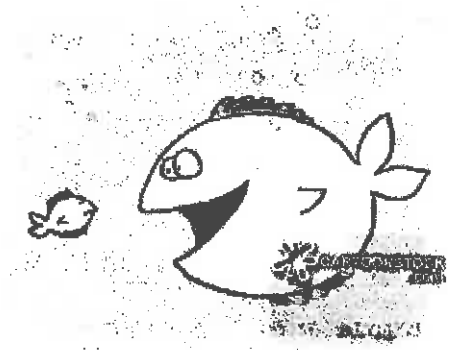
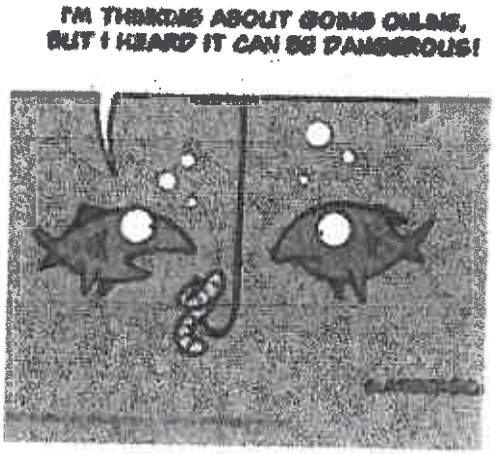
Diversity of Life:



"And now, as a token of my appreciation for the vital role your species plays in the food chain, I'm going to eat you!"



Animals

KINGDOM ANIMALIA pp.650 fwd.

Zoology = the study of animals

GENERAL CHARACTERISTICS

- Multicellular - with a wide range of specialization (cells → tissues → organs → systems
- Heterotrophic - ingest food
- Motile - at some point in their life cycle
- Respond - quickly to stimulus
- Reproduce Sexually - using either external or internal fertilization; lower forms capable of asexual reproduction as well

CLASSIFICATON IS BASED ON:

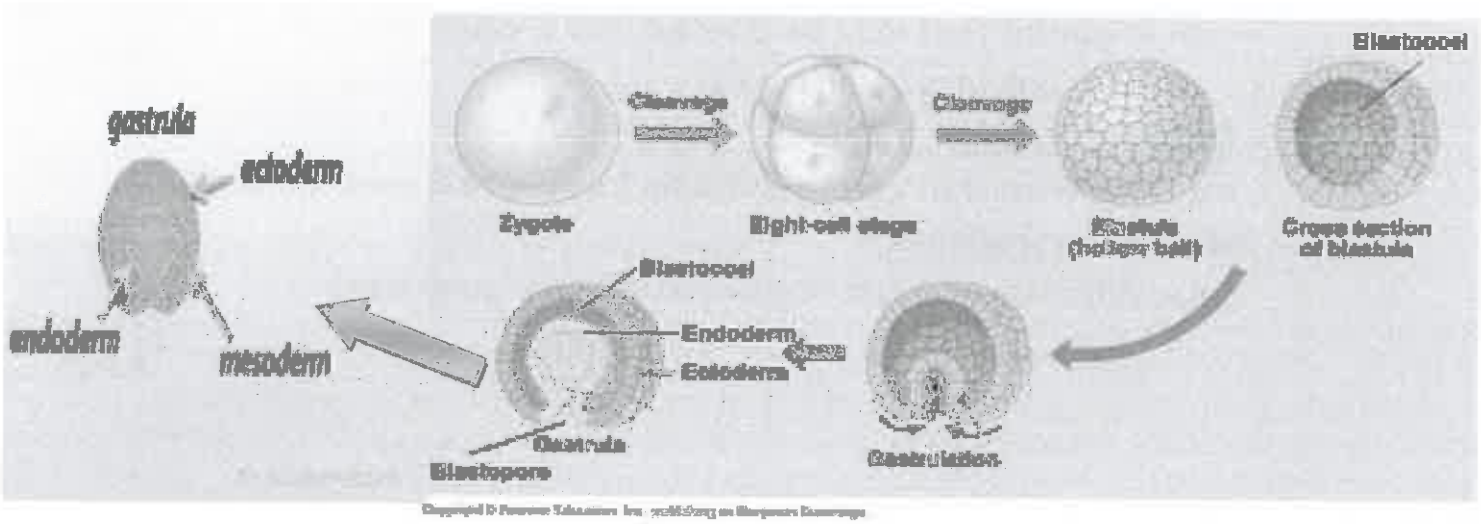
1) Embryological Development

Begin life as a single cell (haploid n), then fertilized to become a zygote (diploid 2n)

2) Level of Organization

Although many animals have the highest level of organization (organ systems) some are only organized at the cellular level. The level of organization an animal has is determined by the number of germ layers present in a developing embryo. These primary tissues develop into tissues and organs.

- **Diploblastic** - 2 germ layers - ectoderm (hair, skin, nails, nervous)
  - endoderm (digestive)
- **Triploblastic** - 3 germ layers - ectoderm
  - endoderm
  - mesoderm (respiratory, muscular, circulatory, etc)



3) Body Cavities = coelom

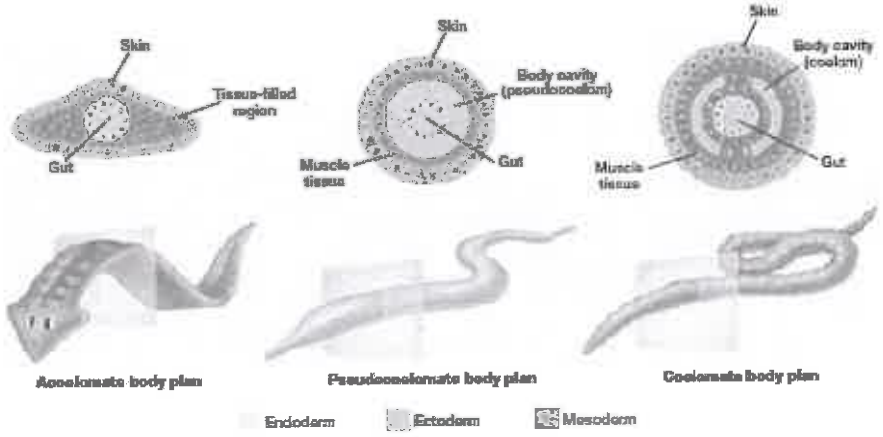
The area or space between the gut and the body wall

- Acoelomate
  - lack a body cavity

  = pouch-like gut with a single opening which acts as both a mouth / anus
- Pseudocoelomates
  - pseudo = false body cavity

  = fluid-filled cavity with 2 openings (mouth & anus) but no lining of the gut
- Coelomates
  - true body cavity

  = body cavity with 2 openings & a lining of epithelial cells (peritoneal lining)



4) Type of Symmetry

= general body form of an animal (balance)

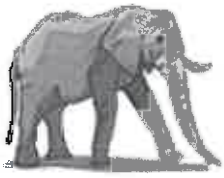
- Asymmetrical Symmetry

  = an organism which does **not** have 2 balanced halves regardless of how it is cut

- Radial Symmetry

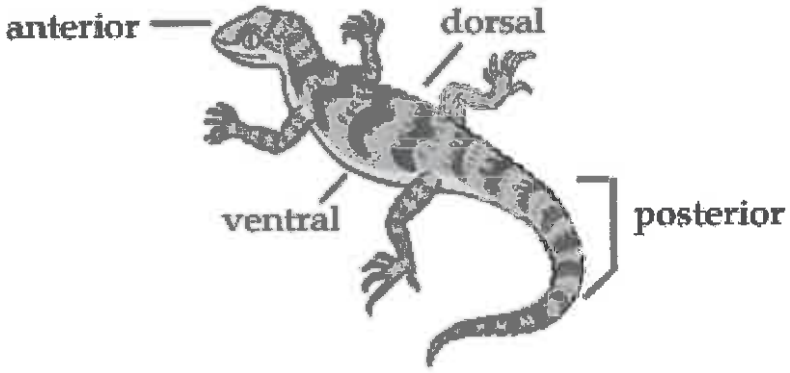
  = an organism that may be divided into 2 equal parts if cut through longitudinal axis
- Bilateral Symmetry

  = an organism that can be cut only 1 way into 2 similar halves



- indicates **cephalization** (specialization of head region for sensory purposes)

- Body Directions:
  Dorsal = back Ventral = front (belly) Anterior = head
  Posterior = tail



5) Skeleton

Animals are divided into to distinct groups:

- Invertebrates = animals without a backbone (95% of all animals)
- Vertebrates = animals with a backbone (5% of all animals)

What are Hox Genes?

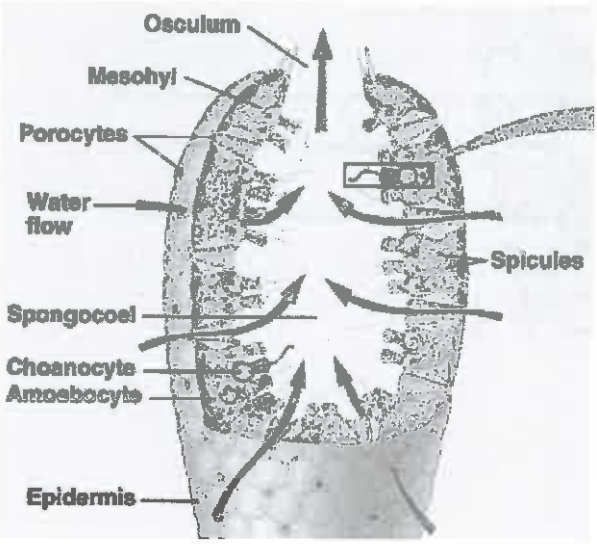
http://www.mcwdn.org/Animals/Animals.html

INVERTEBRATES

Phylum Porifera "Sponges"

-General Characteristics

1. Irregular shape = asymmetrical
2. Sessile adult, motile larva
3. Aquatic (mainly marine)
4. Specialized cells **not** arranged into tissues



: spicules = provide structure
: choanocytes (collar cells) = move water
: amoebocytes = digest and transport food
: Acoelomate body cavity = 2 germ layers
-endoderm & ectoderm separated by a jelly-like **mesechyme**

