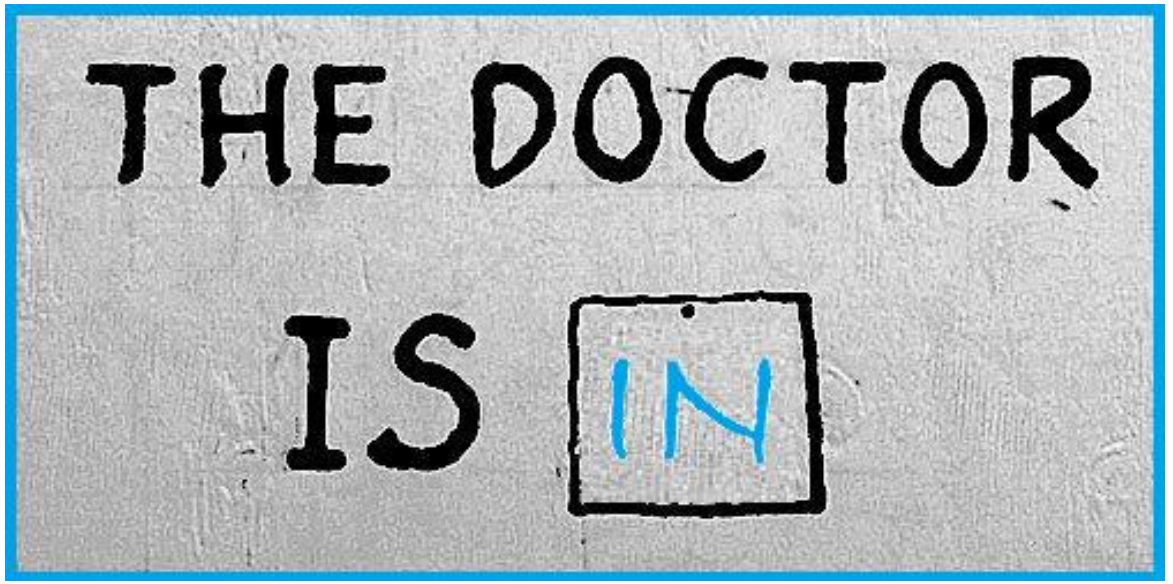
Next Step Office Hours: Learning MCAT Science

- Welcome to Office Hours!
- Introduction
- What Do I Need for this Session?
- Learning MCAT Science
- Techniques for Biochemistry
- How Can Next Step Help?



Next Step Office Hours: Learning MCAT Science

- **Thanks for coming to Next Step Office Hours!**
- **If you haven't been here before, here's how it works…**
- **These sessions are meant to be:**
  - *Interactive*
  - *Problem-focused*
  - *Specific to your needs* ***(so ask questions!)***
- **Today's focus: Learning MCAT Science**
- **Future sessions: Content review, FL exam review**
- **This is NOT a lecture! You can benefit most by:**
  - *Raising your hand and speaking*
  - *Commenting in the Question box*
  - *Responding to poll questions*

Before Getting Started

1. **If you have a microphone, make sure it is turned on and easily available.**
2. **Locate the hand-raise button on the toolbar on your screen.**
3. **Locate the Q box on the toolbar.**
4. **Let me know if you're having any technical issues!**

Memorizing MCAT Science: Techniques

Mnemonics

- *Info that can be represented as a sentence or series of words*

Formula sheets

- *Physics! So! Many! Equations!*

Study sheets

- *Summary of a single topic*

Flowcharts

- *Pathways, logical connections*

Unit analysis

- *Equations!*

Flashcards

- *Disconnected facts (often psych/soc)*

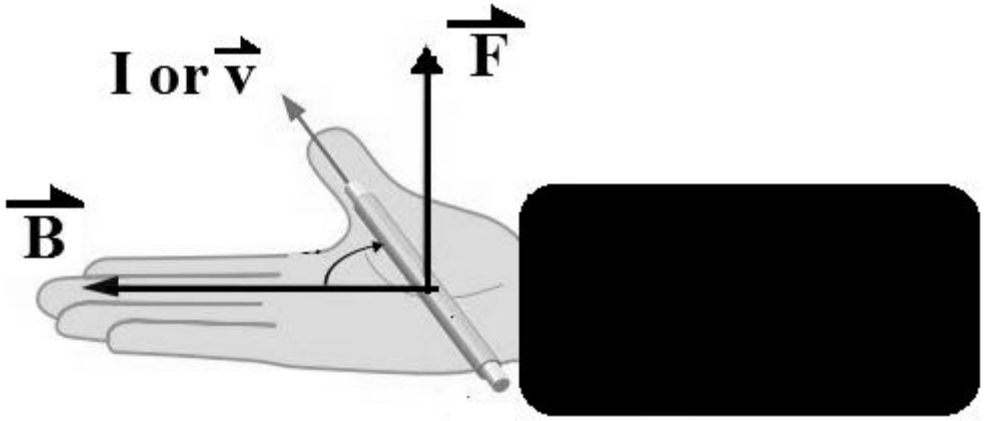
Spaced repetition

- *Literally everything*

Visual / kinesthetic learning

- *Useful for students with visual or physical learning styles*

1 H 1.008																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 76.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29



Mnemonic Devices

Mnemonics

- *Good ones are outrageous, naughty, or related to people you know (or all 3!)*
- *Can be visual, auditory, kinesthetic*
- *You should create a new mnemonic every other week*

Examples:

The classification hierarchy for living things:

King Phillip Comes Over For Good Sex
(Kingdom, Phylum, Class, Order, Family, Genus, Species)

The elements that are diatomic gases at standard conditions:

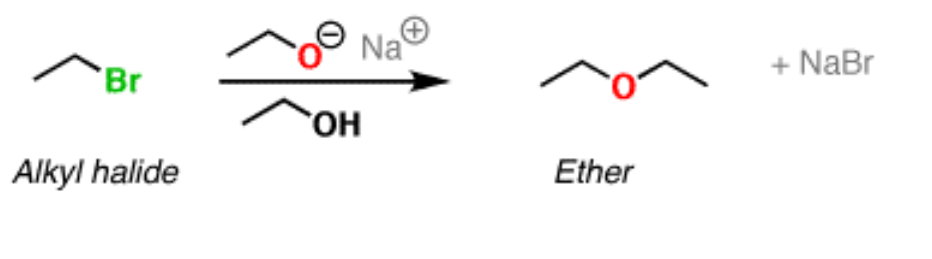
Have No Fear Of Ice Cold Beer
(H_2 N_2 F_2 O_2 I_2 Cl_2 $Br_{2)}$

Or memorize it phonetically *"huh-noff cull-bree": H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2*

Mnemonic Devices

When to Use:	Method:	Example:
For information involving key words	Acronym - an invented combination of letters with each letter acting as a cue to an idea you need to remember.	***FLAT PEG– is an acronym for the anterior pituitary hormones (FSH, LH, ACTH, TSH, Prolactin, Endorphin, GH).***
For information involving key words	Acrostic - an invented sentence where the first letter of each word is a cue to an idea you need to remember.	***Eat Tender Chicken Chunks Elegantly is an acrostic to remember Proteases in the Duodenum:*** ***Enterokinase, Trypsin, Chymotrypsin, Carboxypeptidase and Elastase.*** ***FOL(d)M(a)PS - Ovarian Cycle: Follicular phase, Ovulatory phase, and Luteal phase.*** ***Menstrual Cycle: Menstrual flow, Proliferative phase, and Secretory phase.*** ***SEVEn UP - Path of Sperm in the Male Reproductive Tract:*** ***Seminiferous tubules, Epididymis, Vas deferens, Ejaculatory Duct, n(Nothing), Urethra and Penis.*** ***LAb RAt – to remember the bicuspid valve of the left atrium and the tricuspid valve of the right atrium.*** ***SNoW DRoP – Lab techniques and the material they use. Southern blot, DNA; Northern blot, RNA, Western blot, protein***

Mnemonic Devices

When to Use:	Method:	Example:
For remembering information items	Loci Method - Imagine placing the items you want to remember in specific locations in a room with which you are familiar.	***To remember the path of the blood: The door to your house is the SVC/IVC entry to the right atrium. As you walk through the house, each door will serve as a valve and the room will serve as the next chamber.***
For ordered or unordered lists	Chaining- Create a story where each word or idea you have to remember will cue the next idea you need to recall.	***Williamson-ether synthesis:*** ***Throw a magic wand and your favorite brand of beer into a wishing well, bring up the bucket to find angel wings***  ***WELL is reminiscent of "WILLiamson", the magic wand is a long alkyl chain with Br-and reminding you it ends in a halide, the beer is the alcohol, and the pair of wings represents the ether product***

How to "Memorize" Equations: Formula Sheets

The MCAT emphasizes integration and testing of relationships. Many times the successful use of a formula or equation will depend on the relationships of the equation, not raw calculation.

