

Bio 112 Handout for Animals 1

This handout contains:

- Today's iClicker Questions
- Instructions for joining the Bio-Majors' e-mail list.
- Handouts for today's lecture

iClicker Question #16A - before lecture

Which of the following systems are present in animals but not in plants?

- A. circulatory
- B. gas exchange
- C. excretory
- D. none of the above
- E. all of the above

iClicker Question #16B - after lecture

Which of the following systems do animals have as a necessary consequence of eating other creatures (as opposed to making their own food like plants do)?

- (A) digestive system
- (B) excretory system
- (C) nervous system
- (D) all of the above
- (E) none of the above

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClike by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer

Join the Biology majors' e-mail list!

You will automatically receive info about:

- job offerings at UMass and elsewhere
- advising info
- much, much more.
- course updates & scheduling
- seminars

How do I join?

- 1) Access your e-mail account on any computer just as you would to send an e-mail to a friend.
- 2) Set up a blank e-mail to this address: bio-majors-subscribe@mail.bio.umb.edu
- 3) There is no need to add a subject or message.
- 4) Send the e-mail message.
- 5) You should receive an e-mail message soon that asks you to confirm your subscription.
- 6) Simply reply to that message (to confirm subscription) and you will be set up as a subscriber.

Bio 112: Animal Lecture Outline

This is the material that will be covered in lectures Animals 2-5.

Organism	Sponge	Jellyfish	Planarian	nematode	Squid	tobacco hornworm moth	Earthworm	Starfish	trout	Rotifers
phylum										
habitat										
body plan										
structural support					hatched	hatched	hatched			hatched
motion		hatched						hatched	hatched	hatched
eating										hatched
digestive system								hatched	hatched	hatched
respiratory system										
excretory system										
circulatory system										hatched
nervous system			hatched					hatched		hatched
reproduction	hatched						hatched			hatched
life cycle	hatched	hatched				hatched				
selected other members of phylum			hatched	hatched	hatched					
interaction of selected other members with humans			hatched	hatched	hatched					

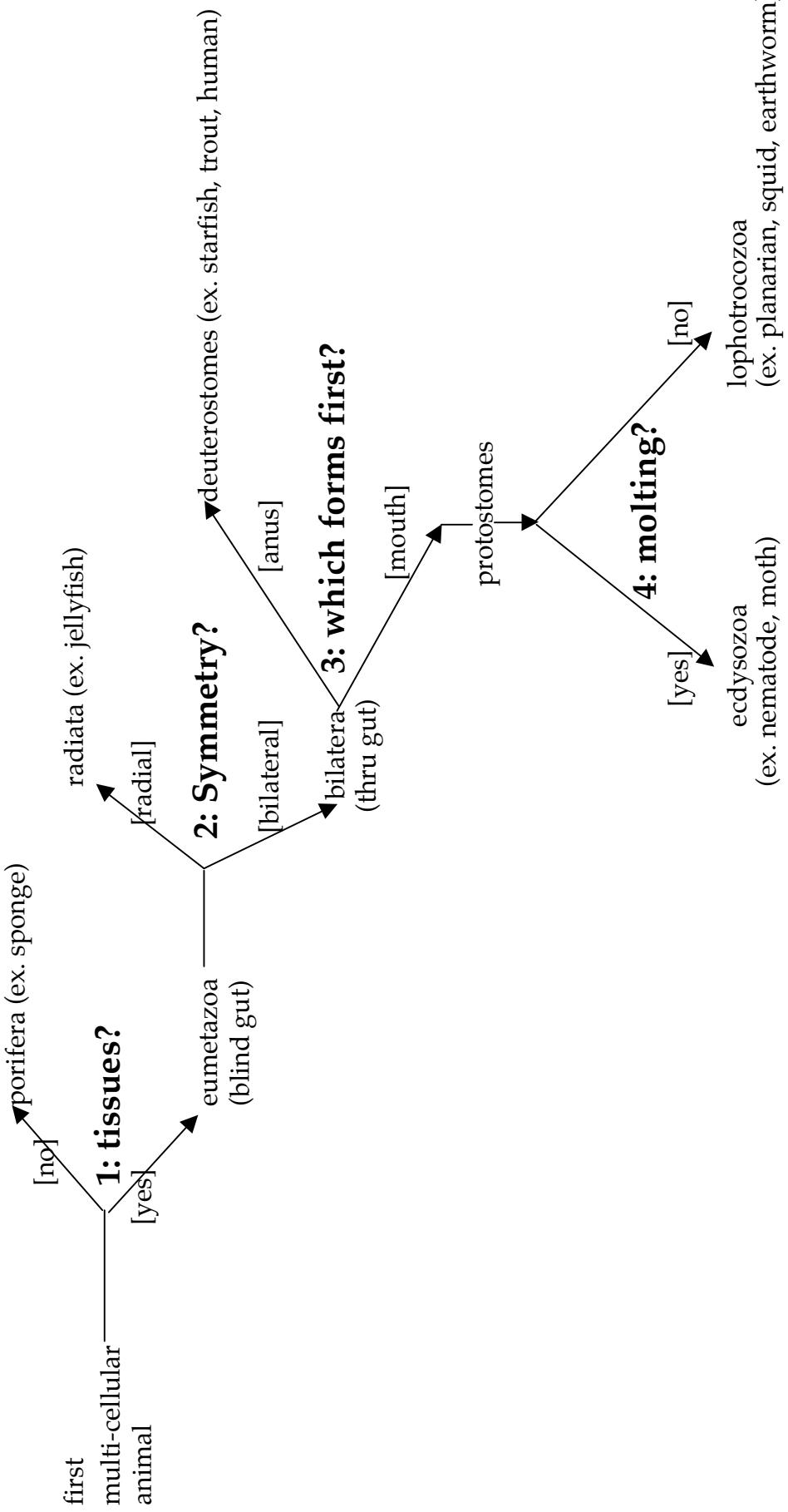
 = you need to know this for the exam; I will cover it in lecture.

 = you need to know this for the exam; I will not cover it in lecture.
(you should get it from reading, lab or the Aquarium field trip)

 = you do not need to know this; I will not cover it in lecture.

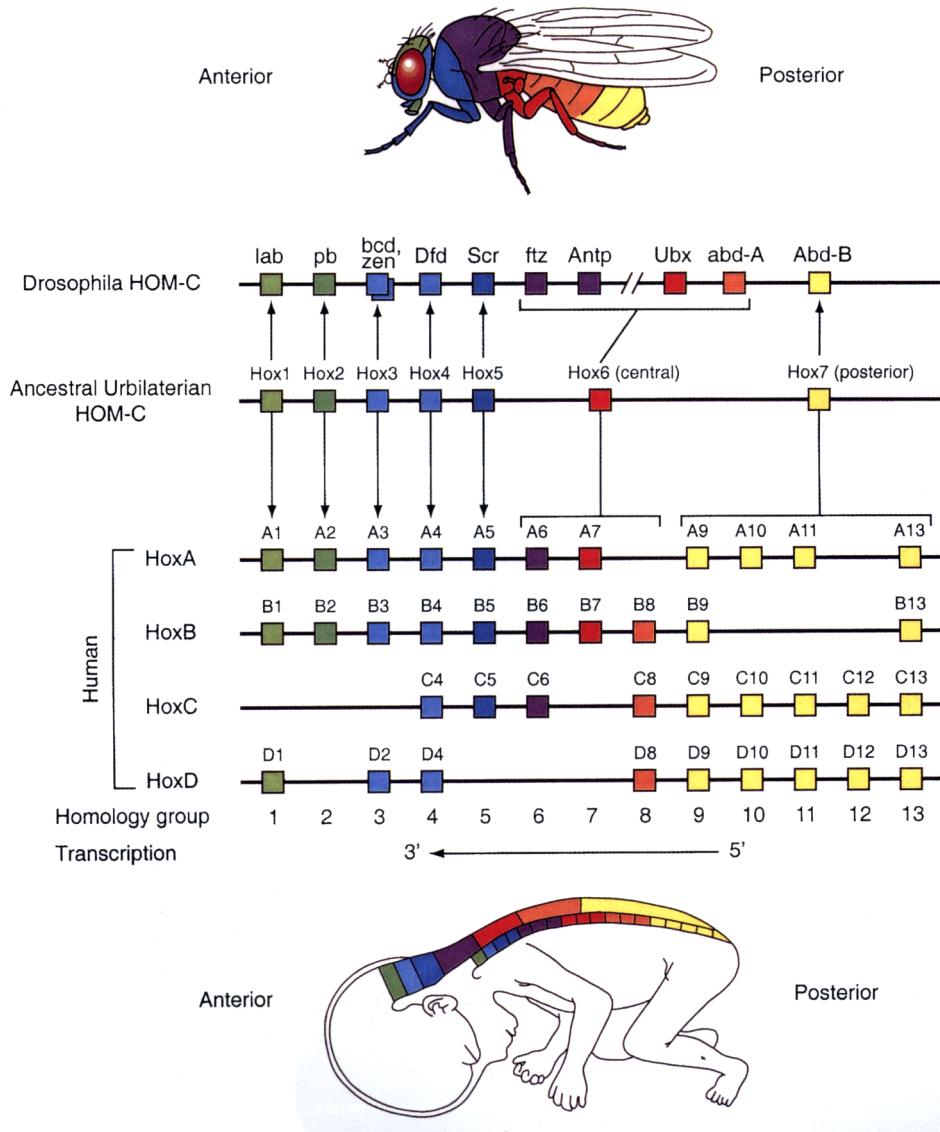
Animal Phylogeny: Major groups

- virtually all groups were present by the end of the Cambrian period (~500Ma).
- organized by increasing "features", fossil evidence, and molecular phylogeny.