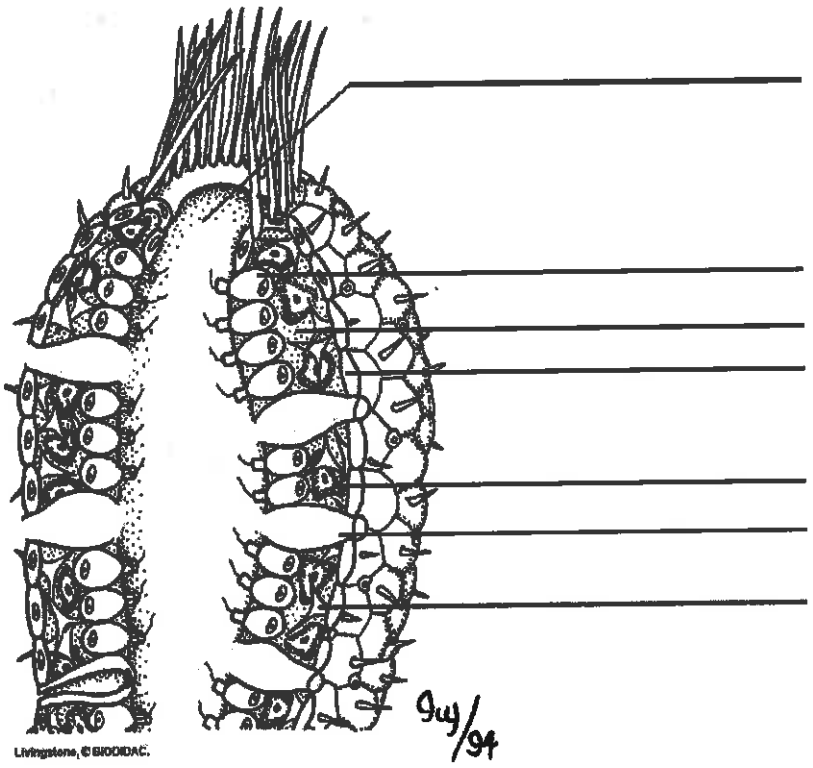
- Biological systems
    1. None = diffusion
    2. No digestive system or mouth (choanocytes and amoebocytes)
        - has **ostia (pores)** which connect to an internal canal system
        - water current takes food in through ostia & waste out through central **ostium**
- Reproduction
    1. Asexual
        - budding = "bud" forms on side
        - regeneration = piece breaks off and grows to new organism
    2. Sexual
        - Hermaphroditic = produces both egg & sperm but cannot self fertilize = gemule

Johnathan Bird's Blue Planet- Sponges https://www.youtube.com/watch?v=m8a0oNsDEx8

Sponge Anatomy

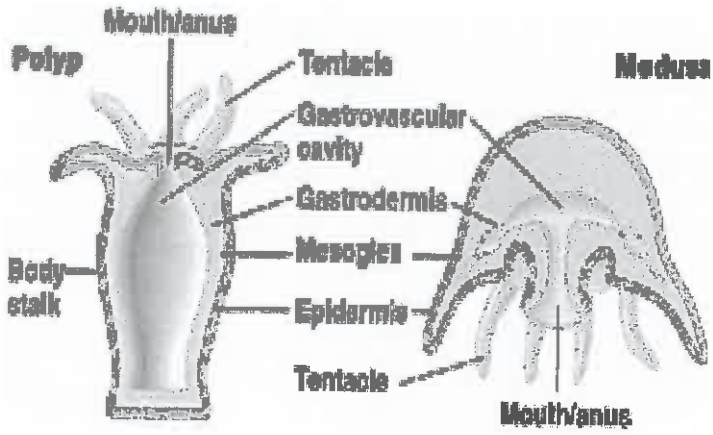
Label the Diagram:

Ostia	Osculum
Choanocyte	Mesenchyme
Ectoderm	Amebocyte
Spicule	



Phylum Cnidaria "Hydra, Coral, Jellyfish"

- formerly called "Coeleterates"
- General Characteristics
  1. 2 body forms:
     - polyp = mainly sessile
     - medusa = free swimming
  2. Aquatic (mainly marine)
  3. Tentacles = for feeding & movement
  4. Nematocysts = stinging cells



- Radial symmetry, but a few asymmetrical (corals)

- Acoelomate body cavity = 2 germ layers
  - ectoderm and endoderm separated by jelly-like mesoglea

- Biological systems
  1. Nervous system = nerve net (ring) around mouth
  2. Digestive system - one opening
     = gastrovascular cavity with digestive enzymes
  3. Respiration and circulation = diffusion

-Reproduction
  1. Asexual
     = budding
     = regeneration
  2. Sexual
     - hermaphroditic

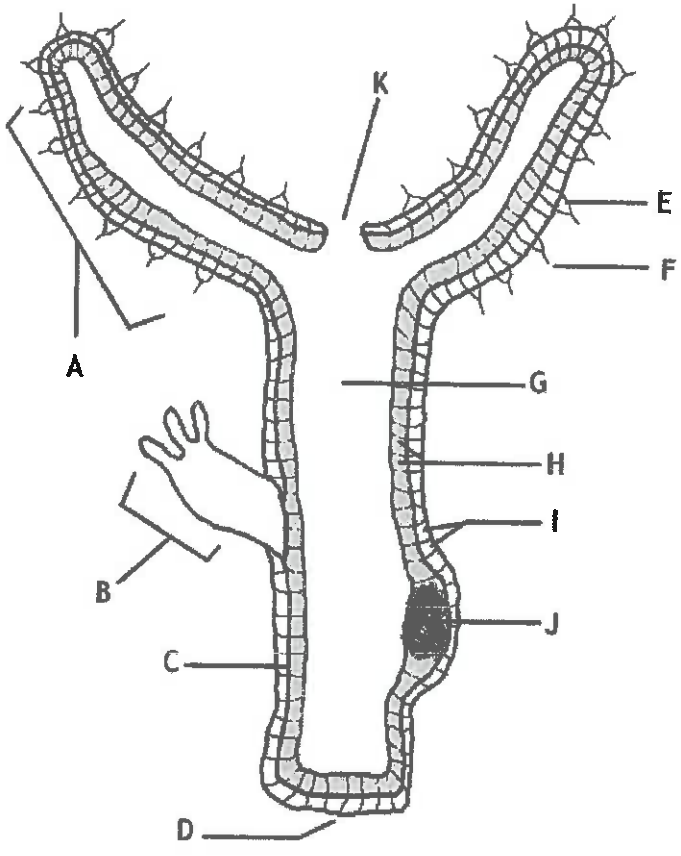
http://www.youtube.com/watch?v=ry9mWlcLOMw

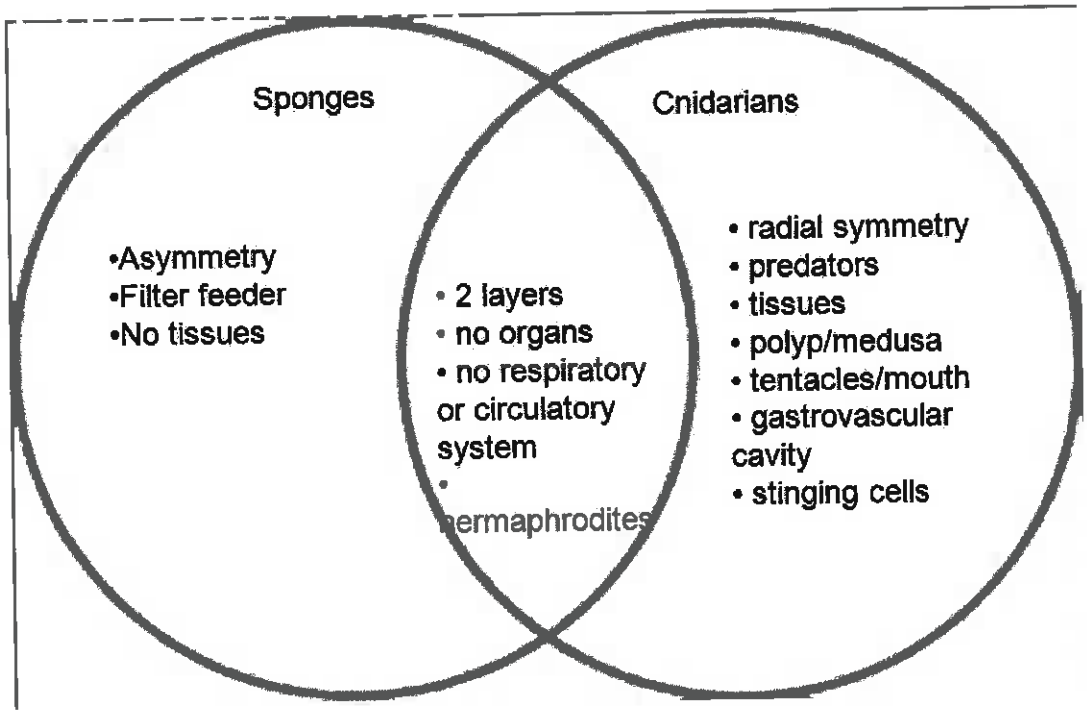
http://www.youtube.com/watch?v=sJn8vB5hBOQ

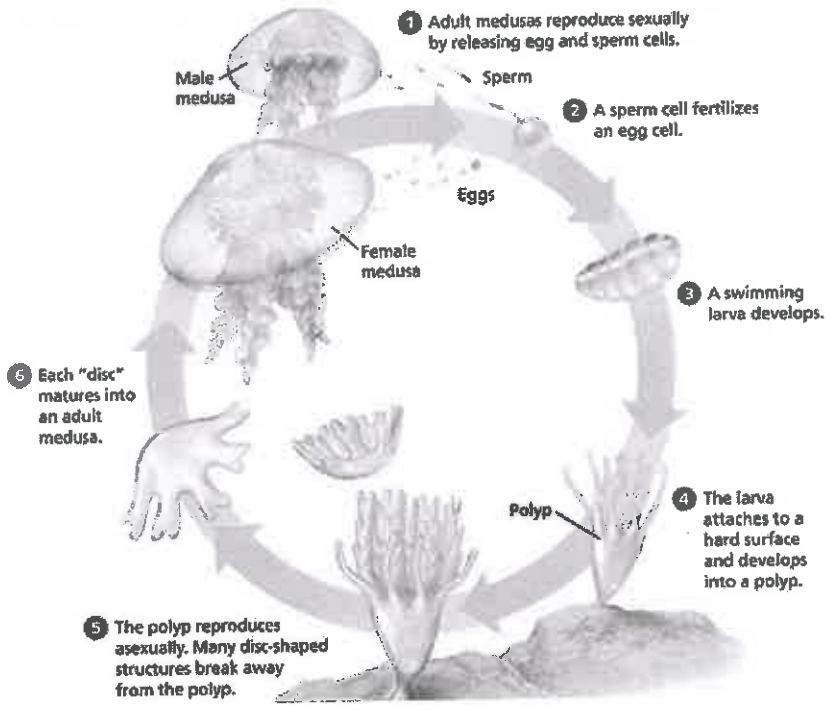
HYDRA ANATOMY

Label the diagram:

Gastrovascular cavity	Tentacle	Ectoderm
Endoderm	Mesoglea	Bud
Ovary/Teste	Nematocyst	Mouth/anus
Basal Disk		





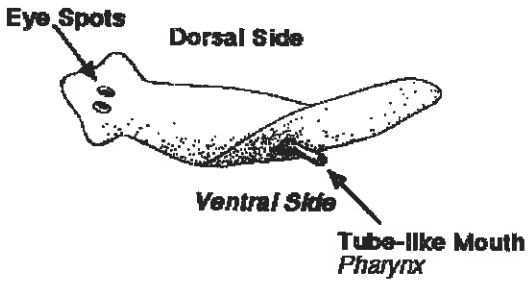


Cnidarians

The life cycle of a moon jelly has both a polyp and a medusa stage.

Phylum Platyhelminthes "Flatworms, Tapeworms, Flukes"

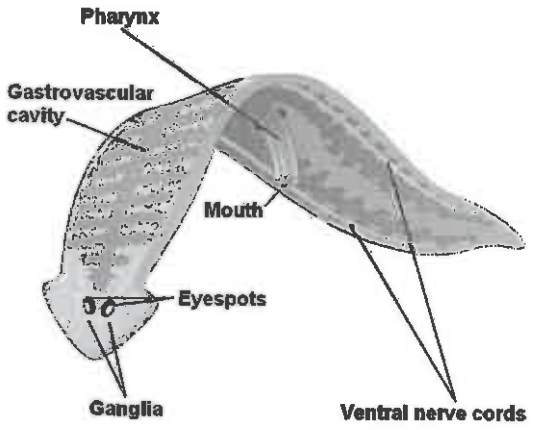
- General Characteristics
    1. Flattened body with definite anterior end
        = cephalization
    2. Organs are more specialized
        = division of labor
    3. Aquatic or terrestrial
    4. Free living or parasitic



-Bilateral symmetry

- Acoelomate body cavity with 3 germ layers (mesoderm)
    = triploblastic - development of organs

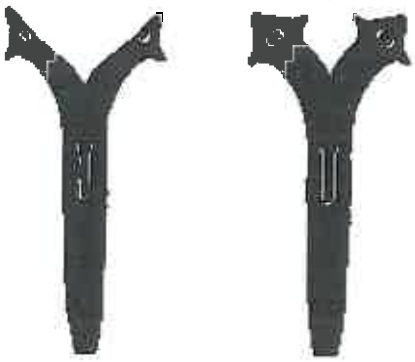
- Biological Systems
    1. Nervous system - primitive brain and dorsal nerve cords
    2. Digestive system - 1 opening
    3. Respiratory and circulatory = diffusion
- Reproduction
    1. Asexual
        = regeneration / fragmentation
    2. Sexual
        = hermaphroditic



- Members:

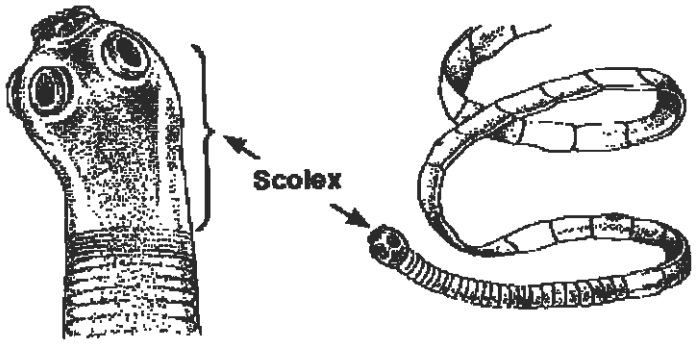
Planaria

- A freshwater, free living Platyhelminthes
- Lives on the under-side of rocks and such
- Feeds using a pharynx tube on its underside
- Uses eye spots to sense light & is photo phobic
- Planaria are noted for their great ability to regenerate missing body parts.

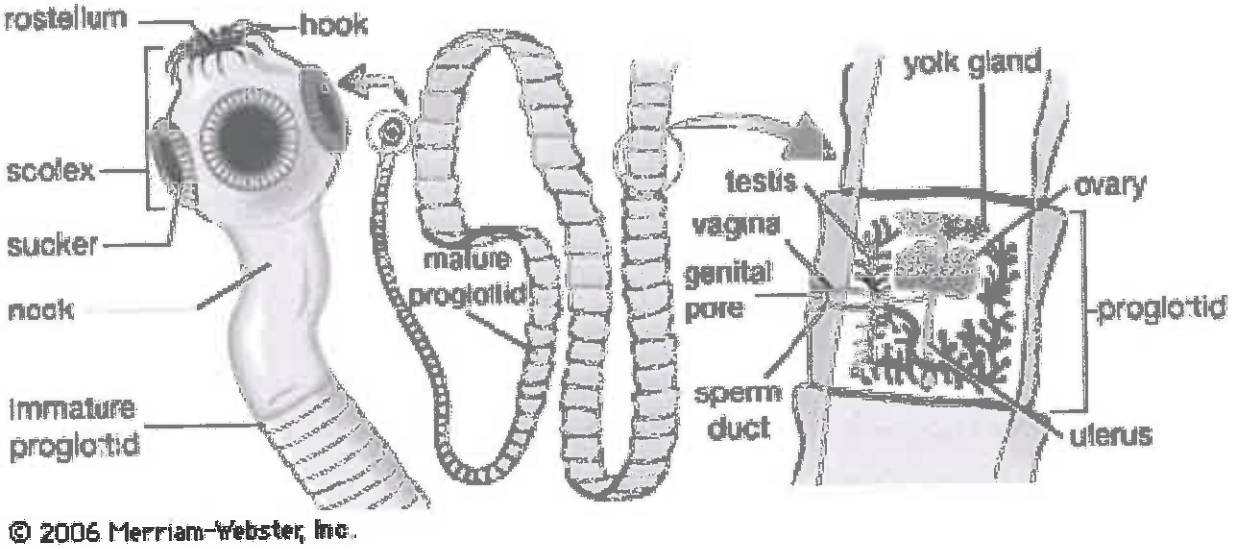


Tapeworms

- Parasitic flatworm.
- The tapeworm obtains food by absorbing it through its skin. The scolex is the part of the tapeworm which attaches to the inside of the intestine with hooks.



- The epidermis is replaced by a tough outer covering called a tegument that prevents the worm from being digested.
- Each flat section is called a proglotid containing reproductive organs with both male and female parts.

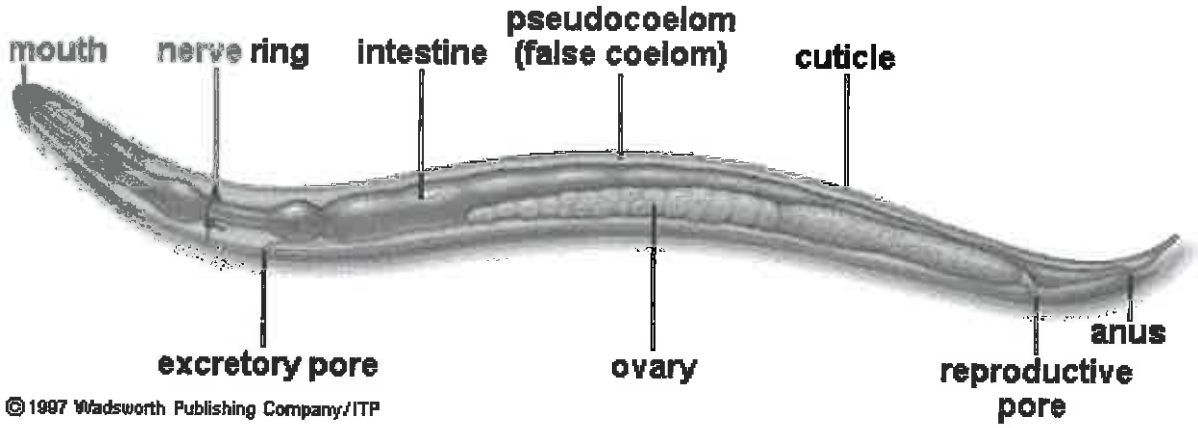


http://www.mcwdn.org/Animals/flatwormsvideos.html

Phylum Nematoda "Round Worms, Hook Worm"

- General Characteristics
  1. Long, cylindrical body with tapered ends = hydrostatic skeleton
  2. Aquatic or terrestrial
  3. Most free living, some parasitic
- Bilateral symmetry
- Pseudocoelomate body cavity
  = triploblastic with a "tube within a tube" body plan

-



Biological systems

1. Nervous system with primitive brain with both dorsal and ventral nerve cords
2. Digestive system is complete
   = has mouth and anus (continuous digestion)
3. Musculature system
   = fluid pressure and muscles allow for movement

- Reproduction
  Sexual with separate sexes, few are hermaphroditic

- **Adaptations of Internal Parasitic Worms (Platyhelminthes & Nematodes)**
  1. No circulatory or digestive systems (use their host`s)
  2. Advanced reproductive systems
  3. Epidermis replaced by a tegument which is a tough outer covering that protects them from being digested

http://www.mcwdn.org/Animals/roundwormsvideos.html

- Common Roundworm Infections:

- **Hookworm (ancylostomiasis)**: A hookworm infection occurs when larvae of the roundworms come into contact with human skin, through contaminated soil or feces. They penetrate the skin, making their way through the lungs to the small intestine, where they attach and mature into adults, laying more eggs. They feed off the blood of the infected person, which can lead to anemia. Children are particularly susceptible to this kind of infection.