$d = v_i t + \frac{1}{2} a t^2$ $v_f^2 = v_i^2 + 2ad$

*When learning equations, focus on: the **relationship** between the variables and h*

*Keeping track of **units** will allow you to derive a needed equation in a pinch.*

$v_f = v_i + at$ $d = \frac{v_i + v_f}{2} t$

	Equation	Units	Relationships
Gravitational Force	$F = mg$	Newtons ($kg \cdot m/s^2$)	proportional
Electrostatic Force	$F = kQq/r^2$	Newtons ($kg \cdot m/s^2$)	proportional , inverse square
Kinetic Energy	$KE = ½ mv^2$	Joules ($N \cdot m$)	proportional, square
Potential Energy	mgh, kQq/r	Joules ($N \cdot m$)	proportional, inverse
Mechanical Work	$W = Fd\cos\Theta$	Joules ($N \cdot m$)	proportional, inverse (cos)
Translational Motion	The core 4	varies	all of the above

Kinematics, Force and Energy – Recall Exercise

Trig Functions

	sin	cos
0	0	1
30	√1/2	√3/2
45	√2/2	√2/2
60	√3/2	√1/2
90	1	0
180	0	-1

Kinematics

$v_f = v_o + at$ $\quad d = v_o t + (1/2)at^2$

$v_f^2 = v_o^2 + 2ad$ $\quad d = [(v_1 + v_2)/2]\, t$

Projectile Motion

$v_o \sin\vartheta = \sqrt{(2gh)}$ $\quad v_o \cos\vartheta = \text{constant}$

$v_o \sin\vartheta = v_{yi}$ $\quad v_y$ @ max h = 0 m/s

$a_x = 0\ m/s^2$ $\quad a_y = -10\ m/s^2$

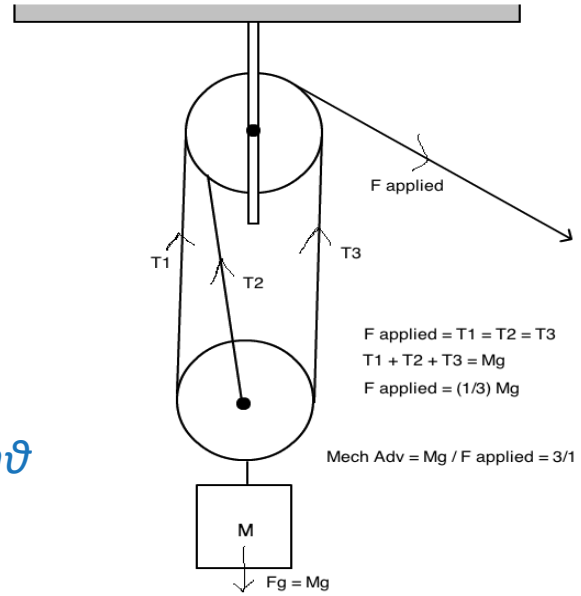
Force

$F = ma$ $\quad F_g = GMm / r^2$

Mechanical Advantage: F_{out} / F_{in}

Efficiency: W_{out} / W_{in}

$F_{spring} = -k\Delta x$ $\quad F_f = \mu F_N$ $\quad \tau = rF\sin\vartheta$



Energy

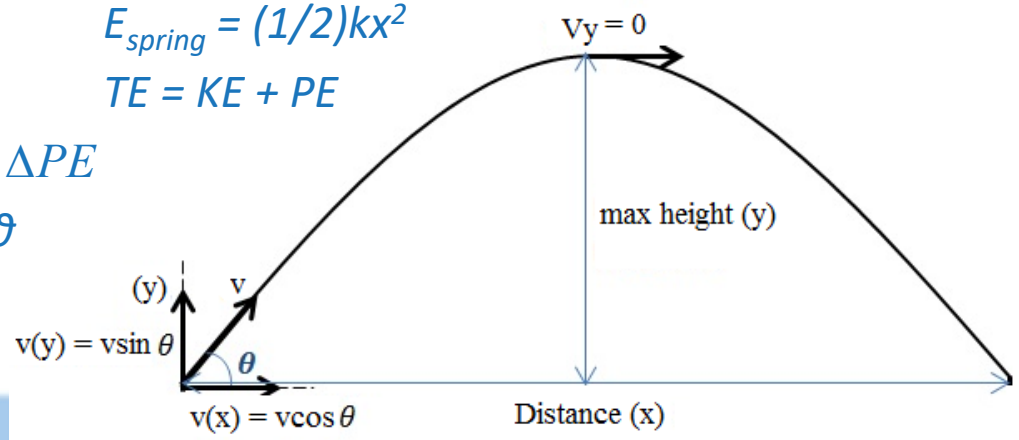
$KE = (1/2)\, mv^2$ $\quad P = \text{Work/time}$

$Work_{net} = \Delta KE$ $\quad E_{spring} = (1/2)kx^2$

$PE_g = mgh$ $\quad TE = KE + PE$

$\Delta TE = \Delta KE + \Delta PE$

Work = Fdcos ϑ



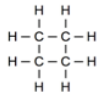
Isomer Flowchart

Turn Dry information into something active.

Make this isomer list into a decision tree, similar to how a physician might make a differential diagnosis.

Isomers

Isomers: molecules with the same molecular formula but a different arrangement of atoms.
Divided into: Constitutional isomers vs. Stereoisomers



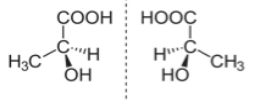
Different connections between the atoms:
Constitutional isomers e.g. cyclobutane, butene are both C_4H_8

Same connections between the atoms:
Stereoisomers – divided into: configurational and conformational

Freely interconvert w/o breaking bonds:
Conformational isomers e.g. chair, boat cyclohexane

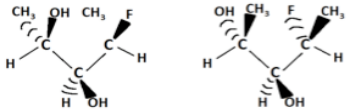
Requires bond breaking to interconvert:
Configurational isomers – divided into: enantiomers and diastereomers

Non-superimposable mirror images:
Enantiomers e.g. R and S 2-hydroxypropanoic acid

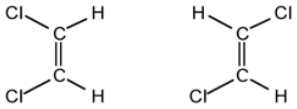


Not mirror images:
Diastereomers – comes in several different types:

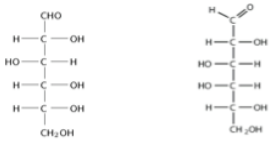
Only one stereo center has been flipped:



Geometric Isomers
Vary around double bond (E/Z, cis/trans):

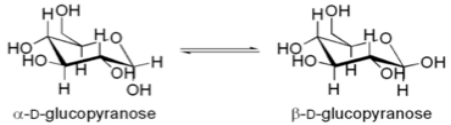


Epimers
Sugars that only vary at one stereocenter
e.g. Glucose and Galactose



Anomers
An epimer based on a cyclic sugar

Mutarotation: conversion between α and β anomers



For example:

1) Do the molecules have the same molecular formula?

Yes? They are isomers.

2) Do the molecules have the same atomic connections and functional groups?

No? They are constitutional isomers.

Yes? Can we rotate one molecule to match the other?

And so on….

Study Sheets: VSEPR and Molecular Shape

# of bonding groups	# of lone pair electrons	Electronic Geometry	Molecular Geometry	Bond Angle
2	0	linear	*linear*	*180*
3	0	trigonal planar	*trigonal planar*	*120*
2	1	trigonal planar	*bent*	*< 120*
4	0	tetrahedral	*tetrahedral*	*109.5*
3	1	tetrahedral	*trigonal pyramidal*	*107*
2	2	tetrahedral	*bent*	*104.5*
5	0	trigonal bipyramidal	*trigonal bipyramidal*	*90, 120, 180*
2	3	trigonal bipyramidal	*linear*	*180*
6	0	octahedral	*octahedral*	*90, 180*
4	2	octahedral	*square planar*	*90, 180*

VSEPR Geometries

Steric No.	Basic Geometry 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	Linear				
3	Trigonal Planar	Bent or Angular			
4	Tetrahedral	Trigonal Pyramid	Bent or Angular		
5	Trigonal Bipyramid	Sawhorse or Seesaw	T-shape	Linear	
6	Octahedral	Square Pyramid	Square Planar	T-shape	Linear

This type of information lends itself well to active learning via *Study Sheets*.