Bio 112 “HOX” genes in animal development

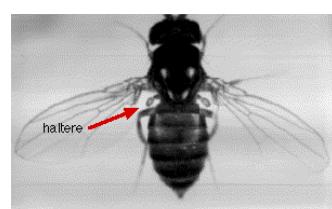
- The “HOX” (short for homeobox) genes are a set of genes that control important parts of development in most, if not all animals.
- Many animal body plans consist of segments; in different segments different sets of HOX genes are expressed.
- Mutations in HOX genes lead to inherited errors of development due to improper segmentation.



Dragonfly (ancestral form) Normal Drosophila



(4 wings)



(2 wings; 2 halteres)

Ubx-mutant Drosophila



(4 wings - duplicated segment)

Animals 1 - 4

Bio 112 Handout for Animals 2

This handout contains:

- Today's iClicker Questions
- Handouts for today's lecture

iClicker Question #17A - before lecture

Which of the following are true?

- A. All animals have a separate mouth and anus.
- B. All animals have a nervous system.
- C. All animals have their mouth at their "head" end.
- D. All of the above.
- E. None of the above.

iClicker Question #17B - after lecture

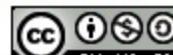
Which of the following statements are true?

- (A) The human digestive system has separate openings for input (mouth) and output (anus) while a gastrovascular cavity has only one opening.
- (B) Digestion of food occurs in the human digestive system; in a gastrovascular cavity, there is no digestion.

- | | |
|------------------|------------|
| <u>(A)</u> | <u>(B)</u> |
| A. True | True |
| B. True | False |
| C. False | True |
| D. False | False |
| E. I don't know. | |

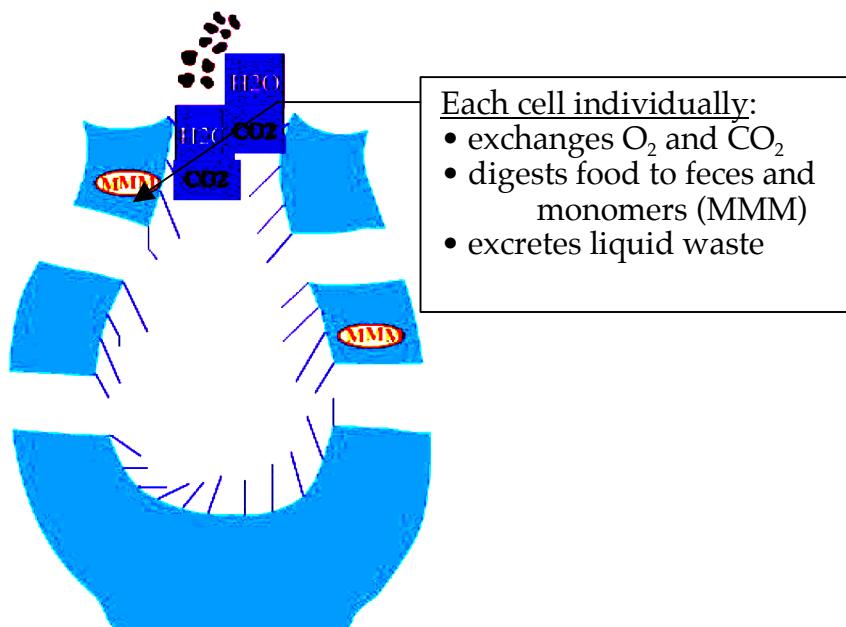
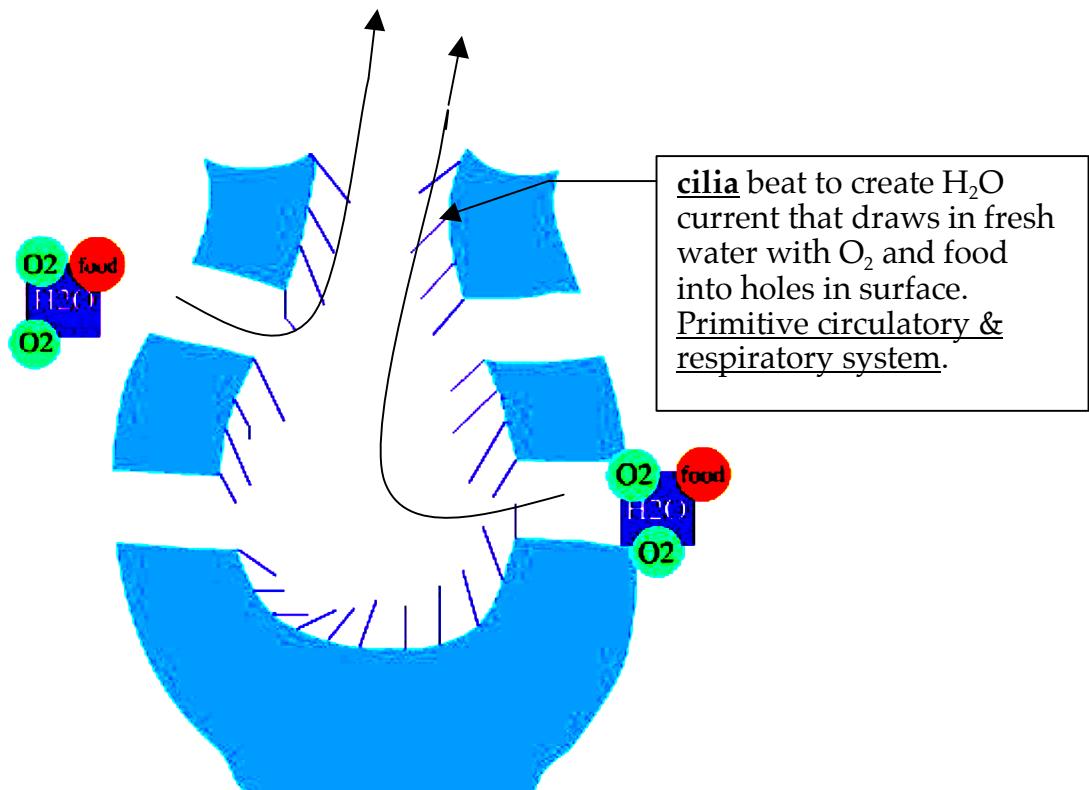
Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClicker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
 - a. Press the button corresponding to the answer you've selected (A thru E).
 - b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should resend it until you get a green "STATUS" light.



Bio 112 Sponges

(cross section)



Thanks to Evelyne Tschibeli for making the animation.

