1) In the diagram above:
   a) fetal hemoglobin has a higher oxygen affinity than adult hemoglobin
   b) oxygen saturation is 0% when oxygen levels are high (above 120 mm Hg)
   c) Adult hemoglobin will pull oxygen away from the fetal hemoglobin

2) Anthozoa:
   a) have a gastrovascular cavity
   b) have an exoskeleton
   c) is the class that jellyfish and sea nettles belong in
   d) have a closed circulatory system

3) The diagram above could be the eight-cell stage of:
   a) a lobster
   b) a porifera
   c) mesoderm
   d) a human
   e) a protostome

4) Collagen from a scurvy patient
   a) melts at 24 degrees C
   b) does not contain glycine
   c) has higher tensile strength than in normal people
   d) is rich in hydroxyproline

5) The golden jellyfish of Lake Palau
   a) has no symmetry
   b) has highly poisonous stinging cells
   c) is a cnidarian
   d) has a closed circulatory system
6) In the human and mammalian digestive system, which of the following is NOT a type of digestion:
   a) Mechanical
   b) Chemical
   c) Enzymatic
   d) Combustion
   e) All of the above

7) In digestion by the human small intestine
   a) The pancreas secretes inactive enzymes (trypsinogen, procarboxypeptidase, chymotrypsinogen)
   b) HCl activates chymotrypsinogen
   c) The gastric gland secretes mucus
   d) The walls of the small intestine are smooth to reduce surface area
   e) Bacteria in the small intestine absorb water and produce vitamin K

8) In the human stomach
   a) There is no mechanical digestion
   b) The pH is 2
   c) Most of the absorption of nutrients occurs
   d) Symbiotic bacteria and protozoa digest cellulose
   e) Membrane bound enteropeptidase activates digestive enzymes

9) Procarboxypeptidase is
   a) An active digestive enzyme
   b) Secreted in the saliva
   c) Directly activated by membrane bound enteropeptidase
   d) Activated by trypsin, which converts it to carboxypeptidase
   e) Converted to chymotrypsin by pepsin

10) Which of the following is the major site of nutrient absorption in humans
    a) Lungs
    b) Stomach
    c) Mouth
    d) Large intestine
    e) Small intestine

11) Which of the following is the main site of cellulose breakdown in humans
    a) Large intestine
    b) Small intestine
    c) Stomach
    d) Appendix
    e) Mouth

12) In horses, rodents, and koalas this organ is the main site of cellulose digestion
    a) Cecum
    b) Appendix
    c) Large intestine
    d) First two chambers of the stomach
    e) Rumen

13) Why doesn’t pepsin digest the stomach?
    a) Pepsin is not found in the stomach
    b) The inactive form called pepsinogen is secreted first, and later activated by HCl
    c) HCl prevents pepsin from breaking down protein
    d) The stomach is not made of protein
    e) Pepsin only digests cellulose

14) Which of the following do not need a digestive system to gain nutrition
    a) Herbivores
    b) Carnivores
c) Omnivores  
  d) Heterotrophs  
  e) Autotrophs – like corals with symbiotic algae

15) The gastrovascular cavity is used for digestion in  
  a) Insects  
  b) Cnidarians  
  c) Humans  
  d) Bacteria  
  e) Plants

16) Comb jellies are in the phylum  
  a) Porifera  
  b) Molluska  
  c) Ctenophora  
  d) Rotifera  
  e) Cnidaria

17) The tapeworm is in the phylum  
  a) Annelida  
  b) Nematoda  
  c) Platyhelminthes  
  d) Mollusca  
  e) Flatworma

18) Lancelets are in the phylum  
  a) Annelida  
  b) Chordata  
  c) Echinodermata  
  d) Gangsta  
  e) Ctenophora

19) Which of these phyla have a true coelom  
  a) Nematode  
  b) Cnidaria  
  c) Porifera  
  d) Mollusca  
  e) Ctenophore

20) Which of these phyla are deuterostomes  
  a) Annelida  
  b) Chordata  
  c) Echinodermata  
  d) Gangsta  
  e) Ctenophora

21) In deuterostome development  
  a) Cleavage is spiral  
  b) There is no blastopore  
  c) The blastopore becomes the mouth  
  d) The coelom forms differently than in protostomes  
  e) The archenteron forms the mouth