Images adapted from Wikimedia Commons

Mitosis vs. Meiosis

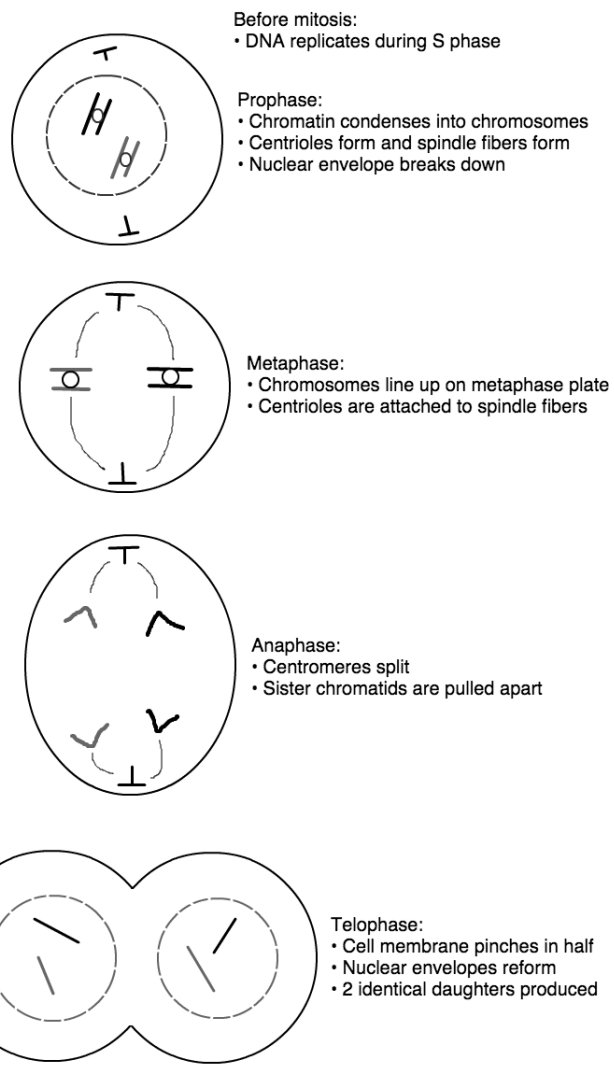
Mitosis vs. Meiosis

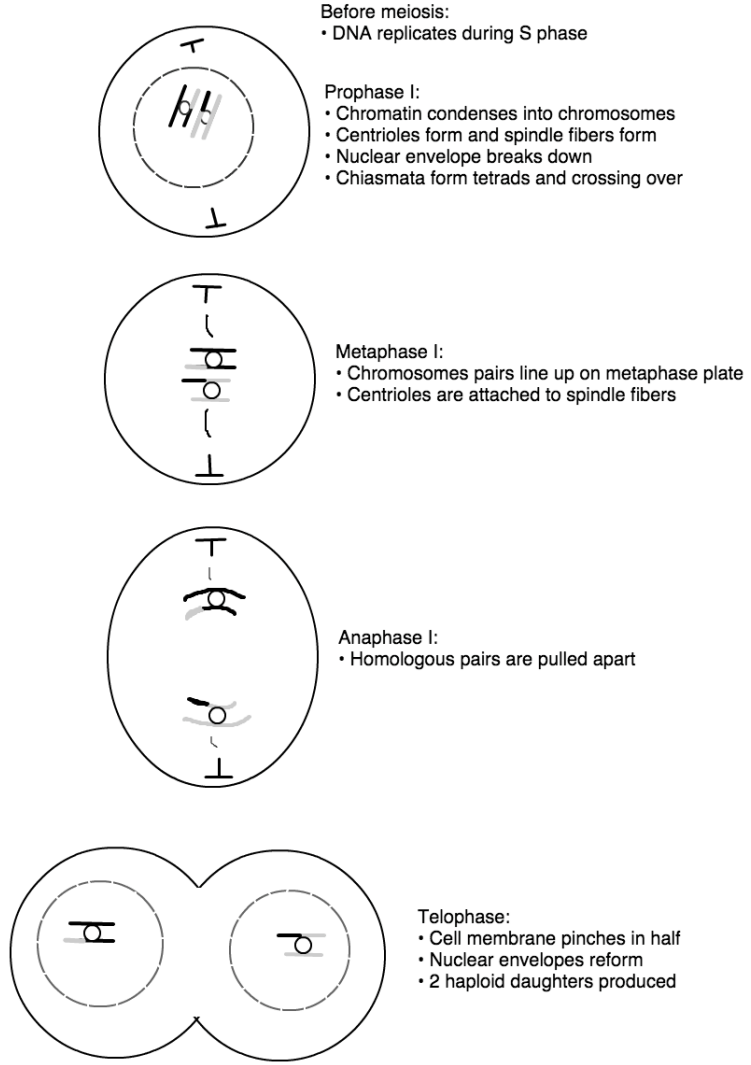
The test makers love contrasts!

We should to, as it allows us to learn 2 pieces of information fro the price of 1.

Important differences are between mitosis and meiosis I.

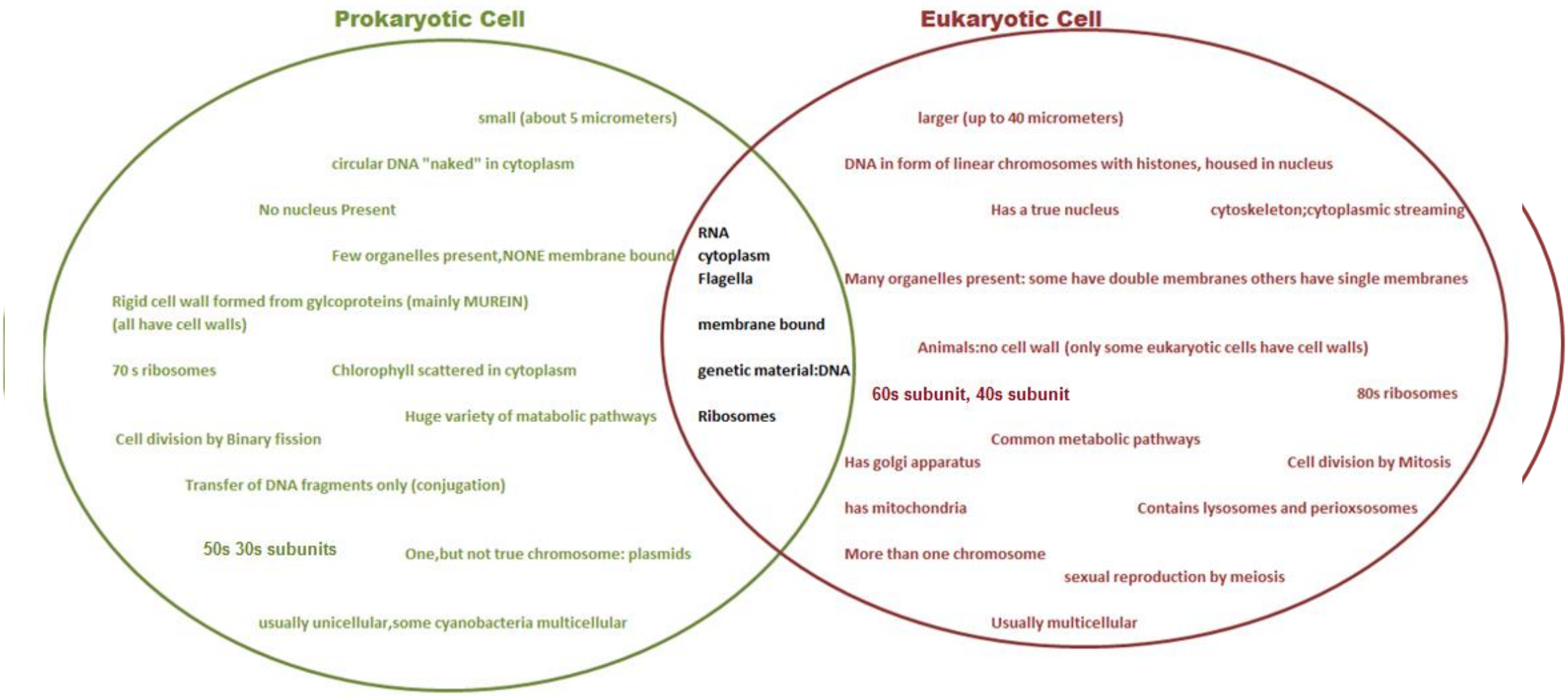
Meiosis II is almost an exact copy of mitosis, just with half the starting nuclear material.





Prokaryotic Reproduction and Growth

Contrast with Eukaryotic Cells



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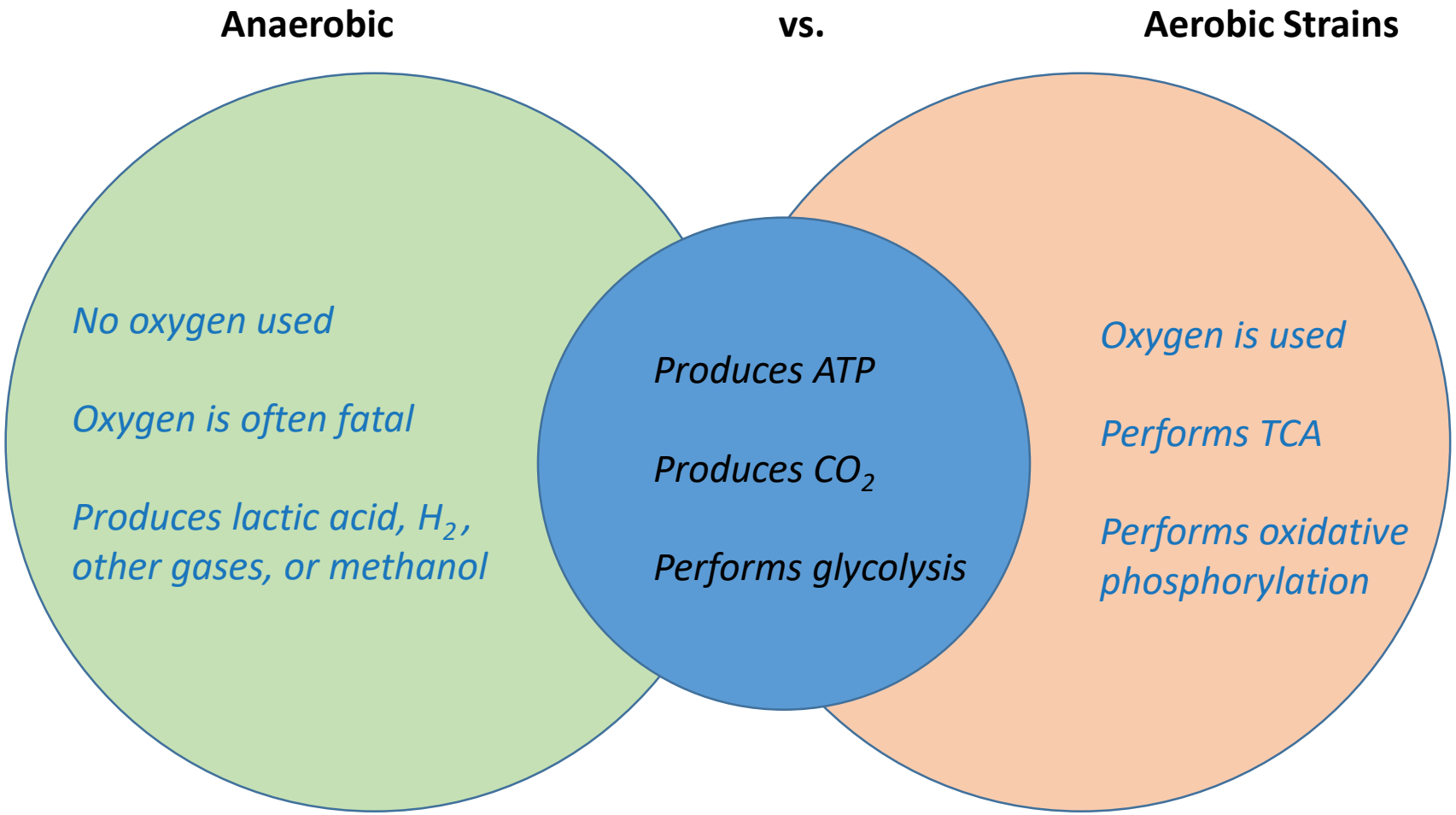


