Name: _____ Block: _____ Date: _____

Biology 12 - The Urinary System Study Guide KEY

1. What is the difference between **excretion** and **defecation**?
   Excretion: process of getting rid of metabolic wastes (esp. Nitrogenous wastes) from the body.
   Defecation: process of ridding the alimentary canal of undigested, unabsorbed food remains (not metabolic end products).
2. Make a table like the following table with the five organs responsible for excretion and the waste products they excrete.

Excretory Organ	Waste Product
Kidney	Excrete urine (water, urea, creatinine, ammonia, uric acid, and ions)
Skin	Excretes perspiration (water, salt, and small amounts of urea)
Liver	Excretes bile which has pigments from the breakdown of RBC's. Also excretes urochrome which is from the breakdown of heme.
Lungs	Excrete carbon dioxide and some water
Intestine	Excretes some iron and calcium salts

3. What are **nitrogenous** wastes? From which processes are they derived? What does ***deamination*** mean?
   Nitrogenous Wastes: nitrogen containing compounds produced by metabolism that are excreted by the body.
   Deamination: the removal of amino groups from amino acids
4. List and briefly describe the various ways in which **water** enters and leaves the human body.
   Water enters the body proper by the large intestine absorbing it from the foods and drink we consume.
   Water leaves the body by being excreted in our urine (kidneys), sweat (skin), exhaling (lungs), and secretions of the digestive system.
5. Name the primary components of ***urine***. Compare and contrast this to ***blood plasma***.

   Urine:
   Water: 95%
   Urea: ~2.5-3%
   Creatinine: .2%
   Ammonia: ~.2%
   Uric acid: ~.1%
   Ions: ~2%
   (Na^+, Cl^-, K^+, SO_4^{2-}, Mg^{2+}, PO_4^{2-}, Ca^+)
   * No proteins are in urine!

   Plasma:
   Water: 90-92%
   Proteins: 7-8%
   Salts: <1%

6. Describe the **function** (not the structure) of the following parts of a nephron in urine formation: Make a table like the following table.

Name	Function(s)
• glomerulus	Filters blood under high pressure to produce a crude filtrate
• afferent and efferent arterioles	Bring blood to and take it away from the glomerulus, respectively
• proximal convoluted tubule	Selectively reabsorbs useful substances, like nutrients, salts, water and some ions from the crude filtrate by both passive and active transport
• distal convoluted tubule	'fine-tuning' the filtrate by actively adding other non-filterable wastes to tubular fluid and reabsorbing ions to control blood volume, pH and electrolyte balance
• Bowman's capsule	Receives the substances that were forced out of blood from glomerulus to form the crude filtrate
• peritubular capillary network	By surrounding the nephron it reabsorbs and excretes substances from and to the tubular field
• loop of Henle	Reabsorbs water and establishes an increasingly greater salt gradient from cortex to inner medulla
• collecting duct	Concentrates urine, making it hypertonic to plasm, by allowing water to be reabsorbed

Name: _____ Block: _____ Date: _____

7. What are **kidney stones**? **Where** do they form in the kidney. What are two ways they can be **eliminated**?
-hard, stone-like objects made of calcium salts and uric acid
-form in the Renal Pelvis of Kidney
-treated by: destroying them in a sound wave bath, or with laser light; or surgically removed
8. How is the **urethra** different in **males** versus **females**?
Male urethra is longer (~8") than female's (~1") because males must ravel from bladder through the penis.
Females more susceptible to bladder infection because less distance for bacteria to travel to invade.
9. Make a table like the following table on the process of **pressure filtration**:

Filterable Blood Components	Nonfilterable Blood Components
Water Nitrogenous Wastes	Blood cells (formed elements) Platelets
Glucose	Proteins
Amino acids	
Ions (salts)	

10. Make a table like the following table on the process of **urine formation**:

Process	Location where it occurs	Summary of Process
1. Pressure Filtration	Glomerulus/ Bowman's capsule interface	Forces all small molecules out of blood to create a crude filtrate
2. Reabsorption	Proximal convoluted tubule/ Peritubular capillary network	Reabsorption of most of materials from crude filtrate minus wastes
3. Tubular Excretion	Distal convoluted tubule and collecting duct	'Fine-tuning of tubular fluid by actively excreting non-filtered wastes

