

Cnidaria



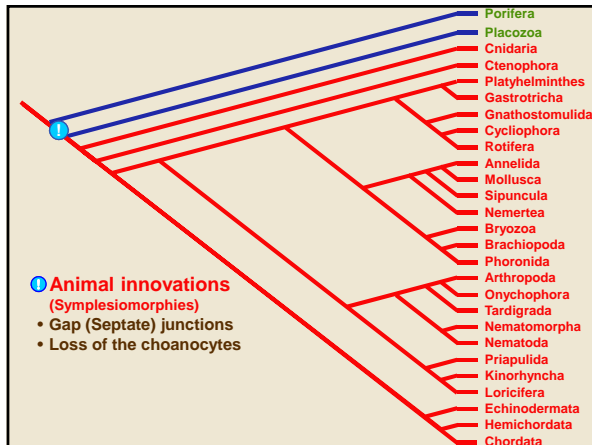
Cnidaria

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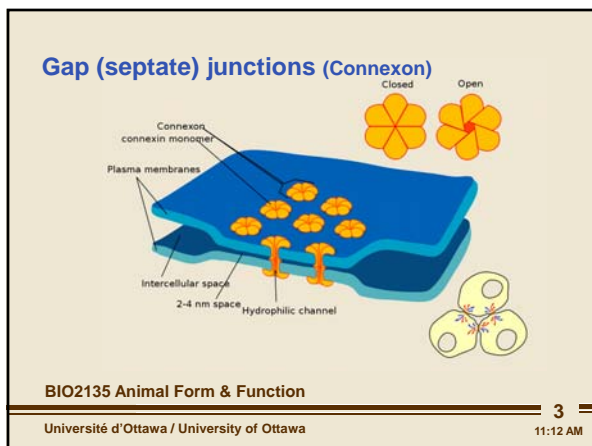
-known mostly as jellyfish/sea anemone/ corals



-now get gap (vertebrates)/septate (invertebrates) junctions appearing
-and lose choanocytes

-the microtubular architecture that is in the microvilli fingers of the collar - identical to the microvilli on the absorptive surfaces of all the animals to come

-they way they are put together to make a microvilli is the same on intestines etc
-why we know choanocytes are ancestral cell to all animals

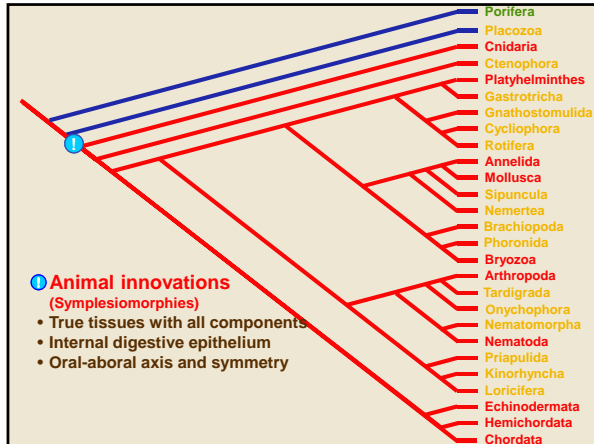


-organisms that just get septate junctions - very important channel between cells

-connexon compounds can open and close- regulates communication between cells

-major innovation

Cnidaria



-group that just has this feature

-true tissues occur- and there is full cell to cell connection
-hemidesmosomes - sit at the basement membrane

-step to cnidarians- animals with true tissues - 2 step process

-first get septate junctions

-second get the rest of the cell junctions plus the basement membrane

-placozoa that is the intermediate group

-cnidarians have true tissues in play

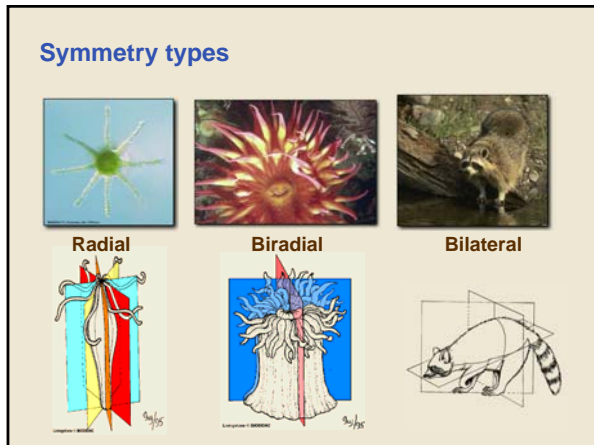
-now that we have tissue, now get an outer epithelial layer - invaginates and internalizes - now have an inner epithelial layer