Transcription

	Eukaryotes	Prokaryotes
Transcription	Positive and negative control by regulatory proteins that act at sites close to and far from promoter Large basal transcription complex interacts with promoter. Mediator complex required.	Positive and negative control by regulatory proteins that act at sites close to the promoter Sigma interacts with promoter.
RNA processing	Extensive processing: alternative splicing of introns addition of 5′ cap and 3′ tail	N/A
Chromatin remodeling	Extensive packaging of DNA Chromatin must be opened for transcription to begin.	Limited packaging of DNA Remodeling not a major issue in regulating gene expression.
mRNA stability	For many genes, RNA interference limits life span or translation rate.	Minimal interference
Translation	Regulatory proteins bind to mRNAs and/or ribosome and affect translation rate.	Same
Post-translational modification	Folding by chaperone proteins Chemical modification (glycosylation, phosphorylation) Ubiquination targets proteins for destruction by proteasome.	Folding by chaperone proteins Chemical modification (e.g., phosphorylation) may change activity.

***In eukaryotes**, transcription and translation occur in separate compartments*

***Bacteria**, mRNA is polycistronic; in **Eukaryotes**, mRNA is usually monocistronic*

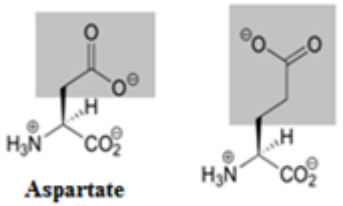
*"Processing" of mRNA is **required in eukaryotes** for the maturation*

In prokaryotes, mRNA matures on transcription

Amino Acid Worksheet

Learn chunks of information – put the amino acids in unique groups and learn the groups!

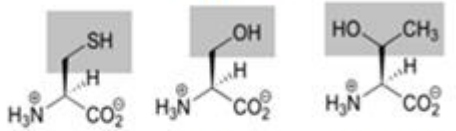
Negatively charged



Aspartate
Asp, D

Glutamate
Glu, E

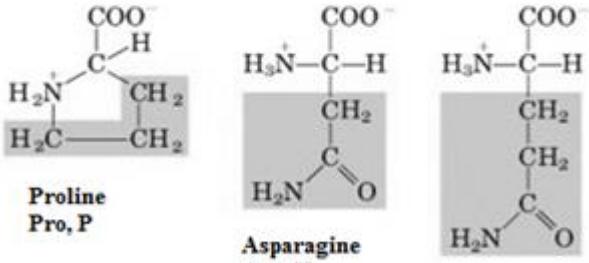
Polar



Cysteine
Cys, C

Serine
Ser, S

Threonine
Thr, T

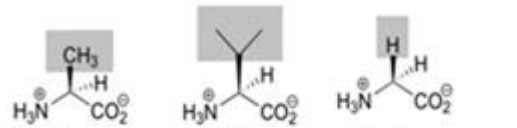


Proline
Pro, P

Asparagine
Asn, N

Glutamine
Gln, Q

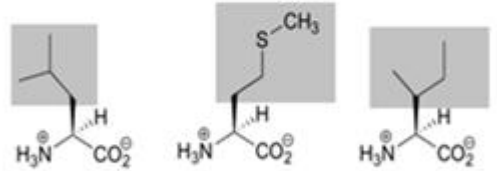
Non-polar



Alanine
Ala, A

Valine
Val, V

Glycine
Gly, G

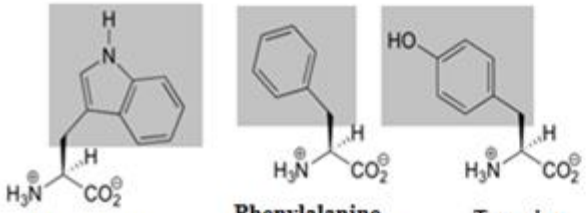


Leucine
Leu, L

Methionine
Met, M

Isoleucine
Ile, I

Aromatic

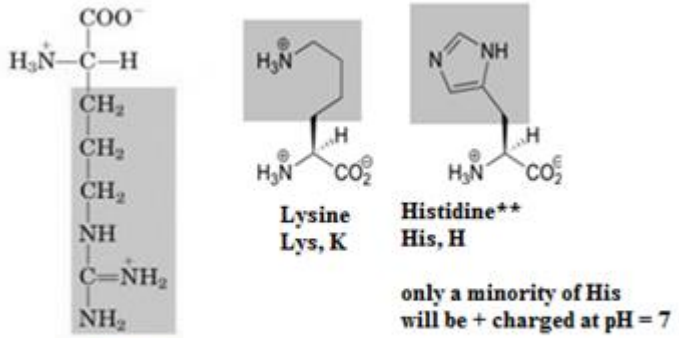


Tryptophan
Trp, W

Phenylalanine
Phe, F

Tyrosine
Tyr, Y

Positively charged



Arginine
Arg, R

Lysine
Lys, K

Histidine**
His, H

only a minority of His will be + charged at pH = 7

Psychosocial Development Study Sheet

Abstract information will stick better when you have concrete examples

Dry information must be studied actively!

Stage	Psychosocial Obstacle	Virtue Developed	Age (expected)	Example behavior
1	Trust vs. mistrust	Hope	0-18 months	If care has been harsh or inconsistent, the infant will develop a sense of mistrust and will not have confidence in the world around them or in their abilities to influence events.
2	Autonomy vs. shame	Will	1 ½ to 3 years	Instead of dressing a child, a parent will have the patience to allow the child to try to dress themselves until they succeed or ask for assistance.
3	Initiative vs. guilt	Purpose	3 to 5 years	Children will plan activities, make up games, and initiate activities with others.
4	Industry vs. inferiority	Competency	5-12 years	The child's peers will gain significance and will become a major source of their self esteem. The child feels the need to win approval by demonstrating skills that are valued by others
5	Ego identity vs. Role confusion	Fidelity	12 to 18 years	Child will develop a sense of self through exploring possibilities ("experimentation") and begin to form their identity based upon the outcome of their explorations.
6	Intimacy vs. isolation	Love	18 to 40 years	Person will share themselves more intimately with others. They will explore relationships leading to long term commitments with someone other than a family member.
7	Generativity vs. stagnation	Care	40 to 65 years	Person will establish a career, settle down within a relationship, begin a family and develop a sense of being a part of the bigger picture.
8	Ego integrity vs. despair	Wisdom	65+ years	Productivity will slow, and the person will enter life as a retired person. During this time they contemplate accomplishments and are able to develop integrity if they perceive themselves as successful in life.