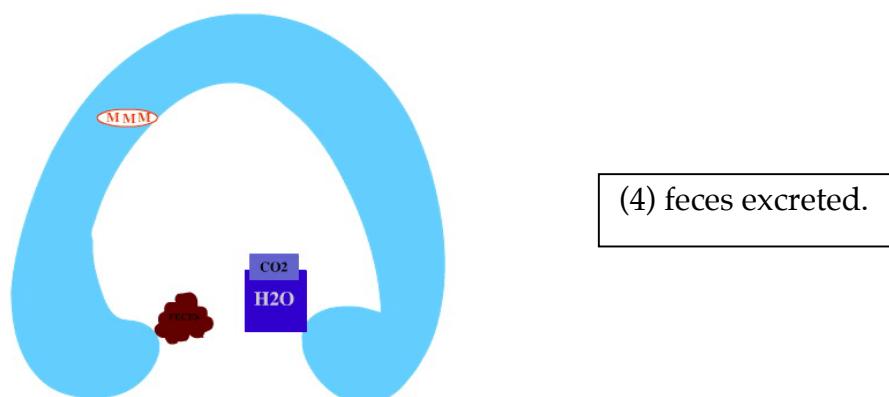
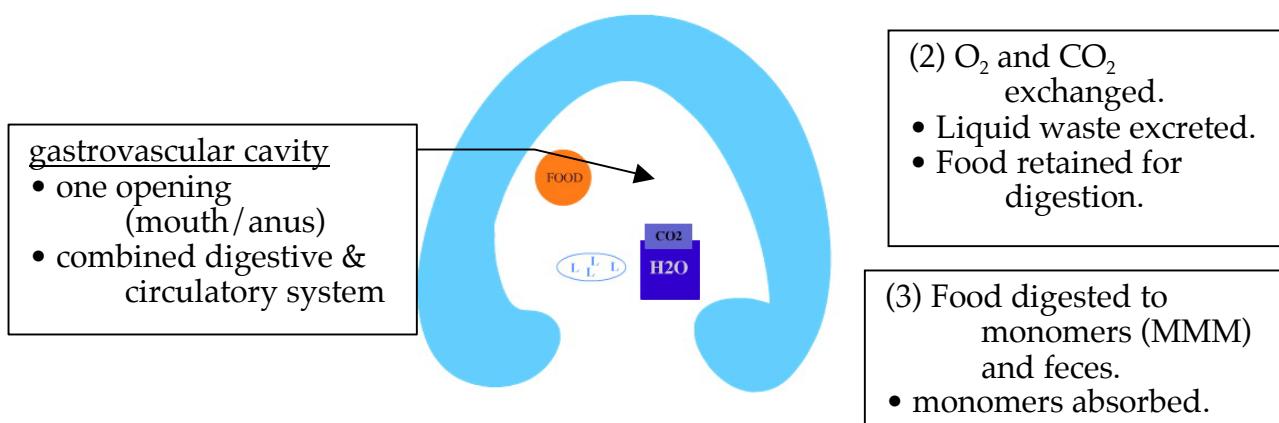
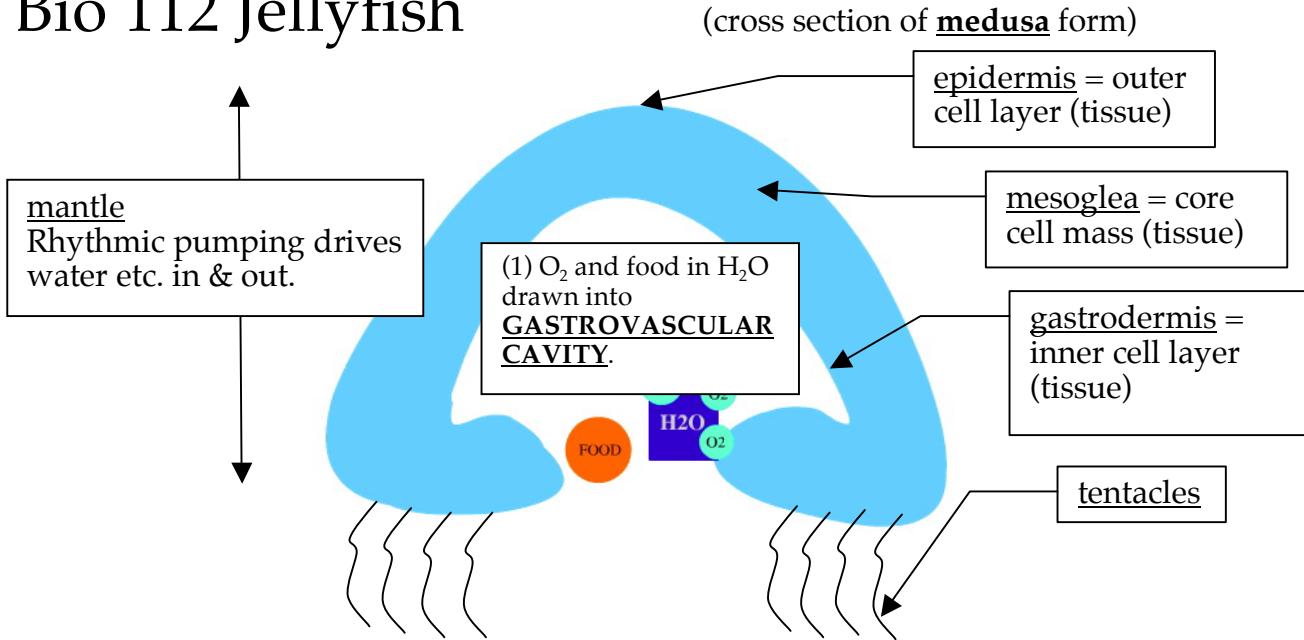
Animals 2 - 2

Brian White Ph.D. © 2011



ocw.umb.edu

Bio 112 Jellyfish



Thanks to Evelyne Tschibeli for making the animation.

Animals 2 - 3

Animals 2 - 4

Brian White Ph.D. © 2011



ocw.umb.edu

Bio 112 Handout for Animals 3

This handout contains:

- Today's iClicker Questions
- Handouts for today's lecture
- Information for Exam 2

iClicker Question #18A - before lecture

Which of the following are functions of a gastrovascular cavity?

- (A) digestion of food
- (B) circulation of nutrients to the body of the animal
- (C) excretion of liquid waste
- (D) more than one of the above
- (E) none of the above

iClicker Question #18B - after lecture

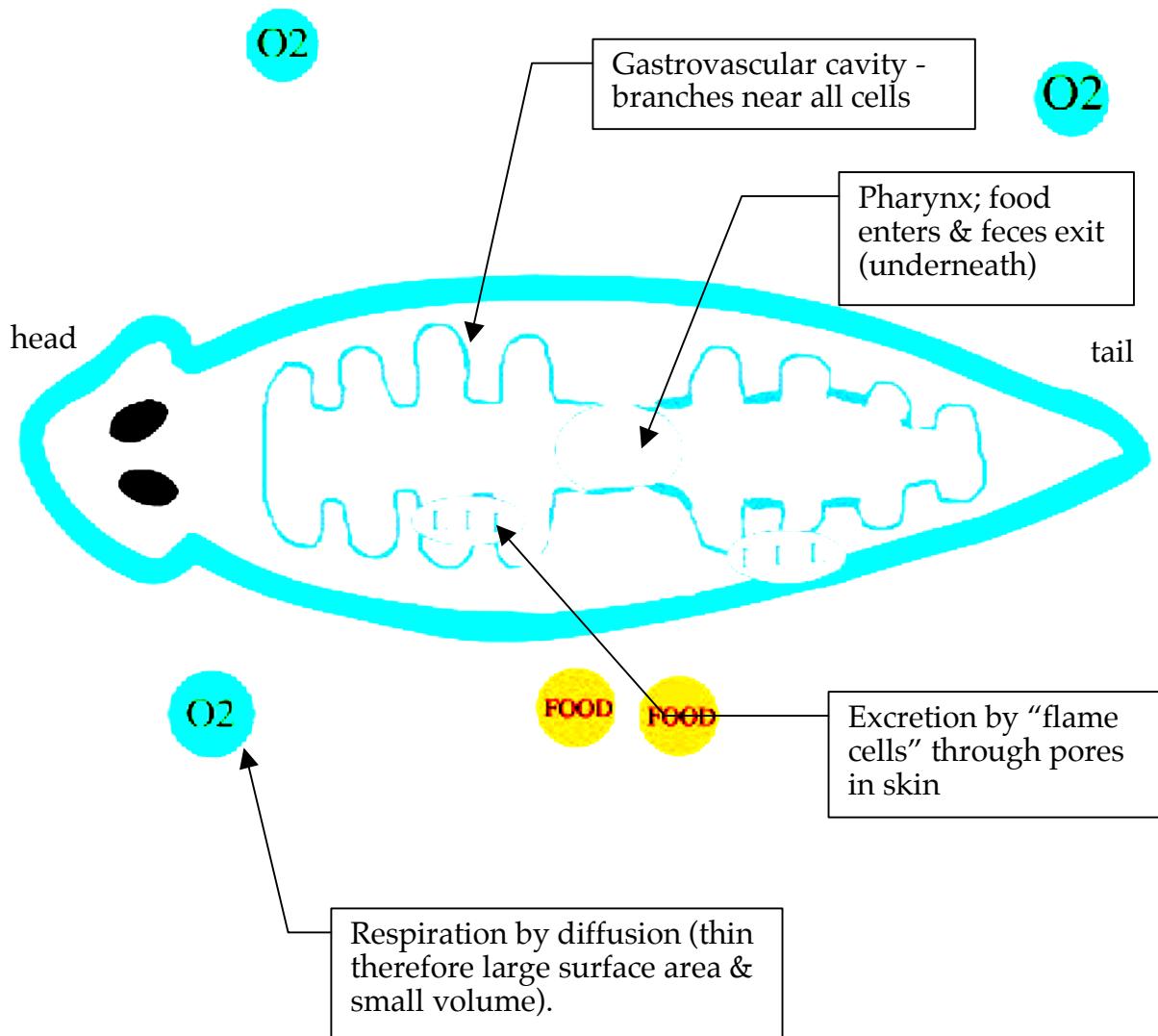
Which of the following animals does not have a "flow-through" digestive system with a separate mouth and anus?

- (A) squid
- (B) planarian
- (C) nematode
- (D) human
- (E) more than one of the above