-inner is associated with digestion - endoderm

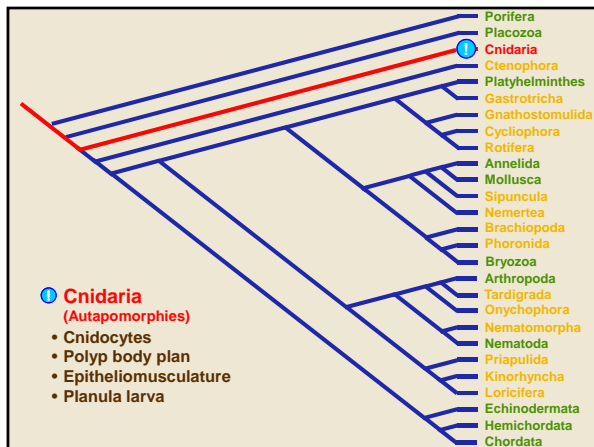
-now have organisms that has an outer (for protective surface/covering) and inner (connected to the outside by a mouth/ oral opening [where food will be ingested and then broken down]) epithelial layer

-results in oral-aboral symmetry

-will be a sympheseiomorphy from ancient past



-now have diploblastic organisms, have a mouth, some form of symmetry



-cnidaria are all predator in terms of how they feed

-the autoapomorphies that are added on - cnidocytes (cell that is used to sting and capture their prey)

-polyp - sac like organism with tentacles surrounding an oral opening

-able to move to capture prey by moving its tentacles

-doesn't have mesoderm - end up seeing a specialized cell (epithelial muscular cell) works as an epithelium that has muscle stands in it


-like vorticella- spring organism

-since it is associated with the epithelium- they are going to be on the outside and the inside

-has a unique larval stage - planula

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Cnidarian diversity



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-jellyfish -has typical radial symmetry that is in organisms that drift in the world
-doesn't have oriented movement - typical of radial symmetry organism
-can be big

Cnidarian diversity



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-can also be very small - small little polyps that are connected together in colonies
- colonies produce a variety of toxins and poisons - brightly coloured to ward off predators
-interconnected- get polyps that help other polyps -ie feeding

Cnidarian diversity



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-most important are the corals -represent minute colonial polyps that secrete calcareous shells/casings in which they live and hide
-pops out to feed and retracts back in - as it grows the casing underneath it grows - end up with large coral reefs
-in shallow sunny waters- highly productive

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Cnidarian diversity

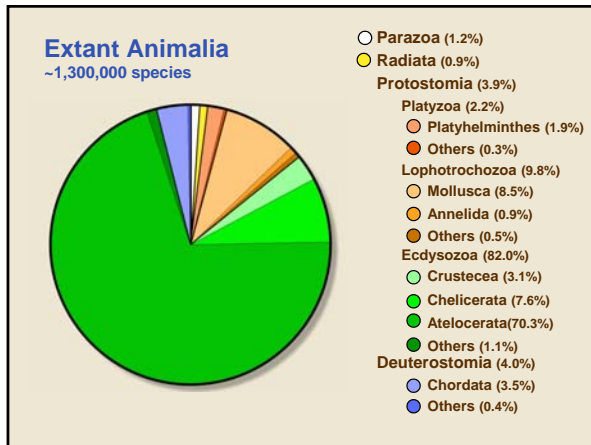


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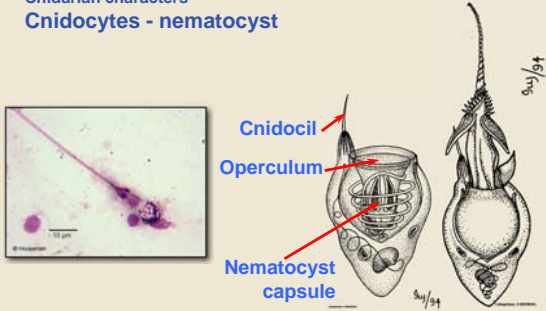
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-sea anemone - large polyp form



-radiata phyla- small number because bilateral symmetry is coming - becomes the dominate structure