Psychosocial Development Study Sheet

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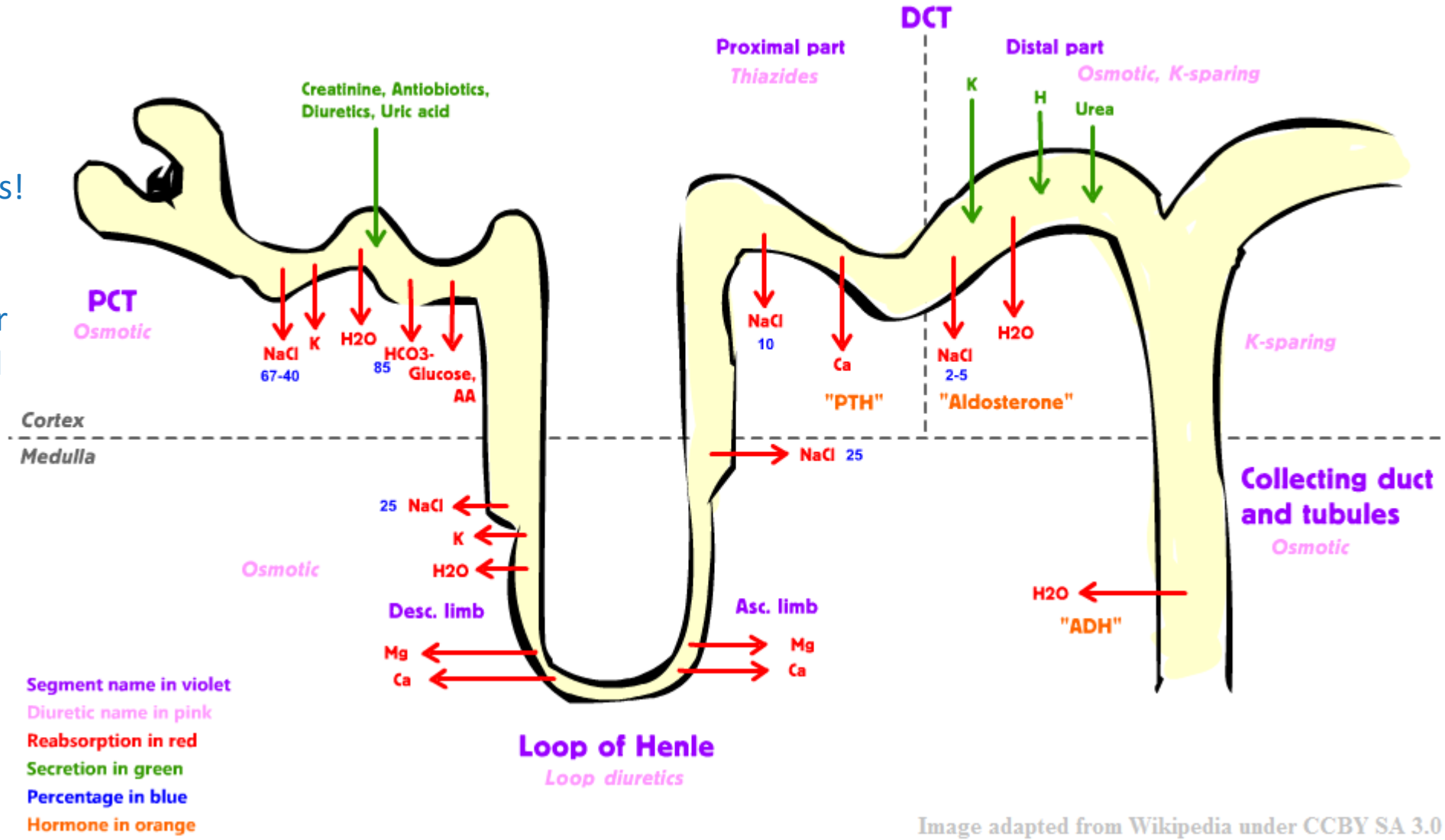
Psychosocial Development Study Sheet

Stage	Psychosocial Obstacle	Virtue Developed	Age (expected)	Example behavior
1				
2				
3				
4				
5				
6				
7				
8				

Renal System Worksheet Exercise

Use color coding to get more visual "pop" out of your diagrams!

This will help maintain your attention and aid recall.



Hormone Worksheet

Hormones are another great place in biology to use contrasts/comparisons to learn more efficiently.

What are other areas of biology where this strategy could be used?

Hormones

Hormone	Secreted by	In response to	Effect	Type
Oxytocin	Posterior Pituitary	Childbirth	Uterine contraction, Emotional Bonding	Peptide
Vasopressin (ADH)	Posterior Pituitary	High plasma osmolality	Retain water, ↑ aquaporin channels in collecting duct, DCT	Peptide
FSH	Anterior Pituitary	GnRH	♀: initiate follicle growth ♂: ↑ spermatocyte development ♀, ♂: maturation of germ cells	Glycoprotein
LH	Anterior Pituitary	GnRH ♀: estrogen spike from follicle just before ovulation	♀: ovulation, follicle becomes corpus luteum ♂: Leydig cells → ↑testosterone	Glycoprotein
ACTH	Anterior Pituitary	CRH, Stress	↑ adrenal release of corticosteroids	Peptide
TSH	Anterior Pituitary	TRH, low plasma levels of T_4 and T_3	↑ thyroid release of T_4 and T_3	Glycoprotein
Prolactin	Anterior Pituitary	Falling progesterone at end of pregnancy	Mammary gland enlargement, milk production	Peptide
Endorphin	Anterior Pituitary	Pain	Pain relief	Peptide
Growth Hormone	Anterior Pituitary	GHRH	Growth of long bones, general anabolism	Peptide
Calcitonin	Thyroid	High plasma [Ca^{2+}]	Reduce plasma [Ca^{2+}]	Peptide
T_4 & T_3	Thyroid	TSH	↑ metabolic rate	Amino Acid Tyr, but act like steroid
Parathyroid Horm.	Parathyroid	Low plasma [Ca^{2+}]	↑ plasma [Ca^{2+}]	Peptide
Glucagon	Pancreas α cells	Low blood [Glucose]	↑ blood [Glucose]	Peptide
Insulin	Pancreas β cells	High blood [Glucose]	↓ blood [Glucose]	Peptide
Somatostatin	Pancreas δ cells	Various, usually high hormone levels	Suppress: GH, TSH, CCK, insulin, glucagon	Peptide
Cortisol	Adrenal Cortex	Stress	↑ [Glucose], Immune suppression	Steroid
Aldosterone	Adrendal Cortex	ACTH, ATII, low bp	Collecting Duct, DCT: reabsorb Na^+, Secrete K^+, water retention, ↑ bp	Steroid
Epinephrine	Adrenal Medulla	Sudden stress	Sympathetic response: ↑ heart rate, breathing, etc.	Peptide / Tyr derivative
Estrogen	♀: Ovaries, ♂: Adrenal	FSH	♀: secondary sex characteristics, endometrial development during menstrual cycle, surge leads to LH surge	Steroid
Progesterone	♀: Ovary: Corpus Luteum, ♂: Adrenal	Ovulation	Thicken, maintain endometrium in preparation for implantation	Steroid
Testosterone	♂: Leydig cells of testes, ♀: Ovaries	GnRH→LH→Testos.	Development, maintenance of secondary sex characteristics	Steroid
Norepinephrine	Adrenal Medulla	Sudden stress	Sympathic responses of fight or flight	Peptide / Tyr derivative
hCG	Placenta	Implantation	Maintains corpus luteum at start of pregnancy	Glycoprotein
GnRH	Hypothalamus	Puberty, Menses	↑ LH, FSH release	Peptide

Amino Acid Recall Exercise

Alanine	A – Ala	Non-p	CH_3
Cysteine	C – Cys	Polar	CH_2SH
Aspartic Acid	D – Asp	Acid	CH_2COOH
Glutamic Acid	E – Glu	Acid	CH_2CH_2COOH
Phenylalanine	F – Phe	Non-p	CH_2-C_6H_5
Glycine	G – Gly	Non-p	H
Histidine	**H – His**	**Base**	**CH_2 – Imidazole**
Isoleucine	I – Ile	Non-p	$CH(CH_3)CH_2CH_3$
Lysine	**K – Lys**	**Base**	**$(CH_2)_4NH_2$**
Leucine	L – Leu	Non-p	$CH_2CH(CH_3)_2$
Methionine	M – Met	Non-p	$(CH_2)_2SCH_3$
Asparagine	N – Asn	Polar	$CH_2C(O)NH_2$
Proline	P – Pro	Non-p	$(CH_2)_3$-own am.
Glutamine	Q – Gln	Polar	$(CH_2)_2C(O)NH_2$
Arginine	**R – Arg**	**Base**	**$(CH_2)_3NHC(NH_2)NH_2$**
Serine	S – Ser	Polar	CH_2OH
Threonine	T – Thr	Polar	$CHOHCH_3$
Valine	V – Val	Non-p	$CH(CH_3)_2$
Tryptophan	W – Trp	Slight-p	CH_2 – Indole
Tyrosine	Y – Tyr	Polar	CH_2-C_6H_4-OH

Respiratory System Worksheet Exercise

Tidal volume (TV), is the amount of air inspired during normal, relaxed breathing.

Inspiratory reserve volume (IRV), is the additional air that can be forcibly inhaled after the inspiration of a normal tidal volume.

Expiratory reserve volume (ERV), is the additional air that can be forcibly exhaled after the expiration of a normal tidal volume.

Residual volume (RV), is the volume of air still remaining in the lungs after the expiratory reserve volume is exhaled.