- **Pinworm (enterobiasis)**: A pinworm infection occurs when person consumes food or drink contaminated with feces containing this roundworm. The eggs hatch in the small intestine, and adult worms ultimately live in the large intestine. The pregnant female worms migrate to the anus and deposit large numbers of eggs in the skin around that area. Pinworm, which is commonly spread in day care centers, schools, and camps, affects as many as 1/3 of all American children.

- **River blindness (onchocerciasis)**: River blindness is an infection of the eyes caused by the roundworm *Onchocerca volvulus*, which is spread by day-biting flies, is the leading cause of blindness worldwide. It affects about 20 million people, mostly in Africa.

- **Trichinosis (trichiniasis)**: Trichinosis is caused by the roundworm *Trichinella spiralis*. These larvae live in pigs and other wild carnivores, People can become infected when they eat such meat (particularly pork) that is undercooked. The larvae mature in the small intestine and migrate to muscle cells where they form cysts and can live for months or years.
https://docs.google.com/gview?url=http://www.cville.k12.in.us/cville/Portals/0/TMS/Users/sguard/Parasitic%2520Worms.ppt&chrome=true

Risk Factors:

The risk factors for roundworm infection include:

- Living in or visiting a warm, tropical climate
- Poor sanitation
- Poor personal hygiene
- Crowded conditions, such as day care or institutional settings
- Weakened immune system
- Malnutrition
- Eating undercooked meat
- Eating dirt or clay (children tend to become infected this way)
- Contact with animal feces
- Multiple insect bites

Treatment:

- It is easier to prevent roundworms than to cure them.
- Antiparasitic medications are the primary treatment for roundworm
- Surgical removal

"Mystery of the Sandbox Killing" Do Reading & Questions

1. When Roberta Hanson was first brought to the hospital, what symptoms did she display?

2. Roberta Hanson died of a brain abscess 1 year after she first got ill. What was the "biological bullet to the brain" that killed her?

3. Explain how Roberta became infected & how this parasite resulted in a brain abcess.

4. Who was responsible for Roberta Hanson's death?

5. The Hanson's decided to drop the charges against the hospital. Do you agree with their decision? Explain.

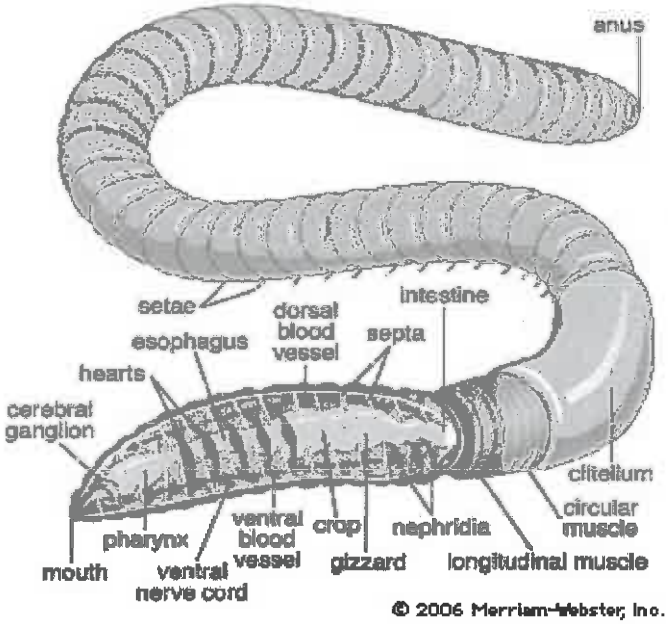
Phylum Annelida "Earthworm, Sandworm, Leech"

- General Characteristics
    1. Body = cylindrical and segmented
    2. Body organized on a system level = greater specialization
    3. Aquatic or terrestrial
    4. Most free living, some parasitic
- Bilateral symmetry
- True coelomate body cavity
    = peritoneal lining of the gut (mesentery lining which separates digestive tract from other systems in body cavity)

- Biological systems
    1. Nervous system
        - advanced = brain and sense organs
        - large ventral nerve cord with peripheral ganglia = nerves
    2. Complete digestive system with digestive organs:
        = mouth → pharynx → esophagus → crop → gizzard → intestine
    3. Excretory organ in each segment with pore to outside = nephridia
    4. Closed circulatory system = blood enclosed in tubes
        - blood flows through 2 large blood vessels pumped by 5 hearts
    5. Respiratory system = through the skin (moist)
    6. Hydrostatic Skeleton
    7. Musculature system = longitudinal and circular muscle
        - bristles (setae) on each segment allow it to "wiggle"

- Reproduction = Hermaphroditic
    : seminal vesicles - store sperm
    : seminal recepticals - store eggs
    : fertilized eggs stored in clitellum until it is shed

http://www.mcwdn.org/Animals/earthwormsvideos.html



Do Virtual Dissection & Hand In

Phylum Arthropoda "Insects, Crayfish, Spiders"

- General Characteristics
    1. Body has hard, crusty exoskeleton
        - replaced by "molting" as the organism grows
    2. Segmented body with segments fused into 3 regions: head, thorax, abdomen
        - a pair of jointed appendages per segment specialized for different functions
    3. Found in all habitats and modes of life.
    4. Most have metamorphosis (larval stage).
        Complete = egg → larvae → pupae → adult
        Incomplete = egg → nymph → adult
    5. Most diverse and successful phyla. (ratio of humans to arthropods = 1:1,000,000)
- Bilateral symmetry
- Coelomate body cavity
- Biological systems
    1. Nervous system with a large brain and 2 ventral nerve cords.
        - cephalization of sense organs
            {eyes (simple or compound), antennae, ears}
        -some communication (ants, bees)
    2. Digestive system is fully developed
    3. Excretory system with malpighian tubes for waste removal
    4. Open circulatory system
        (dorsal heart pumps blood through aorta which washes over organs)
    5. Respiratory system with gills or book lungs attached to appendages by spiracles
    6. Musculature system with muscles in sheets
- Sexual reproduction with separate sexes and internal fertilization in most (land)

SUCCESS OF ARTHROPODS

1. First true walkers
2. Adapted for all environments (land, water, air)
3. Exoskeleton provides protection and is replaced by molting
4. Metamorphosis
5. Some exhibit social behavior: ants = colonies
   bees = hives, hierarchy, communication

BENEFITS & HINDRANCES OF ARTHROPODS

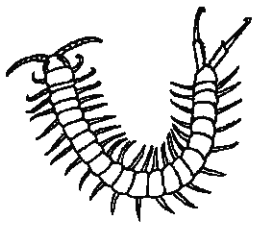
Beneficial	Harmful
1. Decomposers in food chain	1. Crop damage
2. Eat things harmful to humans	2. Vectors of disease
3. Production of materials (honey, silk)	3. Compete with humans for food
4. Pollinate plants	

http://www.mcwdn.org/Animals/Insect.html

5 MAJOR CLASSES OF ARTHROPODS

- major arthropod classes can be separated by comparing their number of body regions, legs, and antennae

1. Class Chilopoda "centipedes"

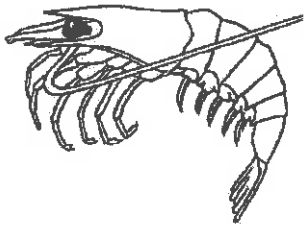


- 2 body regions: head & body segments with 1 pair of legs per segment
- 1 pair long antennae
- 1 pair simple eyes
- mouth parts are mandibles (used for biting & chewing food)
- gas exchange through trachea
- carnivores

2. Class Diplopoda "millipedes"

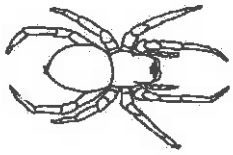
- 2 body regions: head & body segments with 2 pair of legs per segment
- 1 pair short antennae
- 1 pair simple eyes
- mouth parts are mandibles
- gas exchange through trachea
- decomposers

3. Class Crustacea "lobster, crab, shrimp, crayfish"



- 2 body regions: "cephalothorax" (fused head and thorax) & segmented abdomen with 5 pair of legs
- 2 pair of antennae
- 1 pair compound eyes
- mouth parts are mandibles
- gas exchange through gills
- aquatic organisms

4. Class Arachnida "spiders, ticks, mites, scorpions"



- 2 body regions: cephalothorax and abdomen with 4 pair of legs
- no antennae
- most have 4 pair of simple eyes
- mouth parts are mandibles and fangs called "chilicerae"
- gas exchange through "book lungs" (layers of lungs)

5. Class Insecta "mosquito, bee, fly, grasshopper, ant, beetle"

- most numerous animal (75% of all invertebrates)
- 3 body regions: head, throrax and abdomen with 3 pair of legs
- 1 pair of antennae and 2 pair of wings
- most have both simple and complex eyes
- mouth parts are mandibles
- gas exchange through trachea

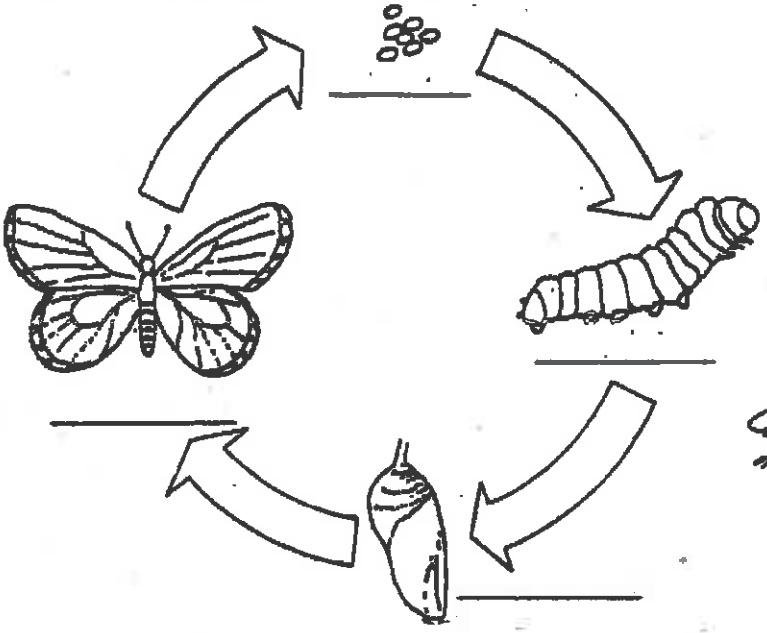
METAMORPHOSIS

As insects develop they undergo metamorphosis, a series of definite changes in appearance. Some insects, such as a butterfly, undergo complete metamorphosis. Other insects, such as the grasshopper, undergo incomplete metamorphosis.