Cnidarian characters
Cnidocytes - nematocyst



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(this is an autoapomorphy in cnidocysts)**

- known for their cnidocytes - specialized discharge cell
 - discharges an organelle called nematocyst (prey capture and retrieval mechanism) -ex. taser
 - as it develops, they both grow together
 - nemaocyst consists of a spring that builds up tension as it gets bigger
 - only springs in certain conditions which are noticed by the cnidocil
 - cnidocil is the trigger - detect chemical qualities that forces the lid (operculum) to pop off - and the force that was built up - shoots out the nematocyst
 - at distal end it is barbed with poison/toxins that cause inflammation- with force it will penetrate the protective layer/outer skin of the organism -reaching deep inside the tissues
 - hunt small organism - so toxins are enough to paralyze them
 - once immobilizes -organisms is still attached (normally on tentacles)- it brings it to its mouth by bending the tentacle to oral opening
 - if not toxins can be glue- just stick to smaller organism
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Polyp body wall

Epidermis
Mesoglea
Gastrodermis
Gastrovascular cavity

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- polyp body plan - an animal with an oral opening, no anus and a gut
- jelly like matrix - mesoglea - between tissues of cells (mesohyl - between walls of cells)
 - layer between outer ectoderm and inner endoderm
- gastrodermis- inner surface of the cell of the endoderm that line the gastrovascular cavity
- on the outside have the epidermis
- movement can be localized

Body wall

Gastrovascular cavity
Gastrodermis
Mesoglea
Epidermis

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- look at it in section
 - can see the thin layer of mesoglea
 - cells on the inside have many vacuoles that are important for secreting digestive enzymes
- into the gastrovascular cavity - has glandular and absorptive cells
 - on the outside epidermous - see densely packed cells - give outer protective surface - where cnidocytes would be found

Hydrostatic skeleton (Polyp)

Epitheliomuscular cells (longitudinal)
Nutritive muscular cells (Circular)
Gastrovascular cavity

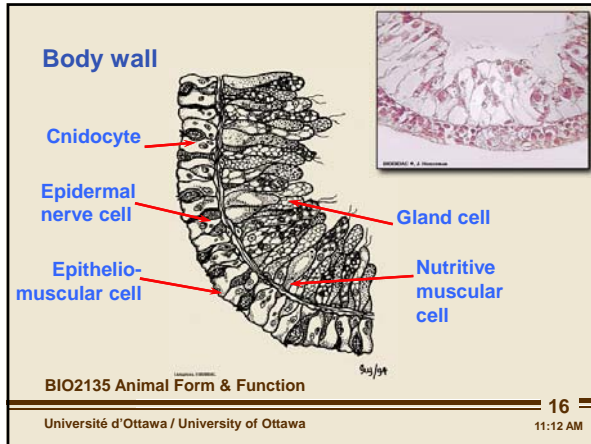
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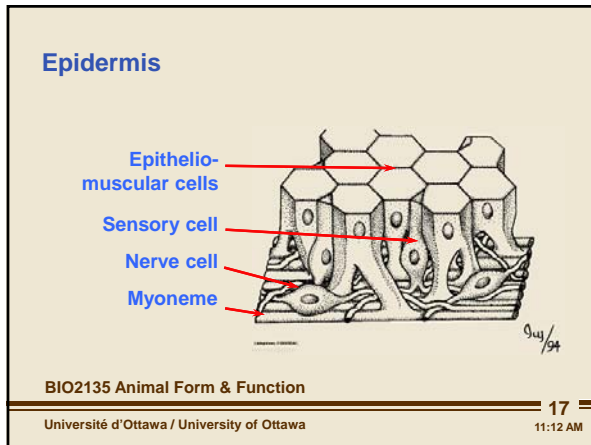
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- have special names for the epithelial layers
 - inside - nutritive muscular cells - circular
 - outside - epitheliomuscular cells - longitudinal
- now have first skeleton
 - role of a skeleton - return muscle to its original length
- ***muscles can use biochemical energy to contract/shorten but need to be stretched back - there is always and antagonistic muscle -exerts its force on the actual muscle through the skeleton
- example of a hydrostatic skeleton - like a balloon
 - contract longitudinal muscles - get smaller and wider
 - contract circular muscles - get skinnier and longer
- end with a water filled cavity