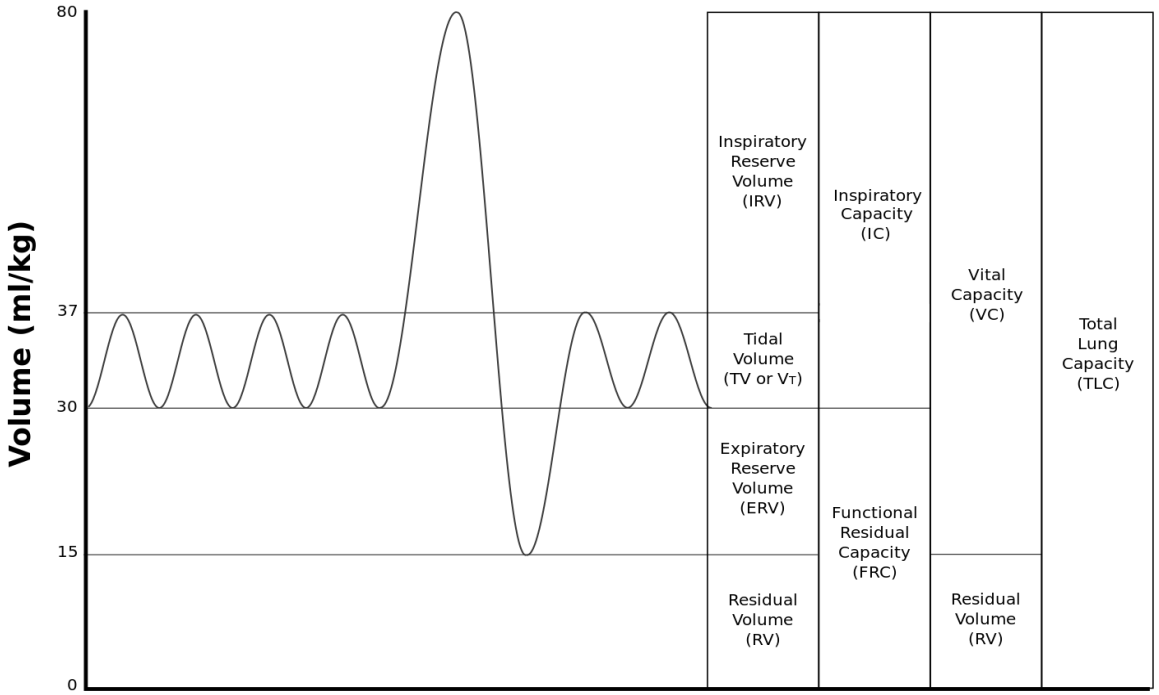
Total lung capacity (TLC), is the maximum amount of air that can fill the lungs.

TLC = TV + IRV + ERV + RV

Vital capacity (VC), is the total amount of air that can be expired after fully inhaling. **VC = TV + IRV + ERV**

Inspiratory capacity (IC), is the maximum amount of air that can be inspired. **IC = TV + IRV**

Functional residual capacity (FRC), is the amount of air remaining in the lungs after a normal expiration. **FRC = RV + ERV**



Build Your Biochemistry Foundation

Rule #1: ***Know your nomenclature.*** *Enzymes typically have their function and/or substrate built into their name. Knowing this you will recognize names faster and connect them to their specific function.*

Rule #2: ***Start with the big picture****. Initially, draw your pathways with only the substrates and products. Repeat this until it is memorized. Then add the enzymes. Then continue to add co-factors and by-products until you have exhausted the MCAT relevant information.*

Rule #3: ***Know the purpose of a reaction.*** *Incorporating the larger concepts will also allow you to predict the flow of reactions in situations throughout the body.*

Rule #4: ***Track the flow of carbon .*** *Track it through the intermediates of the pathway and the reactions that interconvert them.*

Build Your Biochemistry Foundation

Rule #5: ***Track the flow of phosphate groups****. PO_4 movement is key to energy transfer in the pathway. Catabolic pathways increase the cell's supply of ATP and other compounds with high phosphate-transfer potential. Anabolic pathways consume these compounds*

Rule #6: ***Track energy transfer via the flow of e^-.*** *Catabolic pathways are generally oxidative, and they ↑NADH, NADPH (nicotinamides), $FADH_2$ and $FMNH_2$ (flavins). Anabolic pathways are typically reductive, consuming reduced nucleotides, particularly NADPH.*

Rule #7: ***Learn the pacemaker enzymes of the pathway*** *and the chemical signals (e.g. allosteric effectors and hormones) that control their rates first. This will allow us to see the logic of the pathway, including how its rate responds to cellular conditions.*

Rule #8: ***Focus on connections between pathways.*** *This means knowing the inputs, outputs, branch points of the pathway. Regulation will be easier to master if you understand where the pathway's reactants come from and where its products go.*

Biochemistry Mnemonics

Glycolysis steps

"Goodness Gracious, Fred's Father Did Go By Picking Pumpkins (to) PrEPare Pies"

Glucose / Glucose-6-P / Fructose-6-P / Fructose-1,6-diP / Dihydroxyacetone-P Glyceraldehyde-P / 1,3-Biphosphoglycerate / 3-Phosphoglycerate / 2-Phosphoglycerate (to) / Phosphoenolpyruvate [PEP] / Pyruvate
'Did', 'By' and 'Pies' tell you the first part of those three: di-, bi-, and py-. 'PrEPare' tells location of PEP in the process.

Glycolysis Enzymes

"(the) Hungry Pink Panther Pan And The Grinning Peter Pan Eat Pies."

Hexokinase / Phosphohexoisomerase / Phosphofructokinase-1 (6-phosphofructo-1 kinase) / Aldolase / Triose phosphate isomerase / Glyceraldehyde 3-phosphate dehydrogenase / Phosphoglycerate kinase / Phosphoglycerate mutase / Enolase / Pyruvate kinase

Citric acid cycle compounds

"Our City Is Kept Safe-And Sound From Malice"

Oxaloacetate, Citrate, Isocitrate, alpha-Ketoglutarate, Succinyl-CoA, Succinate, Fumarate, Malate

Biochemistry Mnemonics

Citric Acid Cycle Enzymes

“Captain America’s Irate Avengers Spoke Slander For Money."

Citrate synthetase / aconitase / Isocitrate dehydrogenase / alpha ketogluturate dehydrogenase / Succinyl CoA synthetase / Succinate dehydrogenase / Fumarase / Malate Dehydrogenase

Pyruvate products of complete oxidation

"4 Nice Fun (get) 3 Coors + 1 Guinness“

Complete oxidation of pyruvate yields: 4 NADH $FADH_2$ 3 CO_2 1 GTP

Have you made your own mnemonics for learning biochemistry? If so, what are they?

They should be outrageous, dirty, corny, and personal. The unavoidable areas of factual mastery on the exam will be made easier (and you will have good practice for medical school!).

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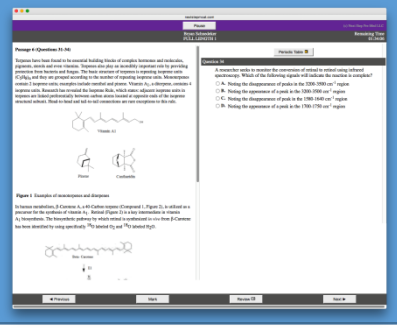
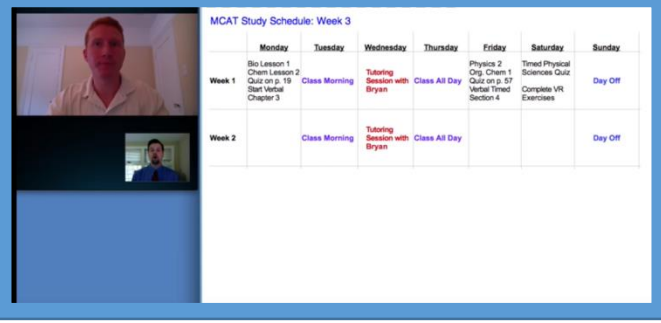


Self-Study

MCAT Class



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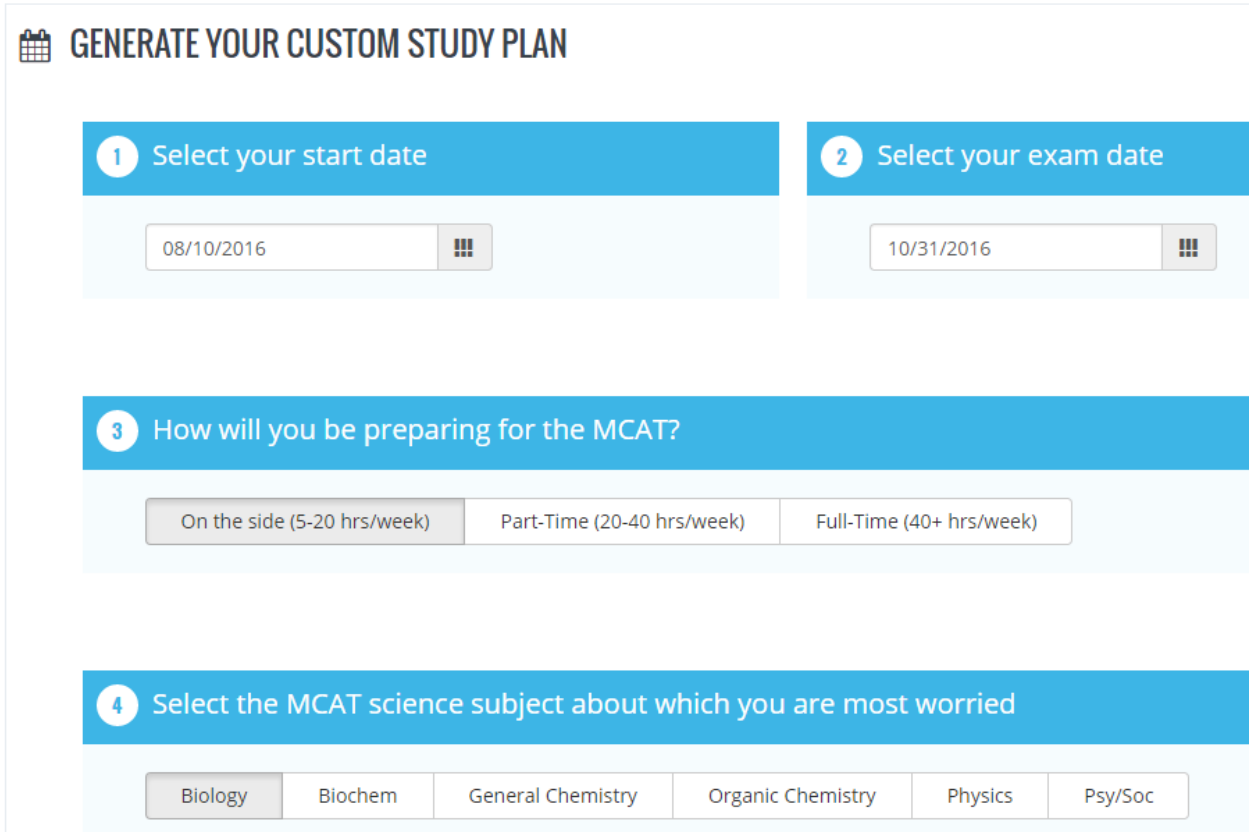