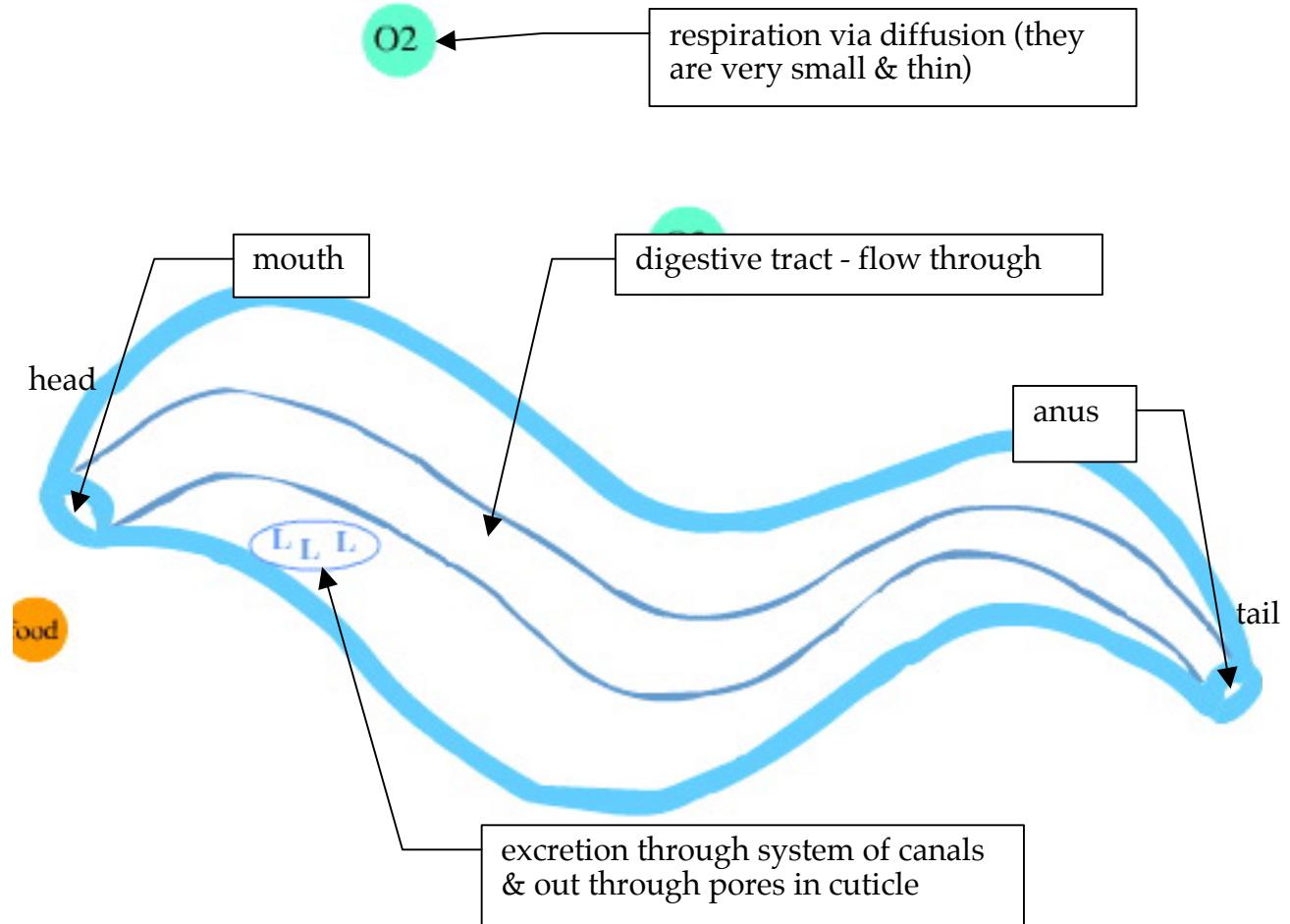
Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClicker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
 - a. Press the button corresponding to the answer you've selected (A thru E).
 - b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should resend it until you get a green "STATUS" light.

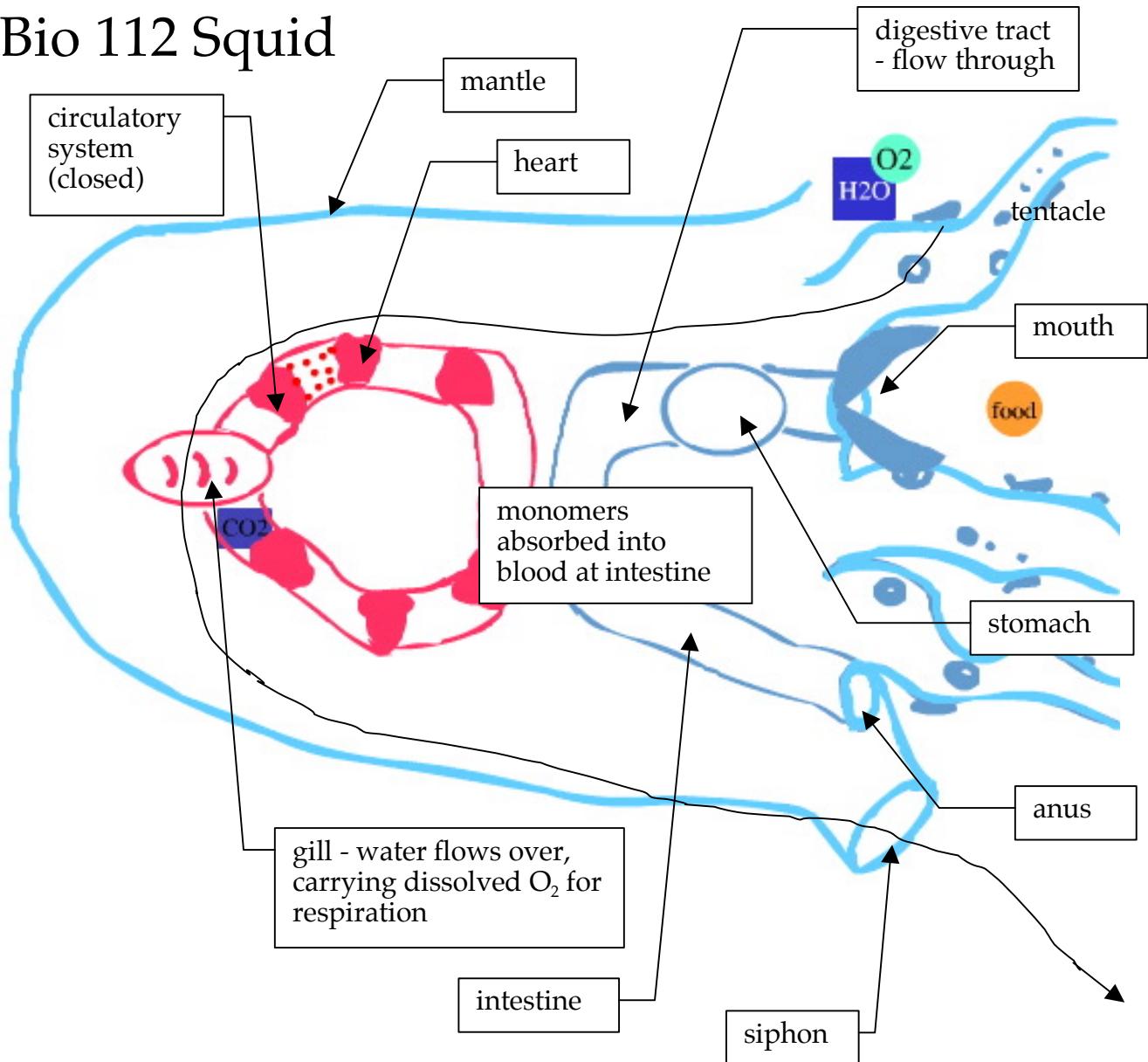
Bio 112 Planarian (dorsal view)



Bio 112 Nematode



Bio 112 Squid



Animals 3 - 4

Brian White Ph.D. © 2011

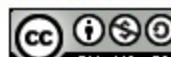


ocw.umb.edu

Bio 112: Information for Exam II

Basic Facts

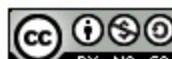
- The exam will be held at locations TBA on the date listed in the syllabus from 12:00 to 12:50.
- The exam will cover reading and lecture from Themes 4 through Plants 5 as described below.
- The exam will consist of approximately 4 questions. These will not be multiple choice; they will be problem-solving or short answer. In general, the questions will expect you to apply and make connections between the things I have talked about in lecture. See Exam II from last year on pages 7 - 13 of this handout (note that Size and Scale and Nutrition - questions like Question 3 - **will not be on this exam**). Remember to write out your answers before looking at the solutions.
- You need to know:
 - the differences and similarities between the life cycles of plants, animals, and fungi as I described in Themes 4.
 - the evolutionary histories of the 5 major plant groups I described in lecture (algae, mosses, ferns, gymnosperms, and angiosperms)
 - the life cycles of the 4 major groups of land plants that I described in lecture (you should know the complete cycles from lecture and the book although you need only know the terms that I used in lecture) Note that I may draw the life cycle in a different orientation than I did in lecture.
 - the major differences between the major plant groups that I described in lecture.
 - apply very basic genetics to plant life cycles (like on the c-fern problems from lab)
 - the basics of flower, fruit, & seed anatomy that I covered in lecture
 - the differences between monocots and dicots
 - be able to identify the following on a picture of a moss, fern, gymnosperm, or angiosperm: haploid & diploid parts, spore, s'phyte, zygote, g'phyte (male or female), gamete
- You **do not** need to know:
 - the themes I described in Themes 1 - 3 and how to apply them to specific situations
 - cellular nutrition (animals, plants, bacteria from lecture)
 - size & scale
 - the cellular metabolism or scale of any particular organism
 - life cycles of any other plant types
 - how to draw any plant parts



- The exam will consist of questions like:
 - "give 3 differences (or similarities) between X and Y"*
 - "correct the mistakes in this life cycle" or "what type of plant is this the life cycle of?"
 - "what part of the life cycle is X?"
 - "what ancestral type did plants of type X evolve from?"
 - "what adaptation led plants of type X to be more adapted to land habitats than type Y?"
 - "plant Q has seeds, but no flowers; what type of plant is it?"
 - given the following trait, what would the genotypes and phenotypes of the gametophytes and sporophytes be?"
 - "indicate a part of this picture that is composed entirely of diploid cells"

* **NOTE:** When noting differences, you **must** include both parts of the comparison. For example, if the question asked "Give one difference between a dog and a cat.", and you answered "Dogs bark" or "Cats meow", you would get very little credit. The full-credit answer is "Dogs bark and cats meow".

- You may bring in a single sheet of (8 1/2 x 11 inch) paper with any notes you want. You may write on both sides.



Bio 112 Exam #2

4/7/08

Your Name: _____

Write your initials on every page in the space provided.

This exam has 7 pages including this coversheet.

Check that you have pages 1-7.

This exam has four questions.