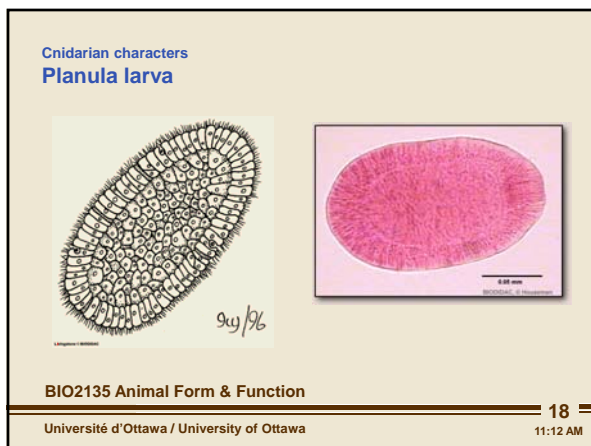
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-body wall is quite complex -has nerve cells
 -outer wall - has cnidocytes, nerve cells and longitudinal muscles
 -inner wall - glands that secrete digestive enzymes and circular muscles also able to absorb nutrients



-on outer layer - nerves are present - potential of gradient of movement and muscles
 -not a centralized nervous system



-last autoapomorphy- the larva
 -when egg and sperm meet to form the zygote - undergoes multiple cell divisions -forms a cluster with 2 cell layers

-endodermal cells in the middle and the ectodermal cells on the outside
 -covered in cilia of 9+2 structures
 -it settles on the ground and moves by the beating cilia - tends to move in one direction (has anterior and posterior end to it)

-when it settles down, morphs itself into a polyp and the life cycle is complete
 -all cnidarians are sessile - the polyp is just stuck on the bottom
 -to disperse its progeny - shoots eggs and sperm into the water column
 -fertilized, settle down from the currents, migrate to a location that is suitable and get a new polyp that is distant from the parent
 -the way that it crawls - acts like a bilaterally symmetric organism

Cnidaria

Cnidarian phylogeny

synplesiomorphs

Anthozoa Scyphozoa Cubozoa Hydrozoa

1 Anthozoan innovations (autapomorphies)

- Biradial symmetry
- Siphonoglyphs
- Muscular septa
- Gonads in gastrodermis
- Opercular nematocysts

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- take phylum and break down into its classes -get to see how they separate in architecture
- anthozoan -sea anemonies
- scyphozoan -jellyfish
- hydrozoa -hydra
- all the autapomorphies for the cnidarian phylum are now synplesiomorphies
- going to see biradial symmetry and radial symmetry- the mixture of the two -wonder which one came first
- siphonoglyphs are involved in pumping water vascular cavity
- going to have muscular septa in terms of divisions inside the cavity
- the gonads are internal in the gastrodermis/gastrovascular cavity - all the others cnidocytes will have their gonads are in the exterior - which will be released from the ectodermal layer
- have unusual type of nematocyst
- will focus mainly on the the first three

Anthozoa

Biradial symmetry
a variation on radial

Modified radial caused by paired structures on a radial body plan

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- when you see an organism with an apparent radial symmetry - and it has a paired structure associated with the anatomy of the organism, it limits the number of planes we can cut through - only get two planes, one cuts through the paired structures, the other goes through the middle
- biradial symmetry is a modified form of radial symmetry whenever there is are paired structures
- paired structures are common in sea anemonies

Anthozoa

Biradial symmetry
a variation on radial

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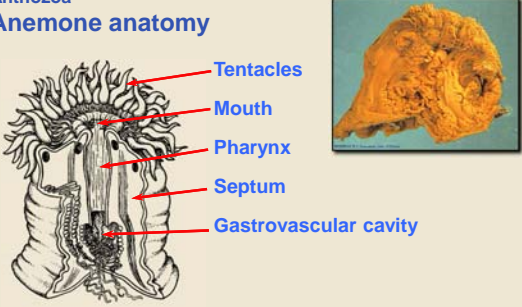
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- only way to get identical halves is to cut in the two planes of symmetry
- because there are 2 siphonoglyphs across from each other at the oral opening
- cut any other way will not result in identical halves