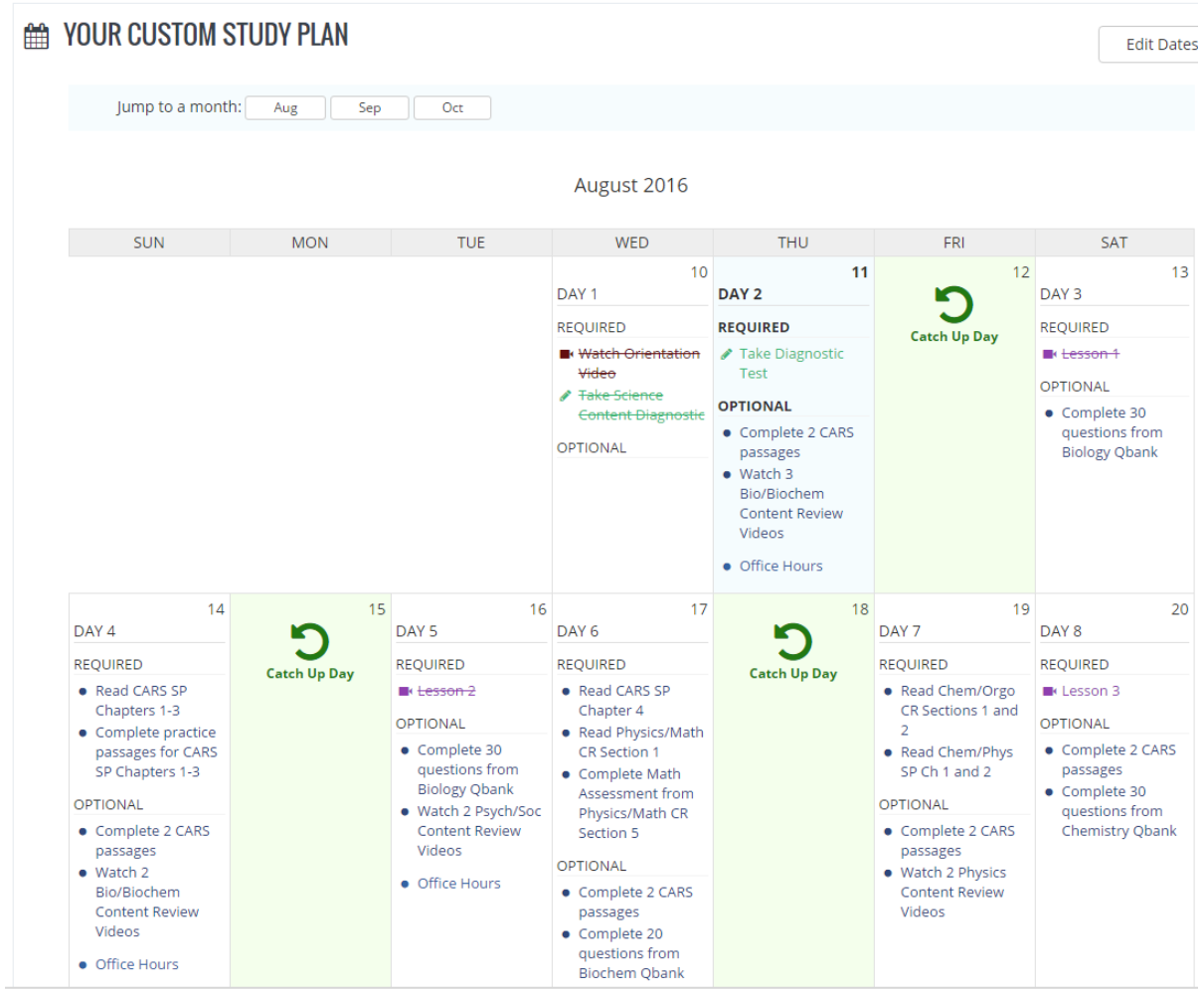

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- Clara: 526 MCAT, 6 years experience
- Phil: 6 years experience; 98% score
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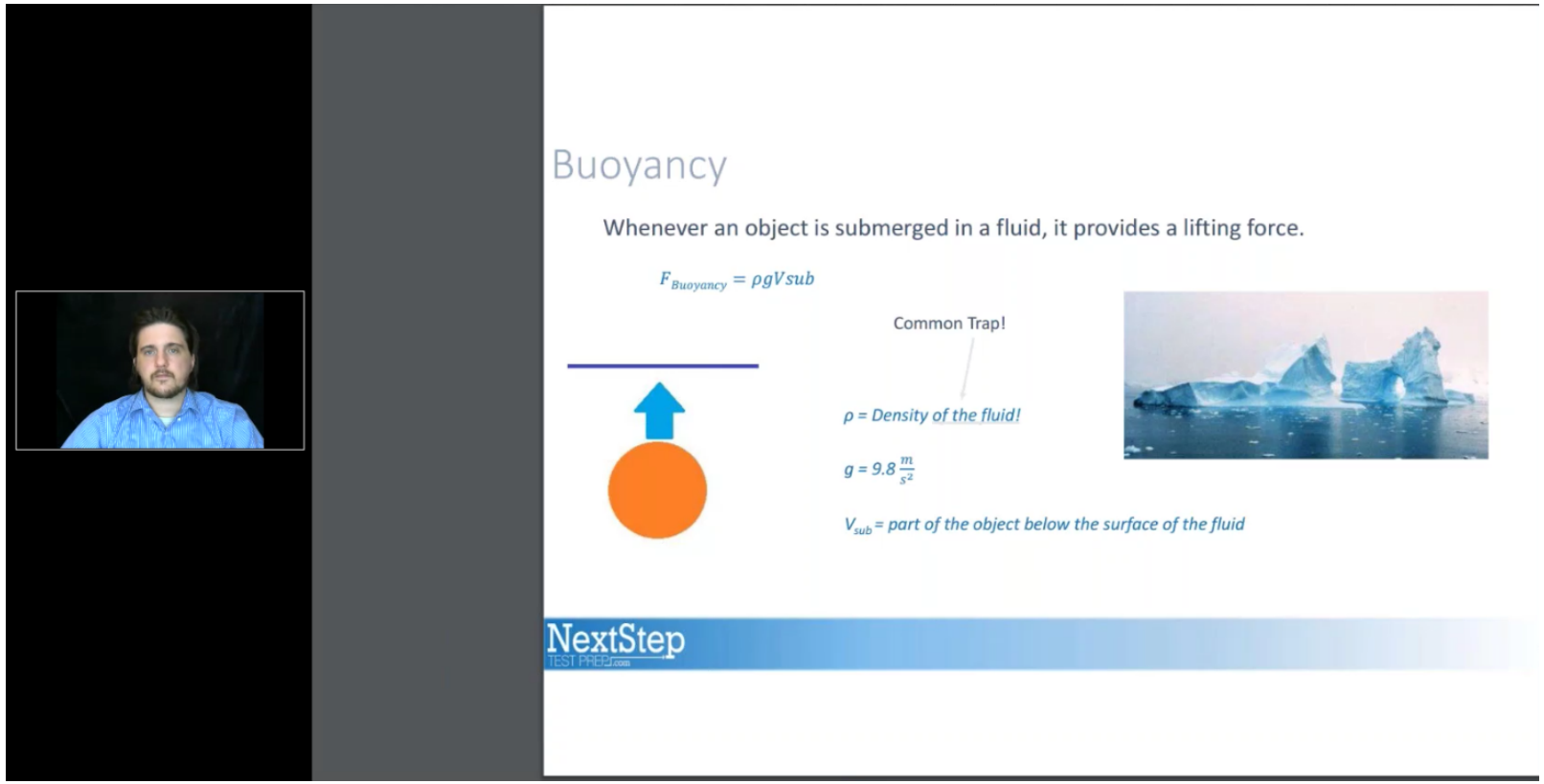