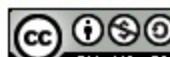
- (1) Tues AM Aimee
- (4) Weds AM Juan
- (2) Tues AM Tsering
- (5) Weds PM Alex
- (3) Tues PM Martine
- (6) Weds PM Juan

- (7) Thurs AM Alex
- (8) Thurs PM Martine
- (9) Tues PM Tsering
- (11) Thurs PM Aimee

**Make your answers as clear and
precise as possible.**

Answer all questions in the space provided.

Question	Value	Score
1	31	_____
2	20	_____
3	24	_____
4	25	_____
Bonus	1	_____
TOTAL:	101	_____



Question 1: Comparing Life-cycles (31 points)

a) Give three major differences between the angiosperm seed and a moss spore.

(1) (2 pts)

(2) (3 pts)

(3) (4 pts)

b) Give two major differences between a moss spore and a moss sperm.

(1) (2 pts)

(2) (4 pts)

c) Give two major differences between the male gametophytes of a fern and a gymnosperm.

(1) (2 pts)

(2) (4 pts)

d) Give two major differences between an angiosperm spore and a moss spore.

(1) (2 pts)

(2) (3 pts)

e) Give two major differences between fertilization in mosses and angiosperms.

(1) (2 pts)

(2) (3 pts)

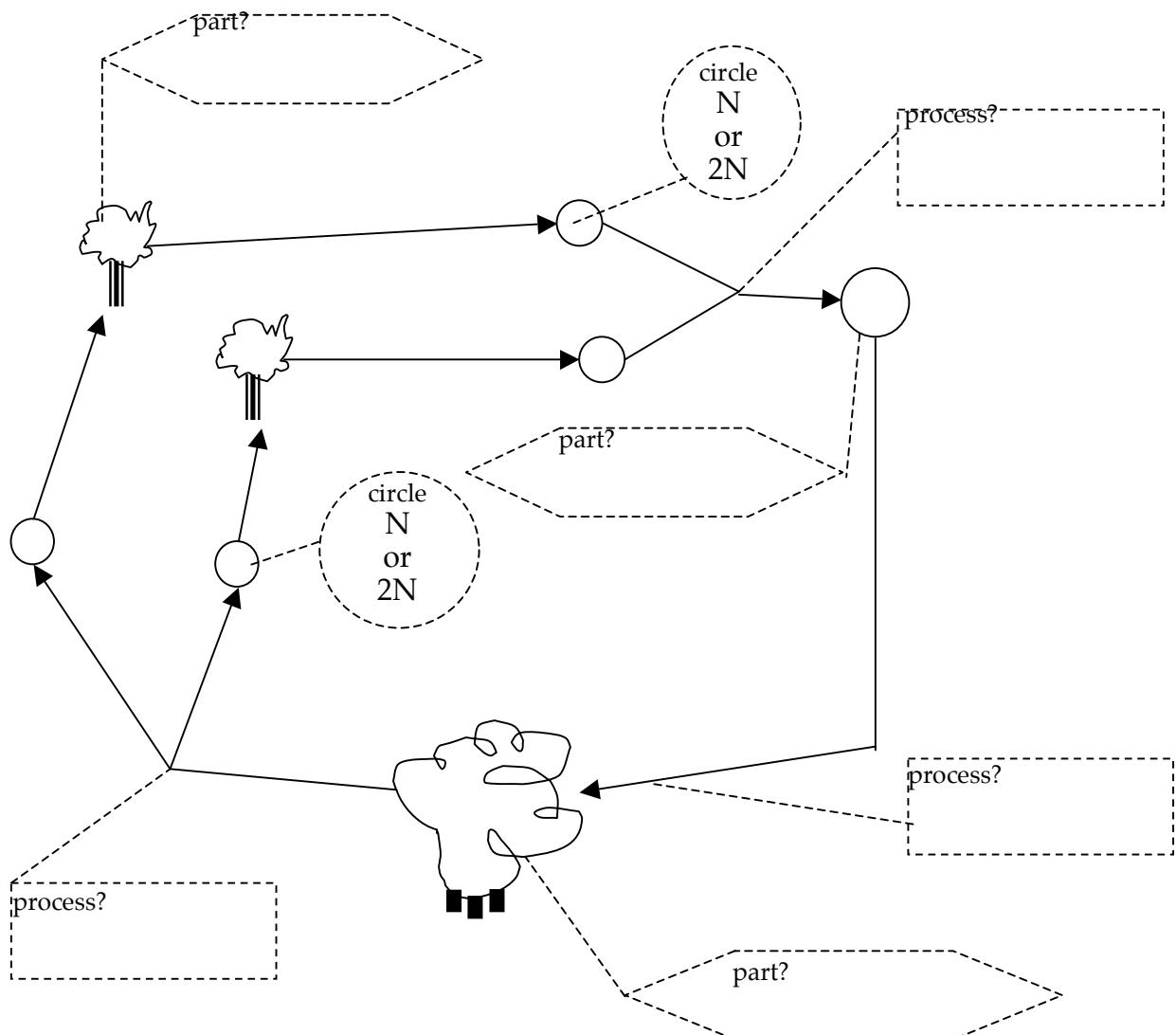
Question 2: Life cycles (20 points)

a) Shown below is the life cycle of a plant.

- in each dotted circle , circle N or 2N as appropriate. (1 pt each)

• in each dotted square , put the name of a process (mitosis, meiosis, or fertilization) as appropriate. (3 pts each)

• in each dotted hexagon , put the name of a part of the life cycle (gametophyte, etc.) as appropriate. (3 pts each)



Question 3: Themes (24 points)

a) Consider a hypothetical creature with a 10mm height. Using the rules of proportional scaling that I described in lecture, calculate the measurements below for a creature that had been made 5-times taller, thicker, and wider. Write your results in the table below: (3 pts per box)

Creature	height	surface area	weight
normal	10 mm	100 mm ²	0.5 gram
5-times larger	50 mm	mm ²	grams

b) Consider the following three hypothetical creatures:

	<u>Creature A</u>  1 mm radius sphere	<u>Creature B</u>  5 mm radius sphere	<u>Creature C</u>  "disc" 0.06 mm tall 5 mm radius
Surface Area (mm ²)	12	300	160
Volume (mm ³)	4.2	525	4.7

Assuming that each creature is made of cells each of which are all the same size and have the same respiratory requirements per cell, which of these creatures is most likely to be able to respire by diffusion through its surface with no specializations at all. Circle your answer and explain your reasoning. (6 pts)

Creature A

Creature B

Creature C

Explanation:

Question 3, continued;

For the next 2 parts, choose from the following lists:

Chemical Forms

- protein • carbohydrate
- lipid • CO₂
- NH₃ • O₂

Physical Forms

- soil • water
- food • gas

c) Consider the paper you are writing on. It is made from the trunks of pine trees (gymnosperms). Consider a carbon atom in the paper you are writing on. (3 pts each)

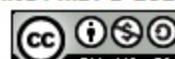
In what chemical form did this carbon atom enter the plant? _____

In what physical form did this carbon atom enter the plant? _____

d) Consider the hand you are using to write with. Consider a nitrogen atom in your hand. (3 pts)

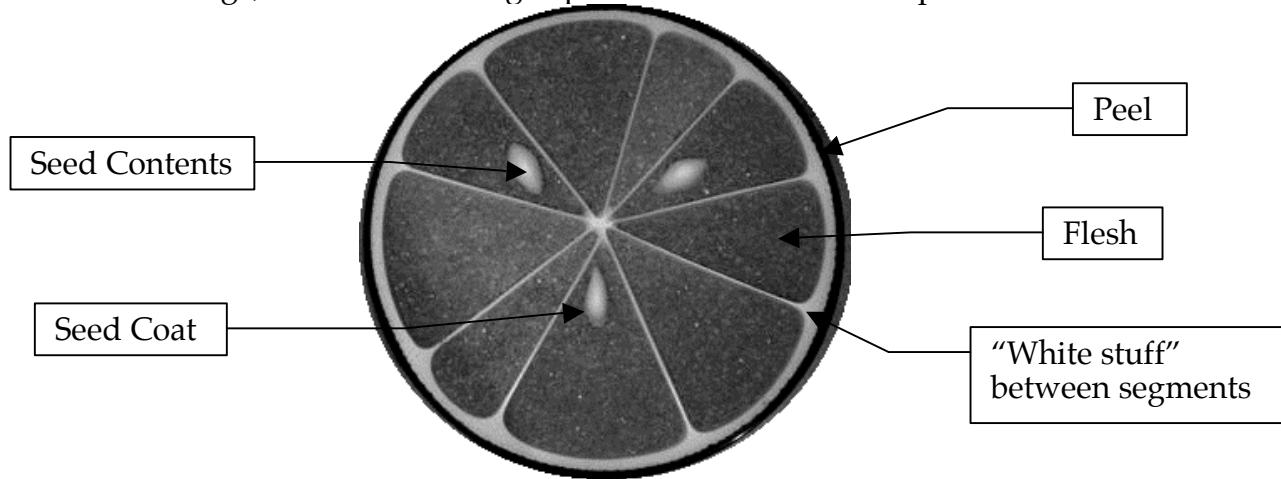
In what chemical form did this nitrogen atom enter your body? _____

In what physical form did this nitrogen atom enter your body? _____



Question 4: Plant Parts & the Real World (25 points)

Consider an orange; the fruit of an angiosperm shown below with parts labeled:



a) Where would you find a sporophyte in an orange (circle all that apply) (4 pts):

Seed Coat	Seed Contents	Peel	Flesh	"White stuff"	Not Present
-----------	---------------	------	-------	---------------	-------------

b) Where would you find an embryo in an orange (circle all that apply) (4 pts):

Seed Coat	Seed Contents	Peel	Flesh	"White stuff"	Not Present
-----------	---------------	------	-------	---------------	-------------

c) Where would you find a gametophyte in an orange (circle all that apply) (4 pts):

Seed Coat	Seed Contents	Peel	Flesh	"White stuff"	Not Present
-----------	---------------	------	-------	---------------	-------------

d) Where would you find a spore in an orange (circle all that apply) (4 pts):

Seed Coat	Seed Contents	Peel	Flesh	"White stuff"	Not Present
-----------	---------------	------	-------	---------------	-------------

Question 4, continued:

e) Suppose that there were a recessive genetic trait in oranges called *albino*. Normal oranges have orange peel and flesh; *albino* oranges have white peel and flesh.

