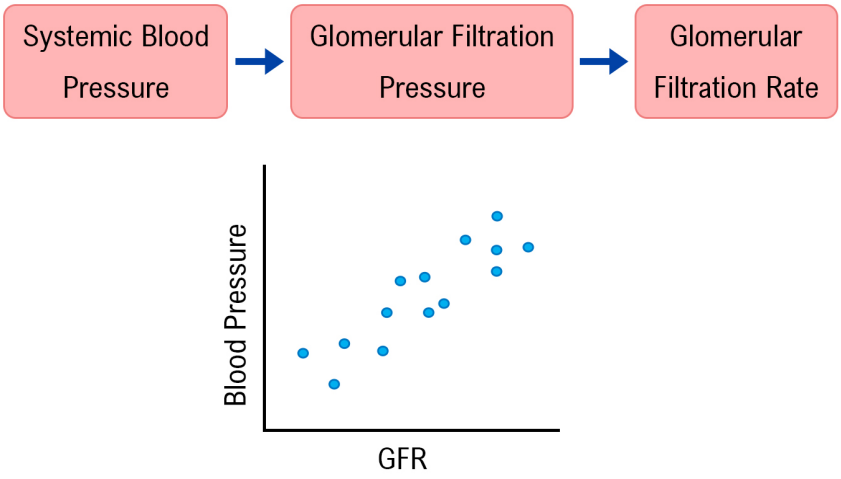
Glomerular Filtration Rate

- Glomerular filtration *pressure* _____ impacts the glomerular filtration *rate*.
- **Glomerular Filtration Rate (GFR)**: Amount of _____ formed by both kidneys in 1 minute (about 125 ml/min).
- On average, in _____ individuals, blood pressure and GFR are positively correlated.



- GFR is _____ regulated due to its impact on blood volume, pressure, and general homeostasis.

Chronically Increased GFR	→	Increased _____ output	→	Decreased blood volume and pressure → **Adverse Effects**: Electrolyte imbalance, Dehydration
Chronically Decreased GFR	→	Decreased urine output	→	_____ blood volume and pressure → **Adverse Effects**: Retention of _____ products

EXAMPLE

Kaitlyn is a 25-year-old women. She has no underlying health conditions and does not take any medications. When her blood pressure increases, which outcome would you expect to see?

a) Blood pressure increase → GFP decrease → GFR increase

b) Blood pressure increase → GFP increase → GFR increase

c) Blood pressure increase → GFP increase → GFR decrease

d) Blood pressure increase → GFP decrease → GFR decrease

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PRACTICE

Which of the following is a possible consequence of a prolonged or chronic decrease in glomerular filtration rate?

a) Dehydration.

b) Leukemia.

c) Edema (swelling).

d) Hypotension.