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Anthozoa
Anemone anatomy



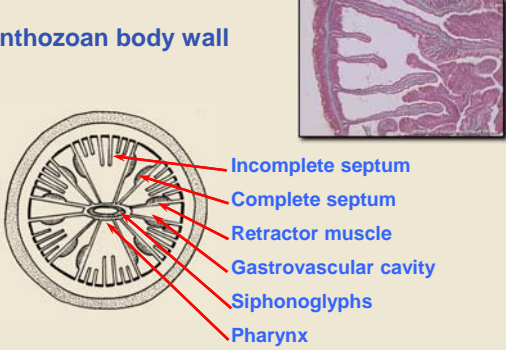
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- see that the siphonoglyphs are at the two side of the mouth
 - the pharynx folds way inside the animal
 - when it feeds, it captures things on its tentacles and retracts them into the mouth
 - muscles of the pharynx grabs the tentacle - scraps them clean and the food go into the gastrovascular cavity
 - the muscles have contracted to shallow the food and it needs to be able to reinflate itself, its uses the siphonoglyphs which pump water into the gastrovascular cavity
 - they are essential in the shape changes associated with organism.
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Anthozoan body wall



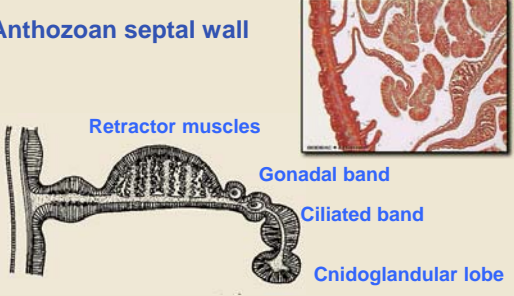
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- siphonoglyphs are paired- end up with biradial symmetry
 - contraction that occurs - there are muscle blocks which are involved in pulling the tentacles inside - retractor muscles which pull the anemone down - then return to its original size by using the siphonoglyphs
 - say that there are muscles but by definition, there are no muscles
 - cells that have been concentrated with so much myosin that they behave and act like muscles - there is a debate whether these are muscles
 - the earliest form have a form of non radial symmetry that have been modified by a paired structure (bilateral) and also seem to have muscles
 - anthozoans may have been the remnants of a triploblastic sessile organism that is stuck at the bottom with cnidocytes - end up with free swimming medusa and then get radial symmetry
 - some kind of bilaterally symmetric animal that developed radial symmetry
 - the hydrozoa have both a polyp and a medusa stage - and they were thought to be at the bottom of the tree but it was changed
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Anthozoan septal wall



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- the incomplete septa have a glandular lobe with cnidocytes -cnidoglandular lobe- part that secretes and release the cnidocytes- this is weird because-
 - In all of the other cnidarians, the cnidocytes are associated with the outer body wall in the ectoderm -but in the anthozoans, they are associated with the inner body wall - makes sens because there are large organism- so end up up stinging their prey once it is in the gastrovascular cavity
 - cant have the liquid inside be stagnant - A band of tissue is covered in cilia which are constantly pumping and mixing the contents of the gastrovascular cavity
 - when it is time to empty the gastrovascular cavity -the pharynx opens to squeeze the remainder
 - the cilia are not only mixing, the flow the create is over the gonads so that the gonads receive the nutrients at the richest content - place the gonads as close as possible to the digestive region get the most nutrients
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Anthozoa: Corals



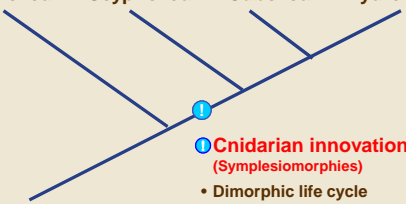
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-also includes the corals which are small polyps that are connected to each other
-have cnidocytes and gonads inside and have bilateral symmetry as well

Cnidarian phylogeny



Cnidarian innovations (Symplesiomorphies)

- Dimorphic life cycle
- Medusa by strobilization
- Opercular nematocysts
- Tetraradial symmetry

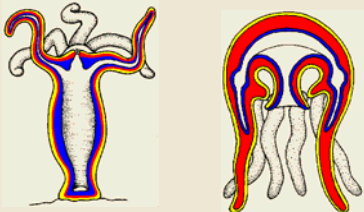
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-the appearance of a free swimming stage which is the medusa - life cycle now has two components
-the polyp and the medusa alternate between the two of them
-the medusa is formed by a process called strobilization
-will see radial symmetry that is based on fours