22) The coelom  
  a) Forms from the blastopore  
  b) Is lined by mesoderm  
  c) Is part of the ectoderm  
  d) Is not found in protostomes  
  e) Is a solid mass of cells that becomes the spinal cord

23) Which of these phyla have a segmented body  
  a) Cnidaria  
  b) Platyhelminthes
24) Some octopuses
   a) Can mimic a lionfish, flounder, and poisonous sea snake
   b) Have a gastrovascular cavity
   c) Have modified their gill tissue to have sucker like organs that are sometimes venomous
   d) have part of their mantle tissue shaped like a fish to attract predatory fish and inject their larvae onto the fish

25) Porifera
   a) release a barbed sometimes poisonous nematocyst
   b) are found on land and in the ocean
   c) are colonies of flagellated cells
   d) have rows of comb-like cilia
   e) have radial symmetry

26) Examples of organisms in the phylum echinodermata are:
   a) Rotifers
   b) Sea cucumbers
   c) Cats
   d) Barnacles
   e) Tunicates

27) What do the phyla mollusca, nematoda and annelida share in common
   a) Bilateral symmetry
   b) Coelom
   c) Deuterostome development
   d) Gastrovascular cavity
   e) Exoskeleton

28) Body size is important. therefore:
   a) A mouse-sized elephant would have a skeleton around 5 times heavier than a mouse skeleton
   b) A elephant-sized mouse would have a skeleton around 5 times heavier than a mouse skeleton
   c) It is easier for *E. coli* bacteria to swim through water than humans
   d) Larger objects have more surface area compared to their volume than small objects. Consequently it is easy for large animals to use their body surface alone for respiration
   e) The surface to volume ratio of a large organism (1 meter) is the same as for a small organism (1 mm)

29) The speed of gas diffusion is:
   a) 1 micron in 1000 seconds
   b) 1 mm in 100 seconds
   c) 225 miles per hour
   d) Faster if temperature is lowered
   e) Not important for animal respiration

30) In respiration
   a) Reduced carbon (such as glucose) is produced
   b) Oxygen and reduced carbon (such as glucose) are consumed
   c) Carbon dioxide is consumed
   d) A 1 meter spherical organism can rely on just its body surface for gas exchange
   e) Hemoglobin transports glucose

31) Collagen
   a) Is rarely found in mammals
   b) Is a protein molecule that has great tensile strength
   c) Is made from cellulose fibers
   d) Is the oxygen carrying molecule in humans
   e) Would not be digested in the human stomach

32) Which of the following is a true statement
   a) Biology has not had any significant advances in the last 30 years
b) Understanding how an organism works involves consideration of biochemistry, cell biology, physiology, ecology and evolution.
c) Physical laws do not apply to organisms.
d) Humans used to be 3 inches tall.
e) 12 foot tall humans would have the same skeleton and physiology as 6 foot tall humans.

33) These structures increase the surface area of the fish gill:
   a) Filaments, villi
   b) lamellae, flagella
   c) filaments, lamellae
   d) ostia, capillaries
   e) capillaries, alveoli

34) The distance from a tracheole to the nearest mitochondria is generally a few:
   a) centimeters
   b) kilometers
   c) micrometers (microns)
   d) meters
   e) millimeters (mm)

35) The avian (bird) lung differs from the human lung since:
   a) Avian lungs use tidal ventilation
   b) Air sacs are used to create flow-through ventilation
   c) There are no capillaries in the avian lung
   d) The avian lung consists of tracheoles
   e) Birds breathe mainly through their feathers.

36) When water and blood flow in opposite directions on the fish gill, this allows countercurrent exchange. This
   a) Results in 25% oxygenation of the blood
   b) Is inefficient
   c) Completely deoxygenates the fish blood
   d) Results in full oxygenation of the fish blood
   e) Occurs in bivalve gills

37) Fish have a:
   a) two chambered heart
   b) one chambered heart
   c) gastrovascular cavity
   d) pseudoceolom
   e) tracheal system

38) Alveoli are small sac-like structures found in the human:
   a) lung
   b) small intestine
   c) pancreas
   d) hypothalamus
   e) large intestine