<u>allele</u>	<u>contribution to phenotype</u>	<u>genotype</u>	<u>phenotype</u>
A	normal (dominant)	AA	normal
a	<i>albino</i> (recessive)	Aa	normal
		aa	<i>albino</i>

Suppose further that you take pollen from an AA tree and put it on the female parts of a flower on an aa tree. This flower then produces an orange. Answer the following questions about this orange.

- i) What would the genotype of the cells in the peel be? _____ (2 pts)

- ii) What would the color of the cells in the peel be? (circle one) (2 pts)

Normal
(orange)

albino
(white)

Both Normal and *albino*
(orange & white)

- iii) What would the genotype of the cells in the embryo be? _____ (2 pts)

- iv) Suppose you planted a seed from this orange; what color(s) would the oranges on this tree

have? (circle one) (3 pts)

Normal
(orange)

albino
(white)

Both Normal and *albino*
(orange & white)



Bio 112 Spring 2008 Exam II Solutions

Prepared by Brenda Silva.

1. Comparing Life Cycles

*in this question many confused fertilization with pollination. It is important to know that pollination is when the pollen is transferred to the structure that contains the ovule. For example when the pollen reaches the stigma. Fertilization is when an egg and a sperm come together to form a diploid cell (zygote).

a. Three major differences between the angiosperm seed and a moss spore.

- (1) The angiosperm seed is diploid while the moss spore is haploid.
- (2) An angiosperm seed is formed by mitosis while the moss spore is formed by meiosis.
- (3) An angiosperm seed grows to a sporophyte while the moss spore grows to a gametophyte.
- (4) In the angiosperm seed there are food reserves and in the moss spore there are none.
- (5) The angiosperm is a multi-cellular while the moss spore is single-celled.

b. Two major differences between a moss sperm and a moss spore.

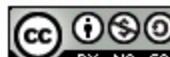
- (1) A moss spore is made by a sporophyte while the moss sperm is made by a gametophyte.
- (2) A moss spore is made by meiosis while the moss sperm is made by mitosis.
- (3) The moss spore is not motile while the moss sperm is motile
- (4) The moss spore grows into a gametophyte while the moss sperm fertilizes an egg.

c. Two major differences between male gametophyte of a fern and of a gymnosperm.

- (1) A male gametophyte of fern grows underground while the male gametophyte of a gymnosperm grows in a male cone
- (2) A male gametophyte of a fern fertilizes by releasing sperm into water, while a male gametophyte has to drop off sperm at egg.
- (3) The male gametophyte of gymnosperms becomes a pollen grain while the male gametophyte of a fern does not.
- (4) A male gametophyte of a gymnosperm stops growing and re-starts and a male gametophyte of a fern does not.

d. Two major differences between an angiosperm spore and a moss spore.

- (1) The angiosperm spore stays in the flower while the moss spore is released.
- (2) There are two kinds of angiosperm spore, a megasporangium and a microsporangium, while the moss spore has only one size.
- (3) The angiosperm spore is not used for dispersal; the moss spore is used for dispersal.
- (4) The angiosperm spore grows to a gametophyte in the flower while the moss spore grows to a gametophyte in the soil.



- e. Two major differences between fertilization in mosses and in angiosperms.
- (1) In mosses the sperm swim to the egg using water, while in angiosperms the sperm is dropped off at the egg.
 - (2) In mosses there is only one fertilization, while in the angiosperm there is double fertilization.

2. Life cycles.

[The best way to start this problem is by something you are sure of, such as when two cells get together you get a zygote that turns into an embryo. Alternatively, when one cell splits into two, this is meiosis, which makes spores.]

Plant life cycle.

- Haploid/ Diploid {top to bottom} N and N
- Process {clockwise from upper right} fertilization, mitosis, meiosis.
- Part {top to bottom} gametophyte, zygote, sporophyte.

3. Themes.

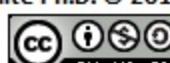
[Information on equations on surface area and weight can be found in Lecture notes of Themes 2. For surface area you square the height of the 'creature', by squaring the change in height you are getting the change in the surface area. Since the change is 25x, the new surface area is (old area) x 25 = $100 \times 25 = 2,500$. Similarly, for weight, to find the increase, you cube 5 to get 125x and since the original weight is 0.5g you multiply that by 125 to get 62.5 grams.]

- a. Surface area: $(50)^2 = 2500\text{mm}^2$
Weight: $(5)^3 = 125 \times .5 = 62.5 \text{ grams}$
- b. Which creature is most likely to respire by diffusion?
 - Creature C is most likely to respire by diffusion. This is because Creature C has the greatest surface per volume, making it easier for molecules to go in and out of skin. Creature A has a surface area per volume of 2.85, and creature B has .57, while creature C has a 34.04 surface area per volume.
- c. Consider carbon atom in paper, made from gymnosperms.
 - Enters plant in **chemical form** of CO₂ *{the way plants get their food, is through photosynthesis. Photosynthesis is a process in which the plants absorb CO₂ from the atmosphere, with the combination of photons (light energy) and water, to make sugars such as glucose}*
 - CO₂ entered the plant in the **physical form** of gas. *{Humans release CO₂ through respiration. CO₂ is released into the air.}*
- d. Consider nitrogen atom in your hand.
 - Enters the body in the **chemical form** of a protein. *{Nitrogen is present in other animals that we eat, and they are proteins.}*
 - Enters the body in the **physical form** of food. *{humans get their chemical energy from food}*

4. Plant parts & Real world.

- a. Where would you find a sporophyte in an orange?
 - Seed coat, seed contents, peel, flesh, "white stuff"

Animals 3 - 15



[The sporophyte is what turns into the fruit]

- b. Where would you find an embryo in an orange?
- Seed contents.

[The seed is what you plant in order for the plant to develop. What develops in the seed is the embryo, therefore the embryo is inside the seed contents]

- c. Where would you find a gametophyte in an orange?
- Not present.

[The gametophytes in a flowering plant are either found in the pollen or the ovule before fertilization; neither of these is present in the mature fruit.]

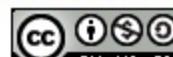
- d. Where would you find a spore in an orange?
- Not present.

[Spores are only present in the flower, and not fruit.]

- e. Suppose pollen taken from AA tree and put it on the female parts of a flower on an aa tree.

Flower than produces an orange:

- (1) Genotype of the cells in the peel would be aa. [this is because the peel is derived from the female part which is aa]
- (2) Color of the cells in the peel would be albino [this is a result of the aa]
- (3) Genotype of the cells in the embryo would be Aa. [embryo is a result of both the female and male together therefore embryo contains both DNA's]
- (4) Color of the oranges in the tree would be : Normal-orange [If punnet square is created all offspring would have genotype of Aa. Based on information genotype of Aa results in a fruit having an orange color.]



Bio 112 Handout for Animals 4

This handout contains:

- Today's iClicker Questions
- Handouts for today's lecture

iClicker Question #19A - before lecture

Which of the following are true?

- (A) If an animal has a circulatory system, it has one and only one heart.
- (B) All animal circulatory systems involve blood cells that carry oxygen.
- (C) An animal's circulatory system can involve 0 or more hearts.
- (D) All of the above.
- (E) None of the above.