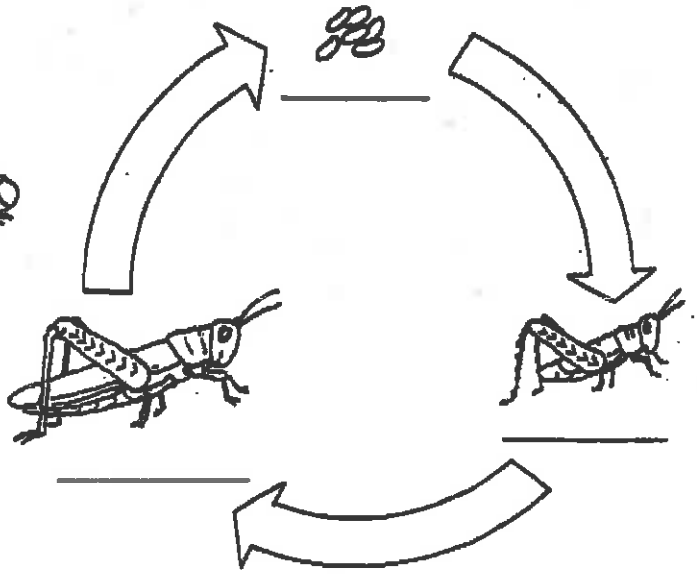
Label the four stages on the diagram of the complete metamorphosis of the butterfly at the left below.

Label the three stages on the diagram of the incomplete metamorphosis of the grasshopper at the right below.

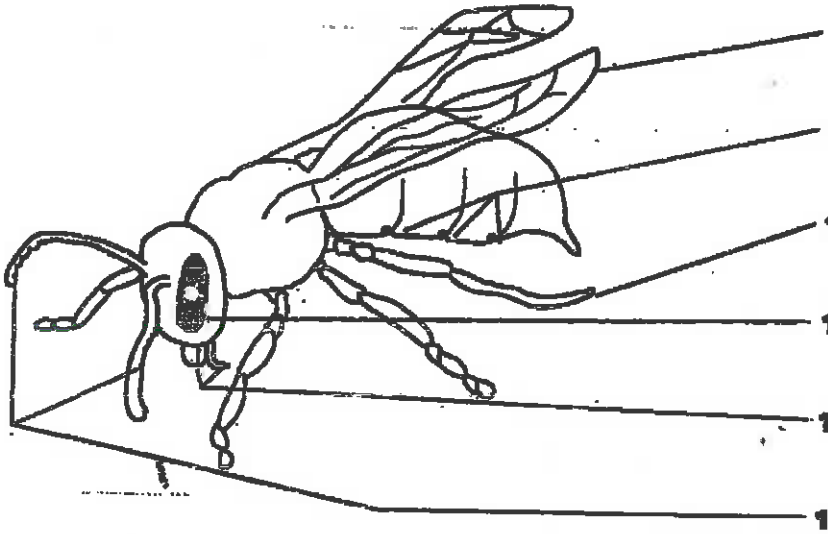
Complete Metamorphosis



Incomplete Metamorphosis



antennae **compound eye** **legs** **mandibles** **spiracles** **wings**



11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

Phylum Molluska "Clam, Snail, Squid, Octopus"

- General Characteristics
    1. Soft body with a mantle
        : secretes a calcium carbonate shell (internal or external)
    2. Free living
    3. Aquatic or terrestrial
    4. Body organized on system level
        = mantle houses the visceral mass containing the heart, gills, digestive, excretory and reproductive organs
    5. Muscular foot for movement
    6. Adult forms differ, but all have the same embryonic dev't & "trochophore larvae"
- have bilateral symmetry
- Coelomate body cavity
- Biological Systems = well developed
    1. Nervous system with brain, nerve cords, ganglia and sense organs
    2. Digestive system with stomach
    3. Excretory system = tubes called nephridia
    4. Open circulatory system for all except Cephalopods have closed circulation
    5. Respiratory system with gills
    6. Musculature system
- Reproduction
    = Sexual with separate sexes and external fertilization for most
        : some members are hermaphroditic

- Common Classes
    1. **Chitons** - Sea Cradles
        - shells divided into 8 overlapping plates
    2. **Gastropoda** - Snails
        - mantle cavity in front of animal
            = allows head to be drawn into mantle cavity for protection
    3. **Bivalvia** - Clams, Oysters, Scallops
        - filter feeders = use incurrent and excurrent siphons to take in water
        - shell divided into 2 valves
        - uses foot or siphons for movement
        - lack definite head region, but have a definite 'front end'
    4. **Cephalopoda** - Octopuses, Squids
        - well developed head with large eyes, sharp beak & a radula (tongue)
        - highly developed nervous system with a large complex brain,
        - muscular foot divided into 8 or 10 tentacles
        - excrete 'ink' for protection
        - have chromatophores which allow them to change color

        http://www.youtube.com/watch?v=9kuAiuXezIU

Do Squid Dissection + Hand In!

Squid Dissection Name: _____

The squid is one of the most highly developed invertebrates. It is in the phylum Mollusca, which is derived from the Latin word meaning "soft body". It belongs to the class Cephalopoda, meaning "head-footed", because its head is pushed down toward the foot. This class also includes the octopus, cuttlefish and ancient nautilus.

All mollusks have a soft body with a special covering called the mantle, which encloses all of the body organs such as heart, stomach and gills. Squid have a large mantle, arms and two longer tentacles all with suckers, a beak and mouth, a siphon, a large head (with a brain), two large eyes, and three hearts. Their large eyes are very similar in structure to people's eyes. The shell has been reduced to a chitinous pen that is embedded in the upper surface of the mantle.

The squid has adapted to life in the ocean. Squid breathe using gills. They move by squirting water from the mantle through the siphon, using a type of movement called jet propulsion. They can move both backward and forward just by changing the direction of the water flow through siphon. Its streamlined body and jet propulsion make the squid a fast, active predator.

This animal also has a very good defense mechanism. Chromatophores in the skin allow squid to change color to mimic their environment and hide from predators. When in danger, squid release a cloud of dark ink from their inc sac in order to confuse their attacker and allow the squid to escape.

These fast-moving carnivores catch prey with their feeding tentacles, then hold the prey with the arms and bite it into small pieces using a parrot-like beak. The esophagus runs through the brain, so the food must be in small pieces before swallowing. Squid feed on small crustaceans, fish, marine worms, and even their own kind!

Squid reproduce sexually by releasing eggs into the water. After mating, a female squid will produce 10-50 elongated egg strings, which contain hundreds of eggs in each string. In many species, the parents will soon die after leaving the spawning ground. The egg strings are attached to the ocean floor, are left to develop on their own, and hatch approximately ten days later.

Phylum Echinodermata "Starfish, Sand Dollar, Sea Urchin"

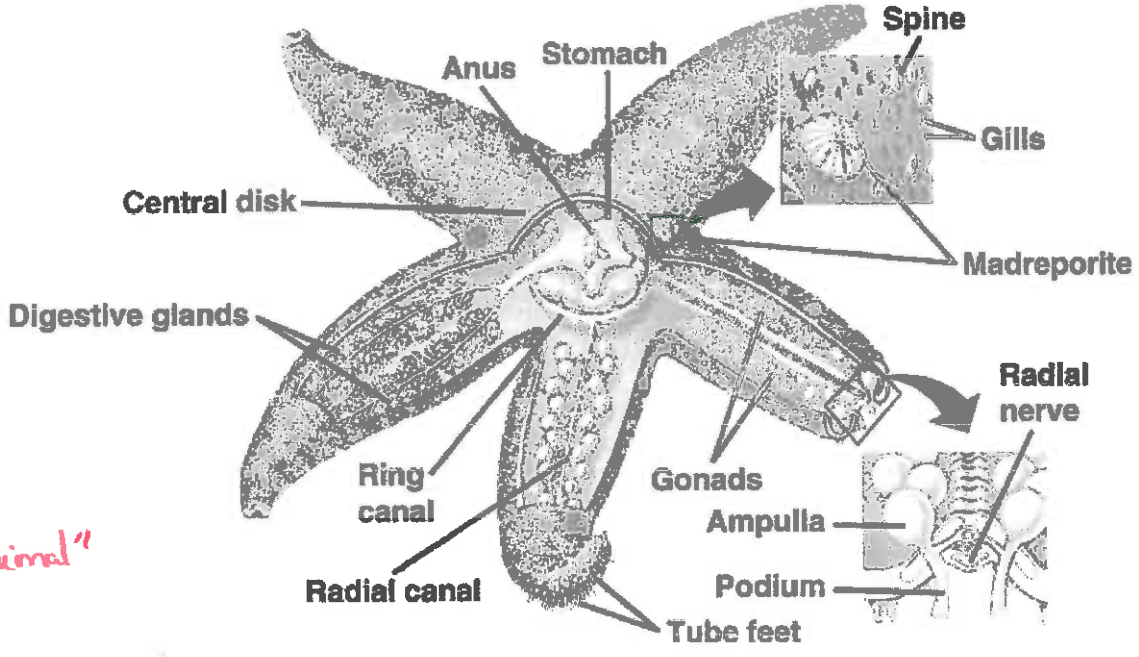
- General Characteristics
    1. Body has an endoskeleton with protecting spines on the outside.
    2. Free living and marine.
    3. Tubed feet
       :connected to radial canals which create hydrostatic pressure allowing movement
    4. Believed to have evolved from the same ancestor as chordates

- Radial symmetry in adults, but larval stage proves a bilateral ancestor
- Coelomate body cavity