39) The pathway of blood flow in a fish circulatory system is:
   a) Atrium → ventricle → gill capillaries → atrium → ventricle → muscle capillaries
   b) ventricle → atrium → gill capillaries → muscle capillaries → ventricle → muscle capillaries
   c) Atrium → ventricle → gill capillaries → muscle capillaries → atrium
   d) Atrium → ventricle → gill and skin capillaries → atrium → ventricle → muscle capillaries

40) Which of these structures is NOT well supplied with capillaries:
   a) villi of small intestine
   b) lamellae of fish gills
   c) the body surface of the Lake Titicaca frog
   d) the mantle cavity of bivalves
   e) alveoli of the lung

41) High blood pH:
   a) Causes hemoglobin to bind oxygen more tightly (oxygen dissociation curve shifted to the left)
b) Causes the urge to breathe  
c) Occurs in the muscle tissues  
d) Is caused by high carbon dioxide levels  
e) Is found in the human left ventricle

42) When there is transposition of the major blood vessels, the baby does not transport oxygenated blood to its body. Which of the following is a pathway of blood flow when there is this defect?

a) Atrium → ventricle → gill capillaries → atrium → ventricle → muscle capillaries  
b) Right atrium → right ventricle → aorta → systemic capillaries → veins → right atrium  
c) Right atrium → left atrium → lung capillaries → atrium → ventricle → systemic capillaries → right atrium  
d) left atrium → left atrium → lung capillaries → right atrium → right ventricle → systemic capillaries → left atrium  
e) Atrium → ventricle → lung capillaries → systemic capillaries → veins → atrium

43) Which of the following is true about the Bohr effect

a) When pH is low the oxygen affinity of hemoglobin is low  
b) When carbon dioxide goes into the blood, blood pH rises  
c) When blood pH rises, oxygen affinity of hemoglobin goes down  
d) When the oxygen concentration increases hemoglobin holds less oxygen  
e) Fetal human hemoglobin has lower oxygen affinity than adult hemoglobin

44) Arteries

a) Have three layers: connective tissue, mesoderm, and ectoderm  
b) Carry blood away from the heart  
c) Only contain oxygenated blood  
d) Have valves to prevent backflow  
e) Are the major blood vessels of insects

45) The Burgess Shale fossils

a) Were mainly dinosaurs  
b) Show that chordates were more abundant and diverse in the past  
c) Are found in Hells Canyon  
d) Consist of many animals with body plans that are completely different than present day animals  
e) Show that dinosaurs have 4 chambered hearts

46) Which of these phyla have radial symmetry

a) Cnidaria  
b) Porifera  
c) Mollusca  
d) Annelida  
e) Starfishia

47) The human urge to breathe is triggered by

a) Increased carbon dioxide in the blood  
b) Water pressure  
c) Low blood glucose  
d) Strange voices  
e) Increased blood flow

48) Which of these animals has an open circulatory system:

a) Earthworms  
b) Crocodiles  
c) Humans  
d) Sponges  
e) Clams

49) Hydrogen sulfide

a) Is used by the bacteria inside of tubeworms to make sugars for their nutrition  
b) Is used by algae to feed corals  
c) Is a gas that is a byproduct of cellular respiration  
d) Is produced by the gastric gland  
e) Breaks down protein
50) In ruminant digestion
   a) Cellulose is digested in the stomach
   b) Cellulose is digested in the cecum
   c) Saturated fats are converted to unsaturated fats
   d) The gastrovascular cavity is used for digestion
   e) The cecum is extremely large
51) Arthropods
   a) Have a closed circulatory system
   b) Are protostomes
   c) Have a three chambered heart
   d) Lack a true coelom
   e) Lack any form of exoskeleton
52) What phylum does the animal in the photograph belong to:
   a) Annelida
   b) Arthropoda
   c) Crustacea
   d) Polychaeta
   e) Mollusca
53) Which of the following animals has a three chambered heart:
   a) Clam
   b) Spider
   c) Crocodile
   d) Frog
   e) Bird
54) The major function of the human large intestine is
   a) Absorption of water
   b) Release of carbon dioxide
   c) Digestion of starch, fats, and protein
   d) Absorption of amino acids and sugars
   e) Food storage
55) Which of the following is a basic part of the alimentary canal:
   a) Heart
   b) Vein
   c) Trachea
   d) Mouth
   e) Lung