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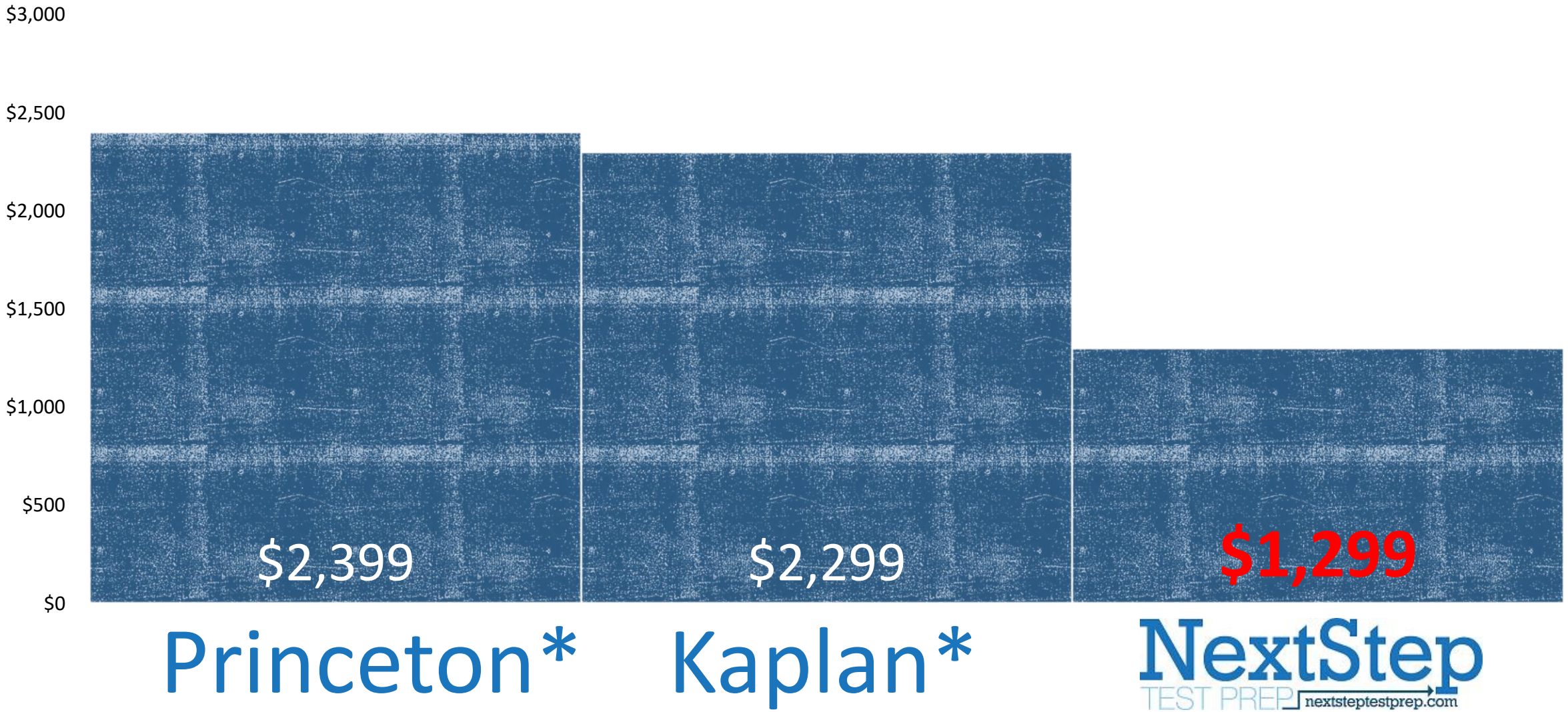

*Competitor pricing taken from corporate website on date of publication; may not be up to date.

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Pause

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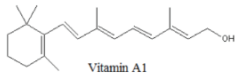
Bryan Schnedeker
FULL LENGTH 1

Remaining Time
01:34:06

Passage 6 (Questions 31-34)

Terpenes have been found to be essential building blocks of complex hormones and molecules, pigments, sterols and even vitamins. Terpenes also play an incredibly important role by providing protection from bacteria and fungus. The basic structure of terpenes is repeating isoprene units $(C_5H_8)_n$ and they are grouped according to the number of repeating isoprene units. Monoterpenes contain 2 isoprene units; examples include menthol and pinene. Vitamin A_1, a diterpene, contains 4 isoprene units. Research has revealed the Isoprene Rule, which states: adjacent isoprene units in terpenes are linked preferentially between carbon atoms located at opposite ends of the isoprene structural subunit. Head-to-head and tail-to-tail connections are rare exceptions to this rule.



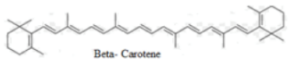
Vitamin A1

Pinene

Cantharidin

Figure 1 Examples of monoterpenes and diterpenes

In human metabolism, β-Carotene A, a 40-Carbon terpene (Compound 1, Figure 2), is utilized as a precursor for the synthesis of vitamin A_1. Retinal (Figure 2) is a key intermediate in vitamin A_1 biosynthesis. The biosynthetic pathway by which retinal is synthesized *in vivo* from β-Carotene has been identified by using specifically ^{18}O labeled O_2 and ^{18}O labeled H_2O.



Beta- Carotene

E1

Periodic Table

Question 34

A researcher seeks to monitor the conversion of retinal to retinol using infrared spectroscopy. Which of the following signals will indicate the reaction is complete?

- **A.** Noting the disappearance of peaks in the 3200-3500 cm^{-1} region
- **B.** Noting the appearance of a peak in the 3200-3500 cm^{-1} region
- **C.** Noting the disappearance of peak in the 1580-1640 cm^{-1} region
- **D.** Noting the appearance of a peak in the 1700-1750 cm^{-1} region

◄ Previous | Mark | Review | Next ►

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Bryan Schnedeker
FULL LENGTH 1

Passage 6 (Questions 31-34)

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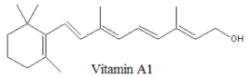
Key terms: terpenes, isoprene unit formula, mono/di terpene, isoprene rule

Contrast: the favored isoprene links are head-to-tail, though exceptions do occur

Cause and effect: repeated isoprene units can combine to form several biologically important molecules



Vitamin A1

Pinene

Cantharidin

Figure 1 Examples of monoterpenes and diterpenes

Figure 1 shows us that the various terpene molecules made up of repeating isoprene units

In human metabolism, β-Carotene A, a 40-Carbon terpene (Compound 1, Figure 2), is utilized as a precursor for the synthesis of vitamin A_1. Retinal (Figure 2) is a key intermediate in vitamin A_1 biosynthesis. The biosynthetic pathway by which retinal is synthesized *in vivo* from β-Carotene has been identified by using specifically ^{18}O labeled O_2 and ^{18}O labeled H_2O.

Periodic Table

Question 34

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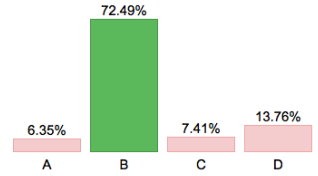
- **B.** Noting the appearance of a peak in the 3200-3500 cm^{-1} region
- **C.** Noting the disappearance of peak in the 1580-1640 cm^{-1} region
- **D.** Noting the appearance of a peak in the 1700-1750 cm^{-1} region

72.49% of students answered this question correctly.

Your answer was incorrect



Answer Explanation:

- Difficulty: 2 Medium
- Reasoning Skill: 2 Scientific Reasoning and Problem Solving
- Concept Category: 4D Light and Sound

B is correct. Retinol differs from retinal in that it contains -OH groups, but does not contain a carboxyl group (C=O). The carbonyl stretching frequency falls in the region 1700-1750 cm^{-1}, whereas the O-H stretching frequency is expected to fall in the region 3200-3500 cm^{-1}.

A: This would indicate a lack of OH groups, which is a characteristic of retinal, not retinol.

C: This peak is indicative of C=C groups, which both molecules have and cannot be used to determine when retinal has been converted.

◄◄ Previous Passage | ◄ Previous | Next Section ►►► | Next ► | Next Passage ►►

Comprehensive Reporting and Analytics

Scaled Scores

Section	Scaled Score	Percentile
Chemical an Systems		
Critical Analy		
Biological an Systems		
Psychologica Behavior		
Total		

SULTS

Results by Reasoning Skills

Concept Category	Total Correct	Correct Percentage
1 Knowledge of Scientific Concepts and Principles	49	71.01% (49/69)
2 Scientific Reasoning and Problem Solving	39	68.42% (39/57)
3 Reasoning About the Design and Execution of Research	23	69.7% (23/33)
4 Data-based and Statistical Reasoning	10	55.56% (10/18)
5 Foundations of Comprehension	12	75% (12/16)
6 Reasoning within the Text	14	60.87% (14/23)
7 Reasoning Beyond the Text	9	64.29% (9/14)

Results by Section

Chemical

Correct:

Critical Ar

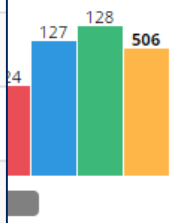
Correct:

Biological

Correct:

Psycholog

Correct:



Results by Concept Category

Concept Category	Total Correct	Correct Percentage
1A Amino Acids and Proteins	4	57.14% (4/7)
1B Molecular Genetics	9	81.82% (9/11)
1C Classical Genetics	9	69.23% (9/13)
1D Metabolism	3	37.5% (3/8)
2A Cell Biology	1	100% (1/1)
2B Microbiology	4	80% (4/5)
2C Reproduction	3	60% (3/5)
3A Nerve and Endocrine	4	50% (4/8)
3B Organ Systems	1	100% (1/1)
4A Kinematics and Force	5	50% (5/10)

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