- Biological systems
    1. Nervous system: nerve ring and ganglion, but no brain
       :1 eye spot on each arm
    2. One way digestive tube with 2 openings
       : mouth → stomach → digestive glands → anus
    3. Water-pumping system for movement and gathering food
       : madreporite → ring canal → radial canal → tube feet
    4. Excretory pores on ventral side
    5. Open circulatory system
    6. Respiration through gill-like structures

- Reproduction
    1. Asexual
       = regeneration
    2. Sexual
       = separate sexes with external fertilization

http://www.mcwdn.org/Animals/echinodermvideos.html



Do "What is an Animal" is Hand in

PHYLUM CHORDATA (5% Of Animal Kingdom)

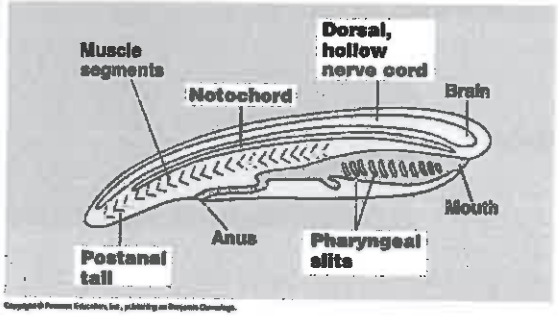
http://www.youtube.com/watch?v=kgZRZmEc9j4&list=TLXbDnnfuh8FRktl3xZSraD3DS6LLBCow4

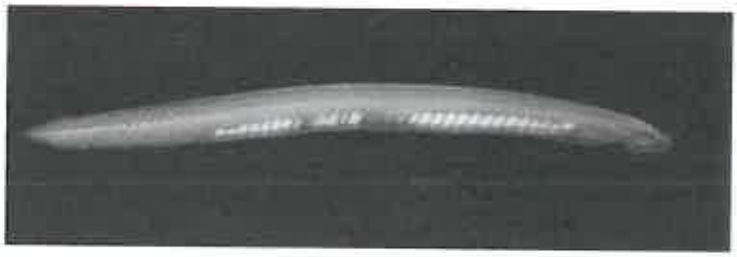
Characteristics of Chordates:

- Notochord = supportive, but flexible rod on dorsal side
- dorsal nerve chord
- bilateral symmetry
- coelomates
- pharyngeal (gill) slits at some point in lifetime
- post- anal tail

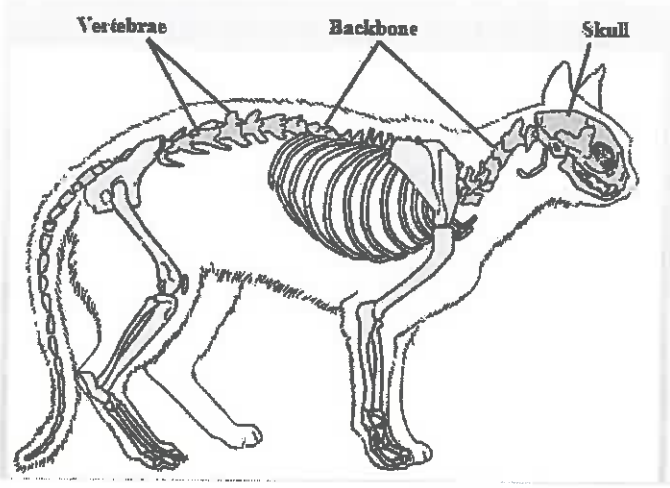
Chordates can be divided into 2 subphyla:

- **Invertebrate Chordates** = flexible notochord
  = transition between invertebrates and vertebrates





- **Vertebrate Chordates** = notochord made of bones called vertebrae



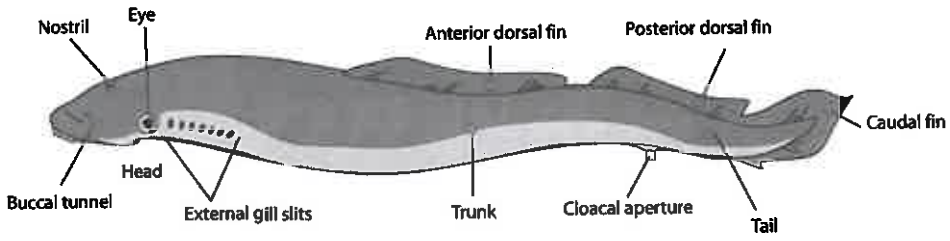
8 Characteristics of Vertebrates:

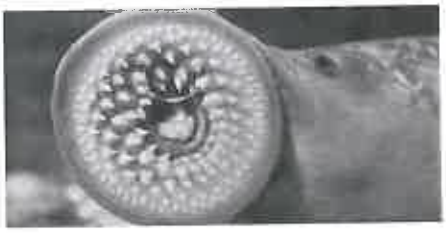
- a backbone of vertebrae (bone and cartilage) containing the dorsal nerve chord
- endoskeleton = living
- advanced nervous system (brain, nerve chord, ganglia, neurons)
- large brain (enlarged anterior end of nerve chord) which is protected by a skull
- complex heart and closed circulatory system
- epidermis specialized for their environment & habitat
- paired appendages specialized for movement
- a large coelom containing vital organs

Class Agnatha (lamprey, hagfish)

= jawless fish
- primitive skeleton composed of cartilage
- slimy skin = no scales
- no paired fins
- uncovered gill slits = must be moving for respiration to occur
- 2-chambered heart (1 atrium and 1 ventricle, so circulation is unidirectional)
- ectothermic = cold-blooded (body temperature varies with the environment)
- external fertilization and hatching of eggs

Lampreys of this class have caused damage to commercial fisheries because they are parasitic, feeding on the blood and body fluids of other fish like white fish, eventually killing the fish.

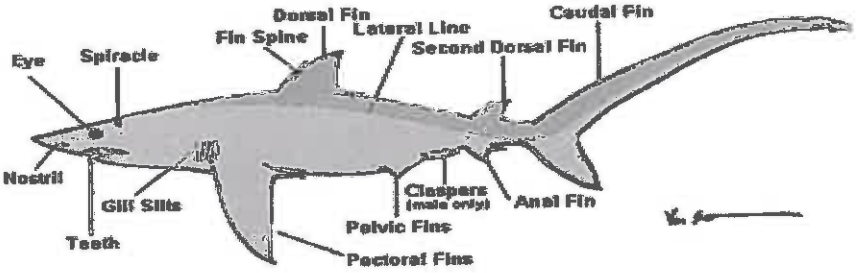




Class Chondrichthyes (sharks, rays, skates)

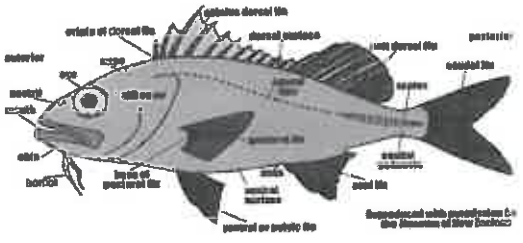
= cartilaginous fish
- in addition to the characteristics seen in Jawless fish, members of this class have:

skeleton & scales made of cartilage
: a biting jaw
: paired fins
: a lateral line allowing it to sense pressure changes of water currents

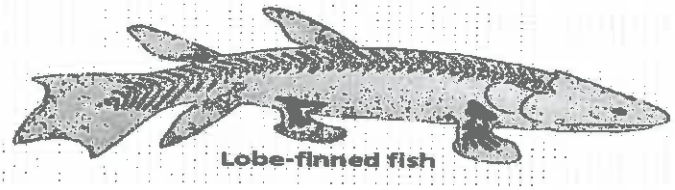


Class Osteichthyes (trout, northern pike)

= bony fish
- unlike other classes of fish, bony fish have:
  : a skeleton and scales composed of cartilage and bone
  : operculum (covered gills)
    = can remain stationary in water
  : a gas-filled swim bladder for buoyancy
- 2 major groups
  : ray finned
    = have flat fins
    - majority of fish



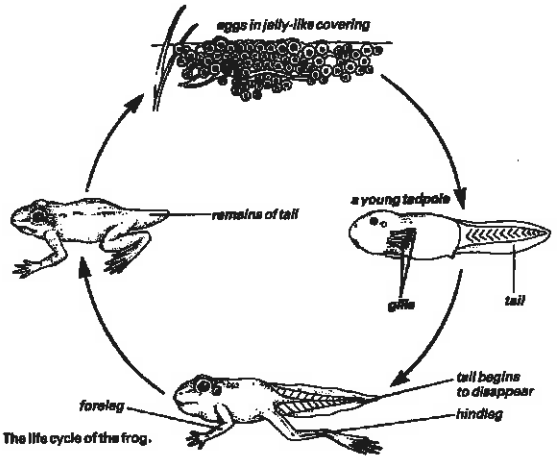
: lobe finned
= fleshy fins that move in an alternating manner



Lobe finned fish are believed to be the evolutionary link to amphibians and therefore all terrestrial vertebrates.

Class Amphibia (salamander, frog)

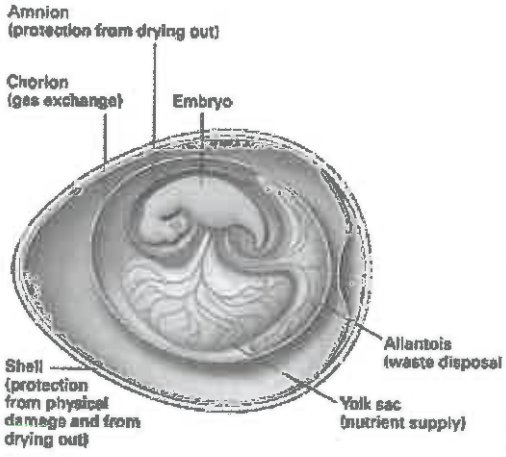
= live double lives
- external fertilization and hatching of eggs in water;
- the larvae undergoes metamorphosis
- have gills as aquatic larvae; lungs as adult
- have 2 pair of limbs suitable for land (adult)
- slimy, moist skin aids in respiration on land
- 3-chambered heart (2 atria and 1 ventricle)
- ectothermic

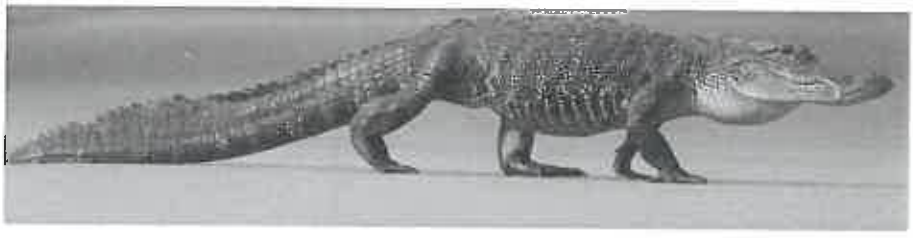


Amphibians represent the transition from water to land because they have 2 lives
= are adapted for both aquatic and terrestrial life.