11. What is the **difference** between active and passive reabsorption? Describe the differences between how Na+, Cl-, and water are reabsorbed.
Active reabsorption: requires ATP and a carrier molecule.
Passive reabsorption: molecule is reabsorbed from high concentration is tubular fluid by diffusion to low concentration in the blood.
Sodium is actively reabsorbed from proximal convoluted tubule and chlorine passively follows. Water passively is reabsorbed.
12. What is a **hypertonic** urine solution? Which part of the nephron plays a role in creating this solution?
Hypertonic Urine: a solution that has a greater dissolved solute concentration (up to 4x) than plasma.
The Collecting Duct and Loop of Henle ensures that urine excreted is hypertonic to blood plasma.
13. Name two substances that are actively excreted during **tubular excretion**.
Actively excreted during Tubular Excretion:
-Histamine
-Penicillin
-H^+
-K^+
14. Describe where the two capillary regions are in the nephron.
The 2 capillary regions surround, like a lattice-work the proximal convoluted tubule (arteriole side), lookp of Henle and distal convoluted tubule (venule side).
15. What happens to the **filterable** and **nonfilterable** components of blood once they enter the glomerulus?
From glomerulus:
-filterable components of blood enter the Bowman's capsule and subsequently on to proximal convoluted tubule
-nonfilterable components stay in blood and depart glomerulus via efferent arteriole
16. Why can't the composition of urine be the same as that of the glomerular filtrate? What would happen if it were?
If the composition of urine was same as glomerular filtrate we would quickly die of dehydrain and starvation because of loss of water and nutrients from blood.

Name: _____ Block: _____ Date: _____

17. What is a **diuretic**, and what does it do to urine production? What is an **antidiuretic**, and what does it do to urine production?
A diuretic is a chemical that inhibits ADH secretion causing a decrease in permeability of the collecting duct and distal convoluted tubule resulting in more water in the urine. Urine production increases.
An anti-diuretic, like ADH, has the exact opposite effect.
Anti "pee-more" or anti "increase urine output"

18. What is the **hormone** that is responsible for **reabsorption** of water? Where is this hormone **produced**? From which gland is it **released**?
-ADH
-is produced by the hypothalamus
is released by posterior pituitary gland

19. **Explain** how this hormone accomplishes its duty.
ADH made in hypothalamus when low blood volume is detected here. ADH sent from posterior pituitary to kidney where it acts on collecting ducts and distal convoluted tubules to cause them to reabsorb more H20 from volume negatively feed backs on hypothalamus.

20. How is the **concentration** of this hormone in the blood regulated?
Answer same as 19.

21. Explain how **blood pressure** can be affected by diuretics and anti-diuretics. Give examples.
Diuretics decrease B.P. by causing more water to be excreted.
-eg. Alcohol, caffeine and diuretic drugs inhibit ADH secretion therefore permeability of D.C.T. and Collecting duct lowers and less water is reabsorbed into blood stream
Antidiuretics increase B.P. by causing more water to be reabsorbed from tubular fluid.
-eg. ADH, Aldosterone

22. How does **drinking alcohol** affect ADH?
Drinking alcohol inhibits Adh secretion causing increased urine to dehydration to hangover

23. Where are the **adrenal glands** located? What hormone do they release that directly acts on the kidneys?
Adrenal glands located sitting atop the kidneys.
-The release Aldosterone which causes the kidneys to retain sodium and excrete potassium. The concentration of Aldosterone is regulated by blood pressure as detected by the juxtaglomerular apparatus.

24. What does this hormone do? How is the **concentration** of this hormone in the blood regulated? Draw the **feedback loop** that illustrates this process.
Answer same as 23.

25. Explain why blood concentration of **sodium ions** is important.
$[Na^+]$ is important because if there is an increase in the amount of sodium in the blood this will make the blood more hypertonic compared to surrounding tissue fluid. Water will then move into the blood via osmosis thus increasing blood volume and blood pressure. Too much sodium leads to hypertension. A decrease in blood $[Na^+]$ makes the blood less hypertonic to osmotic pressure surrounding tissue and even perhaps hypotonic to tissue. Water will leave the blood thus reducing blood volume and therefore blood pressure. Too little sodium leads to hypotension. Loss of sodium reduces Osmotic Pressure exerted by blood at venule end of capillary leading to EDEMA.

26. How does the kidney adjust the blood's **pH** if the blood is too **acidic**?
If blood too Acidic: kidney excretes more H^+ and NH_3, and reabsorbs more Na^+ and HCO_3^-.