iClicker Question #19B - after lecture

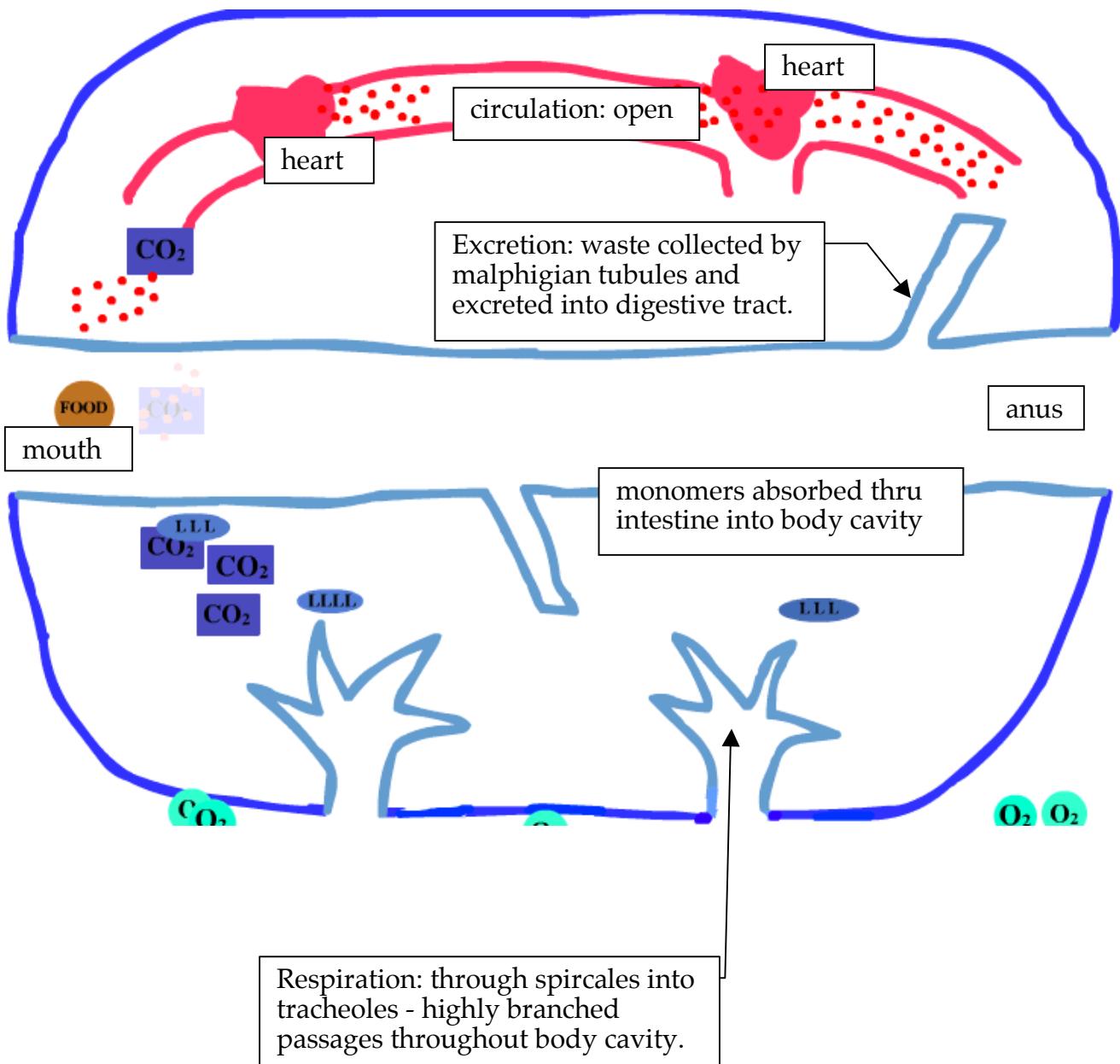
Which of the following animals has an open circulatory system?

- (A) squid
- (B) caterpillar
- (C) human
- (D) more than one of the above
- (E) all of the above

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClicker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
 - a. Press the button corresponding to the answer you've selected (A thru E).
 - b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should resend it until you get a green "STATUS" light.

Bio 112 Caterpillar



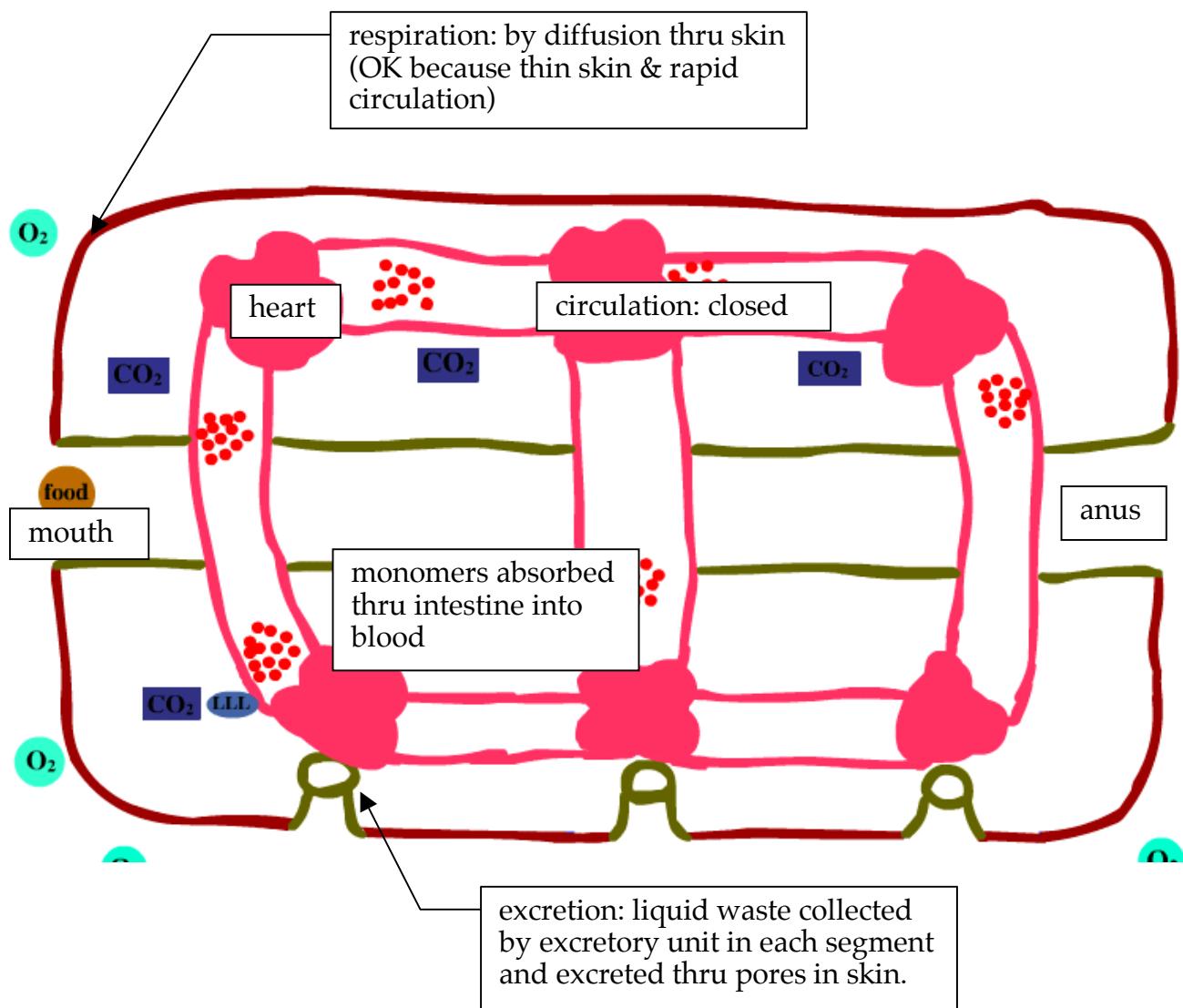
Animals 4 - 2

Brian White Ph.D. © 2011

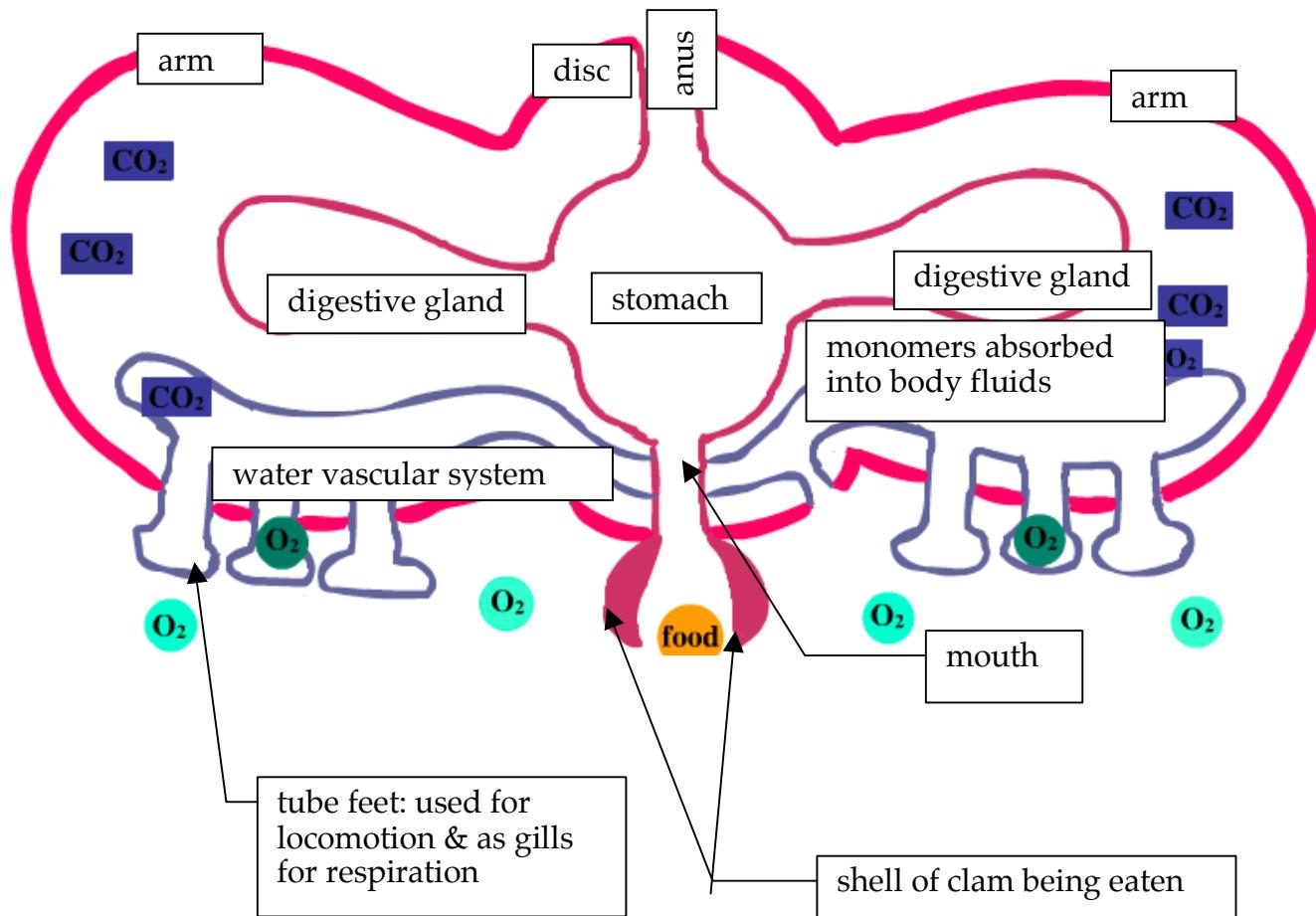


ocw.umb.edu

Bio 112 Earthworm

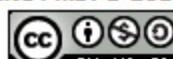


Bio 112 Starfish



Animals 4 - 4

Brian White Ph.D. © 2011



ocw.umb.edu

Bio 112 Handout for Animals 5

This handout contains:

- Today's iClicker Questions
- Handout for today's lecture

iClicker Question #20A - before lecture

Which of the following are true?

- (A) All chordates have a backbone made of bone and cartilage.
- (B) All chordates have a dorsal nerve cord.
- (C) All chordates have a backbone made of bone and/or cartilage.
- (D) More than one of the above.
- (E) None of the above.

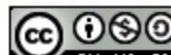
iClicker Question #20B - after lecture

Which of the following animals eats (ingests food) and breathes (takes in air or water for respiration) through their mouth?

- (A) trout
- (B) squid
- (C) caterpillar
- (D) planarian
- (E) more than one of the above

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClicker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
 - a. Press the button corresponding to the answer you've selected (A thru E).
 - b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

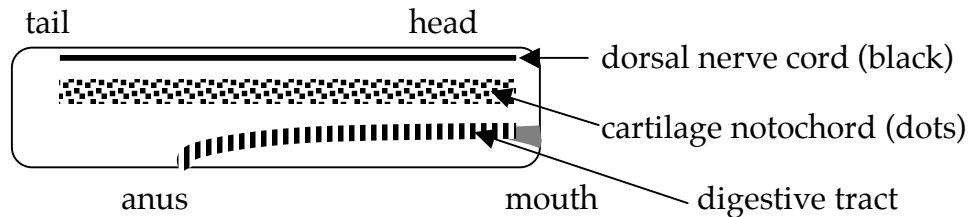


Notochord, backbone, etc.

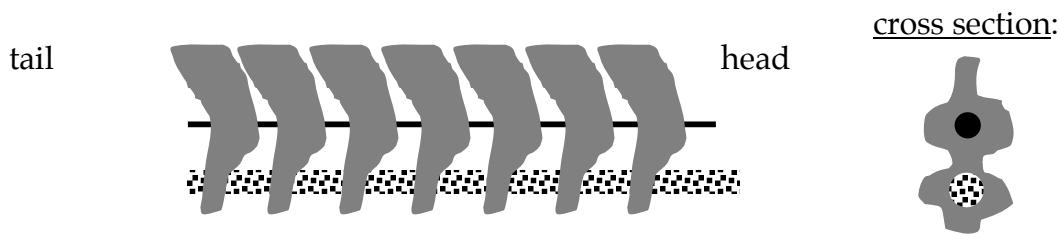
These terms can be confusing as these structures are highly modified in advanced vertebrates like us.

There are two parts of the primitive chordate (for example, a cephalocordate) to keep track of:

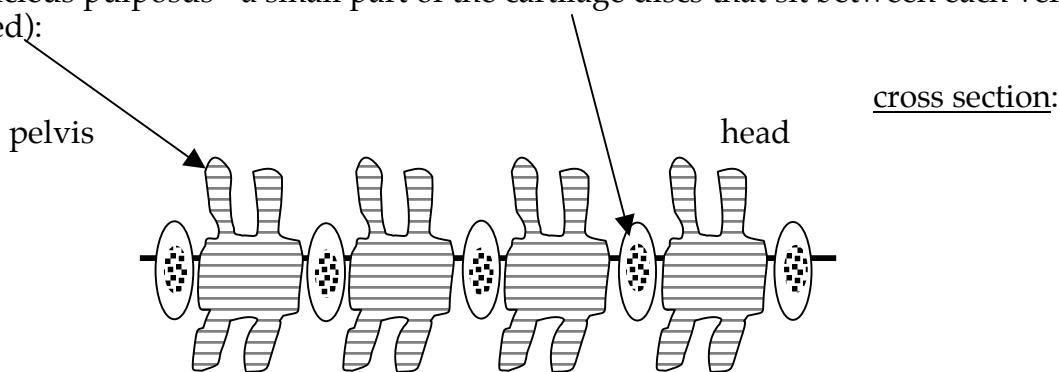
- the nerve cord
- the notochord



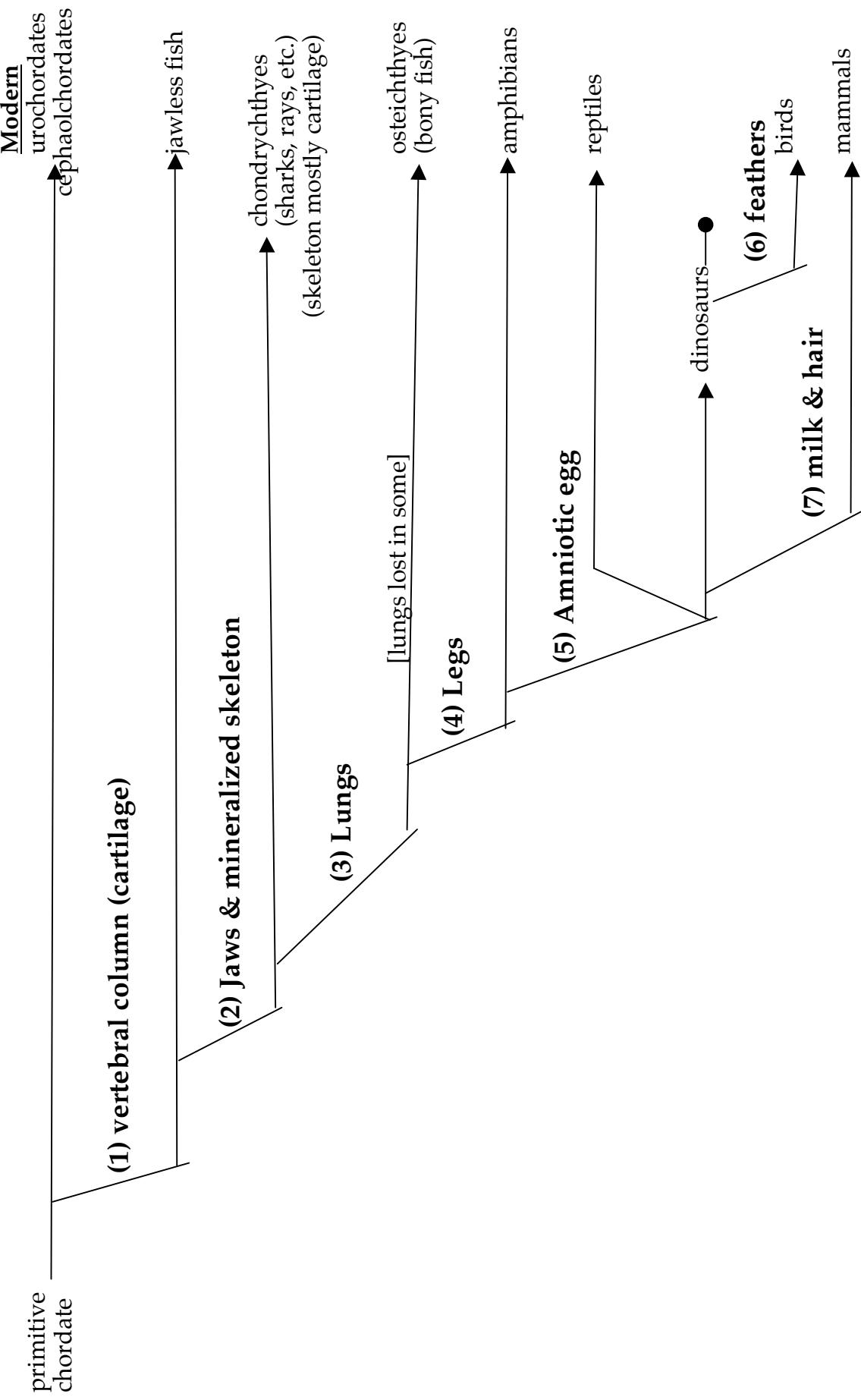
In more advanced chordates, like a shark, cartilage 'vertebrae' (gray) begin to wrap and protect the nerve cord and the notochord like this (a small section of the backbone):



In terrestrial vertebrates like us, the notochord only provides structural support during embryonic development. In mature terrestrial vertebrates, the notochord has been reduced to the nucleus pulposus - a small part of the cartilage discs that sit between each vertebral bone (striped):



Chordate Phylogeny (Campbell fig. 34.2)



Bio 112 Trout