Dimorphic life cycle



Polyp **Medusa**

Epidermis
Mesoglea
Gastrodermis

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-the sessile polyp can now create a stage that is able to swim, disperse, the polyp stage can now create progeny that are dispersed from the parents
-the anthozoans were creating their young by budding and fragmentation -the medusa becomes the equivalent of a polyp upside down
-huge mass of mesoglea which is important in locomotion -possible to have a hydrostatic skeleton that doesn't have antagonistic muscles
-the medusa contains only circular muscles. when the circular muscles contract and the diameter decreases - puts pressure on the jelly - and when the muscles relax, the jelly like spring returns to its original shape - contraction allow medusa to move up
-the medusa is a very similar architecture to a polyp, it is flipped upside down, it has only circular muscles and uses mesoglea to move. -it can rise in the water column drift down and catch things it bumps into with its tentacles
-not all polyps are sessile- when they do move they are always in contact with the substrate -will see that hydra will do somersaults to move around

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Strobilization

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-medusa is formed through strobilization. The polyp settles to the ground after the planula larva has moved and settled down - it undergoes a set of fissions - makes new organism

-by lateral strobilization - stack of plates formed by asexual reproduction

-as they are formed and move away from the base, they start to mature and start to take on its final morphology

-it will then come off, turn upside down making a jelly fish

Cnidarian phylogeny

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-have a rhopalia around the margin of the bell on medusa - light and gravity sensor

Scyphozoa
Aurelia Life cycle

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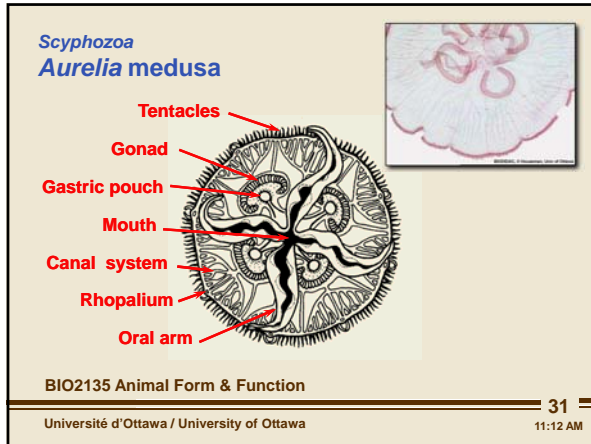
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-the adult releases egg and sperm into the water column and the egg and sperm will fertilize

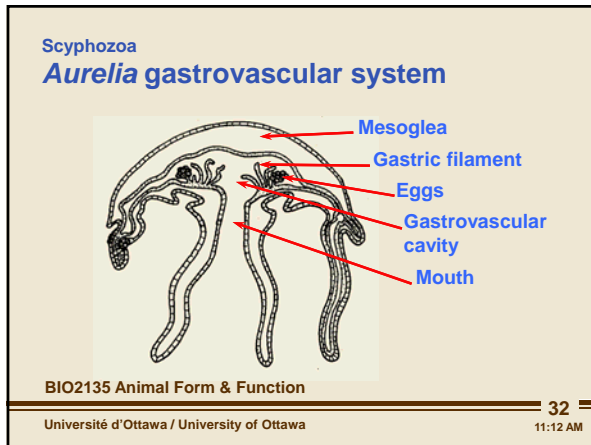
-cell division occurs to form planula - migrates across the bottom, settles down to become a little polyp called a scyphistoma - polyp that will undergo strobilization become a ephyra, mature and become a medusa which will then be able to produce gametes and cycle repeats

-the vast majority is spent floating in the water column and not attached to the ground.

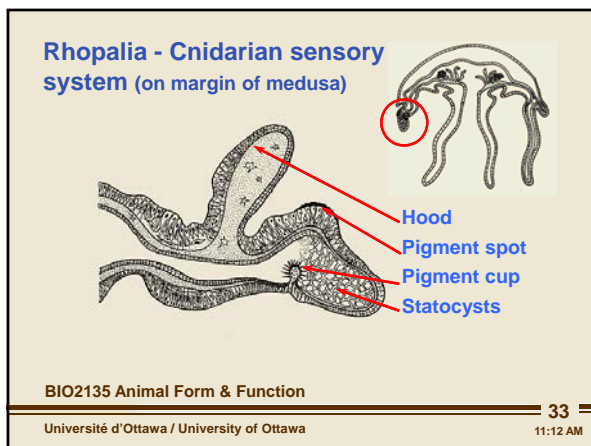
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- see that it has 4 legs/arms
- gastrovascular cavity extends into the bell margin as branches and canal branches through the entire organism - when this animal feeds, the food enters into the gastrovascular cavity, the canal carries it along a route that is unidirectional
- have a very a specific and directed digestive system unsure that nutrients are dispersed
- right at the gastric pouch is where the gonads are located - prime location for picking up nutrients
- creates an efficient nutrient distribution system