Class Reptilia (snake, turtle, crocodile)

- have adaptations to be completely terrestrial:
  : dry, scaly skin to prevent water loss
  : limbs beneath body & claws to enhance land movement
  : the 3-chambered heart has a septum allowing more efficient circulation
  : amniotic egg (encased in hard shell)
    - developed from internal fertilization & laid on land
    - protects the embryo from drying out while providing nutrients and oxygen



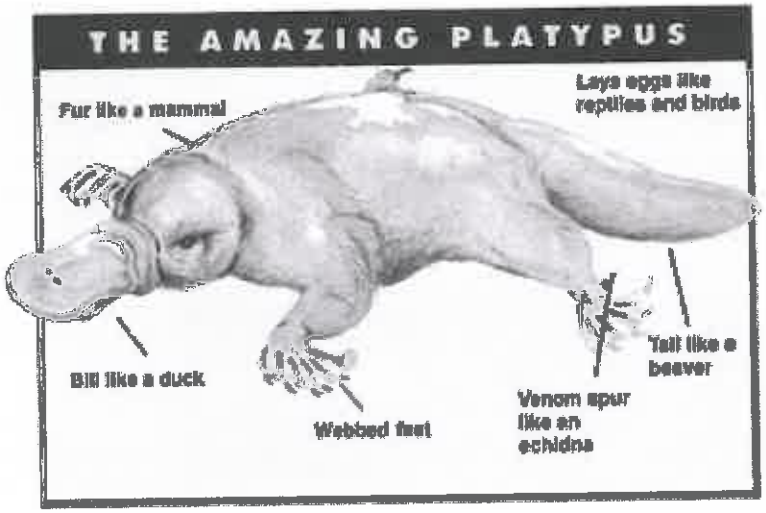


Class Aves (chicken, robin, goose)

- have retained the following reptilian characteristics
  - : thick bones
  - : teeth and claws
  - : long bony tail
  - : scales (most modified to feathers)
  - : amniote egg
  - : lungs
- adaptations which have allowed birds to fly:
  - : feathers = insulation, protection and flight
  - : modified forlimb = wings for flight
  - : porous & reduction of internal organs = lighter
  - : enlarged sternum (breastbone) = muscle attachment
  - : complete 4 chambered heart = quicker circulation
  - : air sacs attached to lungs = continuous oxygen supply
  - : endothermic (warm-blooded) = constant body temperature

Class Mammalia (dog, elephant, human)

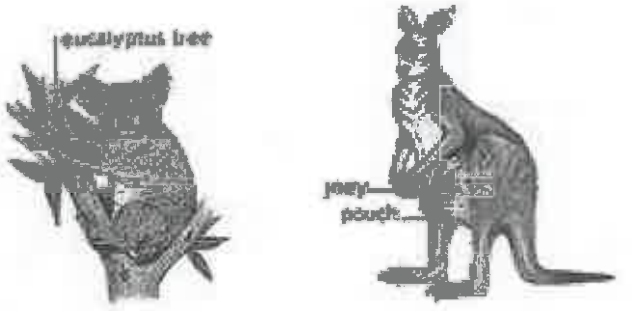
- characterized by the evolution of:
  - : skin covered in hair or fur
  - : internal fertilization and embryo development
  - : mammary glands (produce milk for feeding young)
  - : sweat glands to regulate body temperature (endotherms)
  - : 2 pair of appendages adapted to habitat (walking, climbing, flying, swimming)
  - : well developed brain with capacity to learn
- Mammals are placed in 3 groups:
  - a) Monotremes (platypus)
    - : external hatching of amniote egg



b) Marsupials (kangaroo, koala)

: bear partially developed young which require further development

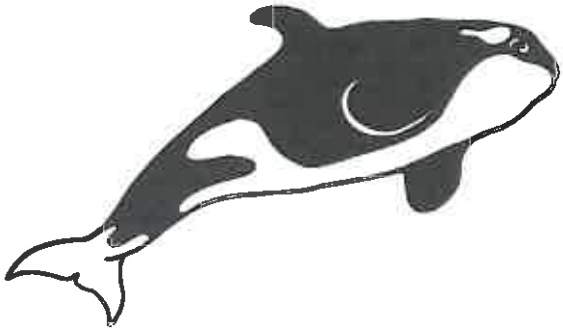
: the offspring develops in the mother's pouch



c) Placentals (bat, dog, human)

: produce a placenta connecting the mother to the unborn embryo

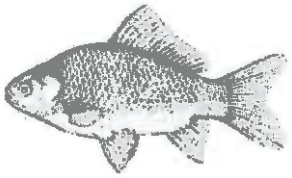
: the placenta provides nutrients and oxygen while removing wastes until the embryo develops into a miniature adult in a placental sac (uterus)

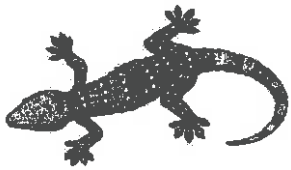
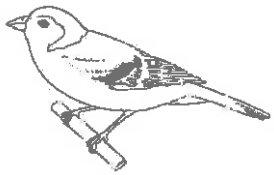


**NOTE: No monotremes or marsupials are native to Saskatchewan

Use notes to complete the table.

COMPARING CLASSES OF CHORDATES

CLASS	CHARACTERISTICS	EXAMPLE
Agnatha Aka. Jawless Fish (lamprey, hagfish)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	
Chondrichthyes Aka. Cartilaginous Fish (shark, skate, ray)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	
Osteichthyes Aka. Bony Fish (perch, pike, trout)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	
Amphibia "Double Lives" (frog, salamander)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	

Reptilia (turtle, lizard, snake)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	
Aves Aka. Birds (robin, penguin, hawk)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	
Mammalia (bat, whale, dog, human)	Skeleton: Outer Cover: Temp. Control: Circulation: Limb structure: Respiration: Reproduction:	

① Do Frog Dissection + Hand In
② Do Vertebrate In class

BIOLOGY 20 REVIEW
THE ANIMAL KINGDOM: CHAPTER 20

Invertebrate

Phylum	Example	Characteristics
Arthropoda		(5)
Cnidaria	Jellyfish	(3)
Nematoda		(3)
Annelida		(3)
	Tapeworm Planaria	(3)
Mollusca		(4)
Echinodermata		(4)
Porifera		(3)

2. Define or explain each of the following and give an example of the invertebrate phylum that exhibits that characteristic.
   a. hermaphrodite
   b. regeneration
   c. segmentation
   d. radial symmetry
   e. endoskeleton
3. List three adaptations the parasitic platyhelminthes have made in order to live a parasitic life. Explain why each adaptation helps the platyhelminthes to be a parasite.
4. What are the advantages and disadvantages of having an exoskeleton?
5. What are 2 reasons that cephalopods (octopus and squid) are the most advanced molluscs.
6. Define the following terms:
   a. sessile
   b. metamorphosis
   c. nematocyst
   d. nephridia
   e. malpighian tubules
   f. zoology
   g. coelom
   h. parasite
   i. trochophore larva
   j. invertebrate
   k. tegument
7. What are the advantages of having the following:
   a. closed circulatory system
   b. cephalization
   c. two opening digestive system
8. Give 3 reasons as to the success of arthropods.

9. What 4 characteristics are common to all chordates?

10. List 8 characteristics used to group organisms into the subphylum Vertebrata?

11. For each vertebrate class know: distinguishing characteristics, biological systems, method of reproduction and representative members.

12. Explain why each of the following characteristics would prove to be an evolutionary advantage:
    a. 4 chambered heart
    b. internal fertilization and development
    c. presence of an endoskeleton

13. List 3 adaptations that have allowed birds to fly.

It was an open-and-shut case. Or was it?

Mystery of the Sandbox Killing

Condensed from "M.D."
B. H. KEAN, M.D. WITH TRACY DAHLBY

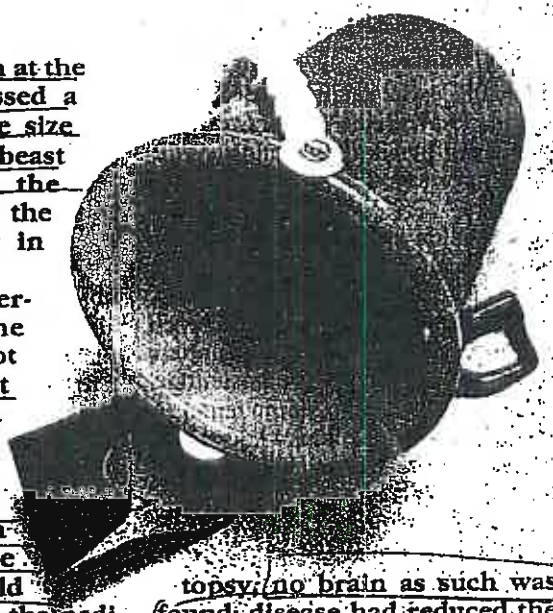
ON THE morning of August 9, 1981, Brenda Hansen, holding her three-year-old daughter, Roberta, rushed into the emergency room of Lee Memorial Hospital in Dowagiac, Mich., a small farming community 25 miles southwest of Kalamazoo. For the past week or so Roberta had become progressively sicker. Her fever, slight at the beginning, had crept steadily higher. She was lethargic and irritable most of the time and had been vomiting periodically.

The doctor on duty thought Roberta was probably suffering from any of a number of routine childhood diseases – viral infection, earache, a mild case of pneumonia, or a communicable disease such as chicken pox in which the rash had been overlooked. He recommended that she be hospitalized and kept under observation until the symptoms sorted themselves into a clearer pattern.