27. How does the kidney adjust the blood's pH if the blood is too **alkaline**?
If blood too Alkaline: kidney excretes less H^+ and NH_3, and reabsorbs less Na^+ and HCO_3^-.

28. What are your options if you are experiencing *renal failure*? What are the advantages and disadvantages of each of your options.

Renal Failure Options	Advantages	Disadvantages
-Kidney Transplant	One time permanent natural solution	-Donors are scare -Possibility of rejection
-Kidney Machine	Works faster than kidneys therefore only down twice a week	-Must make trips twice a week to medical facility
-Continuous Ambulatory Peritoneal Dialysis	Don't need to go to medical facility; can carry out normal activities during CAPD	-Permanent inplant required and user administered every 4-8 hours

Name: _____ Block: _____ Date: _____

29. What is kidney **dialysis**?
Kidney Dialysis: circulation of patient's blood through the semipermeable membrane of dialysis tubing to expose it to dialysate (dialysis solution) in an effort to rid blood of wastes and balance pH, etc.

30. Explain,using a diagram, how the **semipermeable membrane** of a kidney machine filters wastes from blood. By the same principle, how could substances be *added* to the blood during dialysis?
Semipermeable Membrane of Kidney Machine:
-membrane is permeable to salt, waste products and water but impermeable to blood cells and blood proteins
-salt and waste products diffuse from area of high concentration in blood to lower concentration of dialysate
-in order to add substances to blood during dialysis, the concentration of the subsntace has to be greater in the dialysate than in the blood

31. Explain the differences and similarities between the operations of the **artificial kidney** and **continuous ambulatory peritoneal dialysis** (CAPD).
CAPD and Artificial Kidney Dialysis:

Similarities	Differences
-both utilize a dialysate solution to add or remove substances from blood -both utilize a semi-permeable membrane	-artificial kidney dialysis needs only to be done 2 times a week whereas CAPD done every 4-8 hours -CAPD allows individual to do normal activities while it does its job whereas A.K.D. requires person to go to medical facility and be 'tied' to machine for ~2 hours -A.K.D. more efficient at removing wastes

32. Outline the roles of the **skin, liver, lungs**, and **large intestine** in excretion and name the metabolic wastes associated with each.
Skin: - Excretes perspiration primarily for cooling
- metabolic wastes include **water**, **salt**, some **urea**
Liver: - Excretes bile to small intestine; goes out with feces
- contains pigments **bilibrubin** & **biliverdin** from breakdown of hemogobin; also **urochrome** from breakdown of **heme** which goes out with urine
Lungs: - Excrete **CO2** & **H2O** during expiration
Large Intestine: - Excretes some **iron** & **calcium salts** which were secreted into intestine & excreted to the feces

33. Identify the possible causes, characteristics of and methods of treatment for any **two** of the following disorders.

• kidney stones	• glomulonephritis
• cystitis	• diabetes insipidus
• renal failure	• proteinuria
• uremia	• gout

Kidney Stones: precipitation of calcium salts & uric acid form stones. One cause is too much protein in diet. Surgically removed or destroyed by sound waves or laser light.

Cystitis: bacterial infection of bladder causing its inflammation. Bacteria invade via urethra (men's urethra shorter than women's therefore more common in women). Note: Women should always wipe anus away from direction of urethra to avoid infection from bacteria that are in feces. Treat with antibiotics.

Renal Failure: infection procedes to kidneys affecting permeability of glomeruli – either blocks them or makes them more permeable resulting in **'glomerulonephritis'**. Treat aggresively with antibiotics. If more than 2/3 of glomeruli damaged leads to:

Uremia: is wastes accumulating in blood. This also leads to salts & H2O to be retained causing ionic imbalances (which can lead to heart failure & loss of consciousness) & edema.
- Treat by kidney replacements: ie. Transplant, Kidney Machine, or CAPD

Diabetes Insipidus: caused by inability to produce ADH. Sufferers urinate too much thus losing too much salts from blood. Treat with ADH injections.

Proteinuria:

Gout: crystals of uric acid precipitate out of plasma and collect in joints especially in the extremeties. Very painful. 1 cause is diet too high in protein. Treatment

34. Make a graphical representation of a nephron, label its parts, and indicate where and what molecules leave and enter the various parts of the tube during urine formation.