- rhopalium (autapomorphy) is located on the bell margin



- a flap of tissue that sits above the pigment spot and a statocysts at the bottom which detects cavity
- statocyst contains a statolith - have a set of pigment cells - the hood normally shields the pigment cells from light coming from about - differential information - tell about how it is oriented and how it is tilted

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Cnidarian phylogeny

Cnidarian innovations (Synplesiomorphies)

- Medusa produces a single medusa

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-each polyp morphs into only one medusa

Cnidarian phylogeny

Cubozoan innovations (Autapomorphies)

- Polyps undergo metamorphosis into medusa
- Unique eye
- Pedalia

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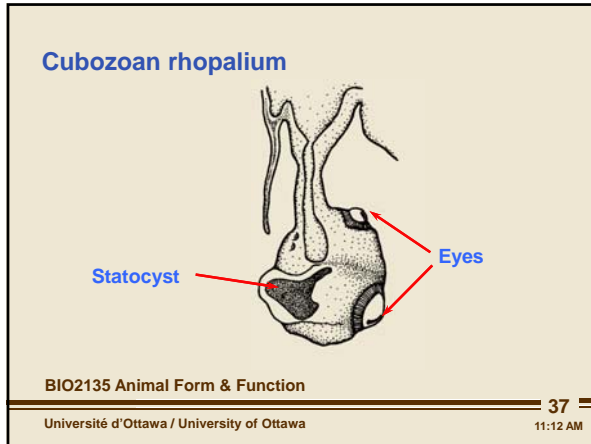
-polyp undergoes a direct metamorphosis - very quick event - not alot of time spent in the polyp state
 -unique eye- like rhopalium but insteads of being at the bell margin it is going to be at the front
 -tentacles are attach by special structure - pedalia

Cubozoa

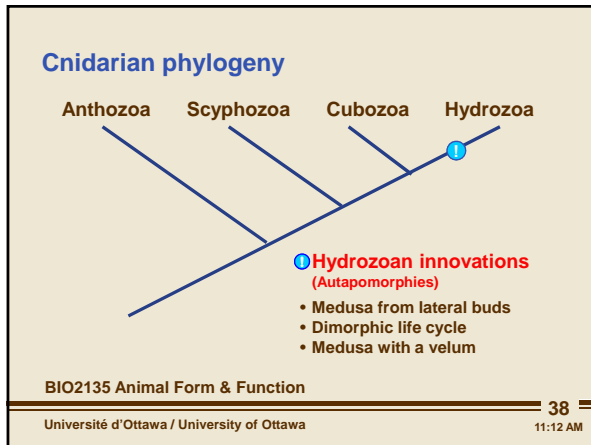
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-known as the boxed jellyfish - have tetradial symmetry
 -rhopalium is on the side of the medusa
 -extremely transparent organism
 -one of the few jellyfish that are deadly to large organisms

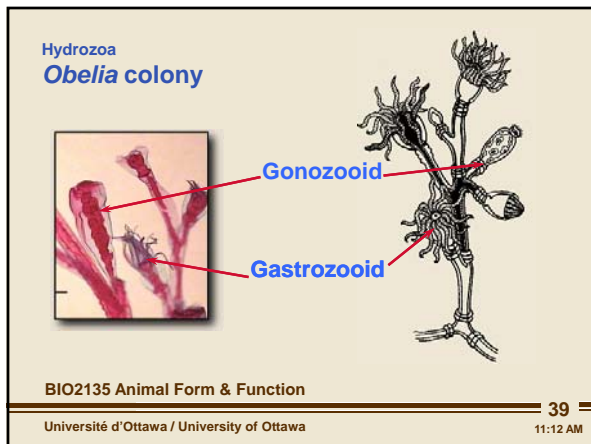
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- has a unique eye (rhopalium) that is suspended from the medusa wall
- has a lens which focuses light and had the potential to form some kind of a crude image
- when one animal gets stung by one boxed jellyfish they all swarm around the prey to complete the attack so it can be consumed - use visual signals too look for large preys
- diffused nerve net, no brain - no idea how it transfers visual information to the organism to respond
- food gets captured on the tentacles but then to feed -pedalium are paddle-like structures that flex inward to force food into the mouth