Ten days later the doctors at Lee Memorial were no closer to a definitive diagnosis. They seemed to be doing something right, though; they had treated Roberta for an undetermined infection with an antibiotic, and her fever disappeared. She began eating regular meals again. On August 18 they sent her home with her mother.

Three days later Roberta was back in the emergency room, this time at a larger hospital, the Borgess Medical Centre in Kalamazoo. She complained of muscle aches and soreness in her joints. The examining physician, a young resident, noticed that her heartbeat was rapid and irregular.

Then a new fact emerged. While in the bathroom at the hospital, Roberta passed a roundworm about the size of a lead pencil – a beast not uncommon to the bowels of children in the South, though rarer in Michigan.



Perplexed by Roberta's symptoms, the doctor concluded, not unreasonably, that she suffered from a common worm infection of the intestinal tract. Brenda Hansen was handed a prescription for the standard drug and told to bring Roberta into the pediatric clinic in a few days for a follow-up examination.

Five days later Hansen entered the Bronson Methodist Hospital, also in Kalamazoo, in a state of panic. Roberta was drifting between consciousness and coma as she gasped for air. Every few minutes her body shuddered with a minor convulsion. A CAT scan revealed a huge brain abscess.

Roberta was operated on immediately. Complications required a second operation, then a third.

Now deep in a coma, Roberta was kept on a respirator for the next ten months. Finally, on August 3, 1982, she died, a full agonizing year after the onset of her symptoms. At autopsy, no brain as such was found; disease had reduced the organ to a gelatinous mass.

Roberta's parents sued the three hospitals and the attending doctors for $50 million. They charged that the doctors had repeatedly misdiagnosed and mistreated the little girl's illness and were ultimately responsible for her death.

The press dramatized the image of a young mother shuttling from one hospital to another, unheeded and intimidated, in the fruitless attempt to save her child's life. Expert medical witnesses portrayed a case of coldhearted incompetence. The parents, their neighbours – and a firm of high-powered attorneys – had absolutely no doubts about who had killed Roberta.

The family's names have been changed to protect their privacy.

Emotionally, the response was perfectly understandable. But was it justified? Were the doctors really to blame for her death? Could they indeed have saved her?

I BECAME involved in the case when an attorney named Richard Baxter phoned me. I was a clinical professor in tropical medicine at Cornell University Medical College in New York and an expert in parasitology. He represented the defendants. A former student of mine, who was familiar with the case, thought I might be able to help.

Since I was no specialist in brain abscesses, I wondered why my former student had recommended me.

"Well, there's a parasite involved," Baxter said. "He thought this might have a bearing on the case."

I was hooked! Boxes containing medical records, pre-trial testimony and the written opinions of various experts soon arrived at my office. My secretary cancelled all appointments for the next three days.

The first thing that caught my eye was the testimony of two leading experts on infectious diseases of the brain. Each man argued persuasively that early, accurate diagnosis and swift treatment would have saved the child's life. I knew both men personally and respected their knowledge and honesty. Only a fool would try to contradict their conclusions.

Unmistakable Odour. But as I read on, it became increasingly clear that everybody had overlooked the key medical clues. As a result, several young doctors were about to have their careers needlessly ruined and three hospitals would be plunged into financial hot water.

I leaned back while I tried to piece things together. What I needed was a common denominator, a starting point. That was obviously the brain abscess.

One of the most common causes of brain abscess in children is the spread of a chronic middle-ear infection. Doctors at two hospitals had found no evidence of that. Nonetheless, Roberta had responded favourably to the antibiotic, a standard remedy for middle-ear infection.

Hoping to find out why, the first surgeon had removed large amounts of infected fluid from Roberta's brain and turned it over to a bacteriologist. Two of the seven organisms identified could indeed be linked to an infection of the ear or the upper respiratory tract.

The other five types of bacteria were all essentially "good" organisms that help digest food in the intestinal tract. In the brain, however, they were a long, long way from home – and highly toxic. How did they get there?

I recalled something noted in the surgical report – the faint but unmistakable odour of fecal matter in the normally odourless environment of the brain.

Voilà! I had all the major clues I needed to solve the "killing" of Roberta Hansen. I spent another week impatiently gathering corroborating evidence, then phoned Baxter.

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"I've solved the case," I said, "but I can't travel to Michigan."

"That's okay," said Baxter. "Michigan will come to you."

Shortly after, eight lawyers appeared at my office to record my testimony. The Hansens' attorneys appeared comfortable in the knowledge that the high-megaton yield of their own expert testimony would easily flatten whatever feeble arguments I was about to muster.

"Have you reached a conclusion about the cause of death, Dr. Kean?" Baxter asked.

"I have."

"And is your conclusion in harmony with the opinions of the medical experts who have previously testified on behalf of the plaintiffs?"

"No, it is not."

"What then, in your opinion, Dr. Kean, caused Roberta's death?"

"Involuntary manslaughter," I declared.

Surprised, Baxter managed to ask, "Involuntary manslaughter by whom?"

"Roberta's three-year-old cousin," I replied. "But 'manslaughter' may not be appropriate in this case." The lawyers sat in stunned silence.

"Please explain," said Baxter.

Wrong Turn. "Roberta Hansen," I began, "was killed by a biological bullet to the brain." I pointed to the first important clue: the seven organisms discovered in the brain abscess, five of which – normal inhabitants of the intestinal tract – had no business being inside the skull. Bacteria coming all the way from the remote, unsanitary bowel had been responsible for Roberta's roaring infection. The fecal matter smelled by the surgeon was further proof of their presence in the brain. So how did they get there?

"The biological bullet," I said, "was a parasite called *Ascaris lumbricoides*, the roundworm." I looked around the small, impromptu courtroom and counted eight pairs of knitted brows.

I explained that *A. lumbricoides* had been vastly underestimated by the medical experts in the case. Roberta had passed roundworms several times. For the most part, however, they were considered unrelated to Roberta's more baffling, more serious symptoms. The worm got lost in the shuffle.

In the vast majority of cases involving humans, the roundworm is a fairly benign character. The patient becomes infected by swallowing eggs that have been deposited via another person's feces, usually in the soil (poorly washed raw vegetables, especially lettuce, are common transmitters of the infection). Usually the worm larvae travel to the liver and lungs, on to the epiglottis near the larynx and back down the esophagus.

"But sometimes the larvae make a wrong turn," I continued. "Instead of arriving back where they started – in the gut – they lose their way and wind up in exile in some remote organ, even the brain, carrying many harmful bacteria from the bowel. The host organ reacts by forming

first an abscess and then a cyst around the invaders.

"Occasionally the immune system fails to fight off the infection. The abscess, instead of shrinking, gets bigger and bigger. The brain is a particularly poor resister.

"In the case of Roberta," I continued, "one or more of these maverick larvae entered her brain. Roberta died of a tropical disease in northern Michigan."

One of the Hansens' lawyers blurted out: "But what about the cousin? You said the cousin was guilty of manslaughter."

I explained: "Roundworms do exist in Michigan, though rarely. The disease is much more common in the South. Roberta had never travelled outside Michigan, so the disease must have come to her. But how?

"We know that Roberta must have become infected sometime in May 1981. It would have taken that long for the roundworm wriggler to hatch, work its way to the brain and produce that severe infection Roberta had exhibited when she appeared at the first emergency room in early August.

"Mrs. Hansen reported," I went on, "that in the fall of 1980 her sister came to visit from North Carolina, accompanied by her three-year-old son, who had a history of roundworm infection. For several days Roberta and her cousin played in a sandbox in the backyard.

"We can never be entirely sure," I said, "but my guess is that Roberta's cousin, in the informal toilet habits of young children, deposited the eggs in the sandbox during one of the play sessions. The eggs have a hard coating that allows them to withstand vast swings in temperature – even a Michigan winter. So there the eggs remained, buried in the sand, under several feet of snow.

"Come spring, Roberta played in the sandbox again. The eggs were lying in wait, and Roberta managed to infect herself. Her cousin was the accomplice."

The Hansen men had lost their earlier shine.

"Are you saying, Dr. Kean," Baxter interrupted, "that no matter what might have been done for the child, she would have died?"

"That's precisely right," I replied. "Up against that agglomeration of organisms, no antibiotic regimen could have been successful. The child was doomed before she set foot in the first emergency room."

The following day the Hansens dropped their suit. The hospitals agreed to help defray the Hansens' medical bills. In return, the doctors were cleared of all charges.

It had taken a lifetime of experience – and luck – to solve this unusual case. The satisfaction was outweighed, however, by the sadness I felt over the death of young Roberta.

He who reads is never alone. – Helder Simone

Laughter, the Best Medicine

A MAN aproaches the Gate of Heaven and asks to be let in. "Tell me one good thing you did in your life," Saint Peter says to him.

"Well," replies the fellow, "I saw a group of punks harassing an elderly woman, so I kicked their leader in the shins."

"When did this happen?"

"About 40 seconds ago!"

– Contributed by Michael S. Coffey

OVERHEARD: "My neighbour's dog is taking the advanced course at obedience school. He knows how to fetch, heel and beg – now he's learning to fax." – Jay Trachman in *One to One*

A FARMER sitting on his porch noticed a highway-department truck pull over on the road's shoulder. A man got out, dug a sizable hole in the ditch and got back in the vehicle.

A few minutes later, the other occupant of the truck got out, filled up the hole, tamped the dirt and got back in the truck.

Then they drove forward on the shoulder about 20 metres and repeated the process – digging, waiting, re-[illegible]ng.

After a half dozen repetitions, the farmer sauntered over to the workers. "What're you doin'?" he asked.

"We're on a highway beautification project," the driver said. "And the guy who plants the trees is home sick today." – Contributed by Larry Lotzer

A COUPLE went for their yearly check-ups. The doctor saw the man first and asked him how he'd been feeling. "I have one problem, Doc," he answered. "The first time my wife and I make love, everything is fine, but the second time I sweat a lot."

The doctor completed the physical and then examined the wife. "Your husband says the first time you make love is perfect, but that he perspires the second time. Do you know why?"

"Of course I do!" she exclaimed. "The first time is in December, and the second time is in August!"

– Quoted on "The Ken and Barkley Show," KABC, Los Angeles

SHELLEY, a talent scout for a large recording studio, was walking by a convent when he heard someone singing in a voice so beautiful he couldn't belie[illegible] his ears. He rang the bell and asked