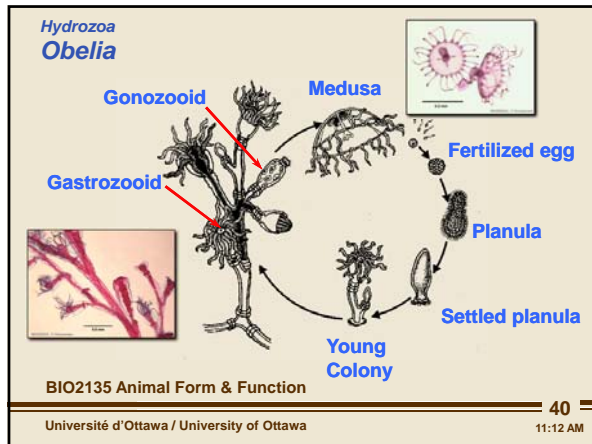


- both the polyp and medusa contribute equally to the life cycle. The medusa forms lateral buds off the sides of the polyp- no metamorphosis of the polyp into the medusa like the cubozoa
- medusa uses a velum to swim which is on the underside of the bell
- the velum is a specialized shelf which allows for better control of movement
- pushes water out of small hole so more rapid and fill up with a big hole so backward thrust is little

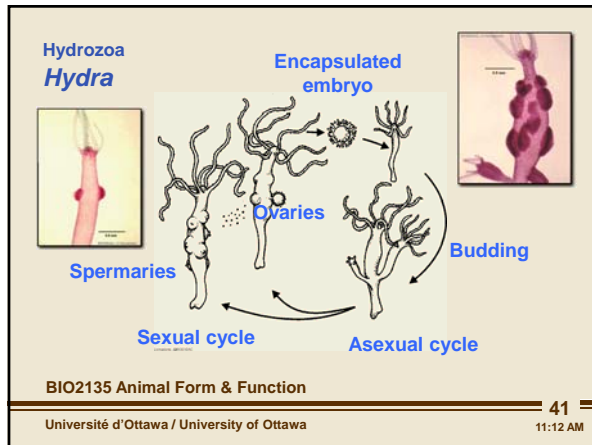


- marine forms are colonial - connected to each other - Obelia consist of polyps that are specialized that are all connected together by their gastrovascular cavity
- hydrozoans develop polyps that have specialized functions: feeding polyp (gastrozooid), and one to make medusa (gonozooid)
- division of labour between polyps on the colony

Cnidaria



- life cycle where the gonozooid - have baby medusi inside - will be released - grown into adult medusa - get fertilized egg, then planula which will settle and make a not polyp - colonies get gastrozooid and then forms gonozooid - completing the life cycle
- hydrozoan - spend most of their time in both polyp and medusa
- scythozoon and cubozoon - most of their time in medusa form
- anthozoan life is only in polyp form, no medusa



- hydra - freshwater species
- male and female hydras that develop ovaries or spermaries in the ectodermal layer
- sperm will be release and picked up by other hydra- egg with be fertilized - end up with sexual reproduction
- the embryo goes into an arrested state of development and settles into the ground - happens during the fall as things start to deteriorate
- the embryo sits at the bottom of the lake - when it grows - it makes a polyp - when conditions are good, asexual reproduction by budding dominates
- when conditions deteriorates, meiosis occurs - get genetic mixing to have variability to be able to respond to conditions to survive
- fresh water and create resistant structure like gemmules
- no medusa in this life cycle, fresh water jellyfish doesnt have polyp - possible exam question****
- when we see marine organisms move into a freshwater environment, the life cycle is dramatically changed
- has to do with the trophic structures of fresh water environment compared to marine
- in a marine environment, the primary productivity is the algae and the primary herbivores are the zooplanktons - means that first carnivores are minute
- in fresh water systems, the primary productivity is associated with other plants -primary carnivores are big compared to the oceans
- small little things like embryos are not common - because it is not set up in the same trophic structures as the marine environment -life cycle are adapted to fit to freshwater environments
- the hydrozoans are the only ones that have made it to freshwater environments.