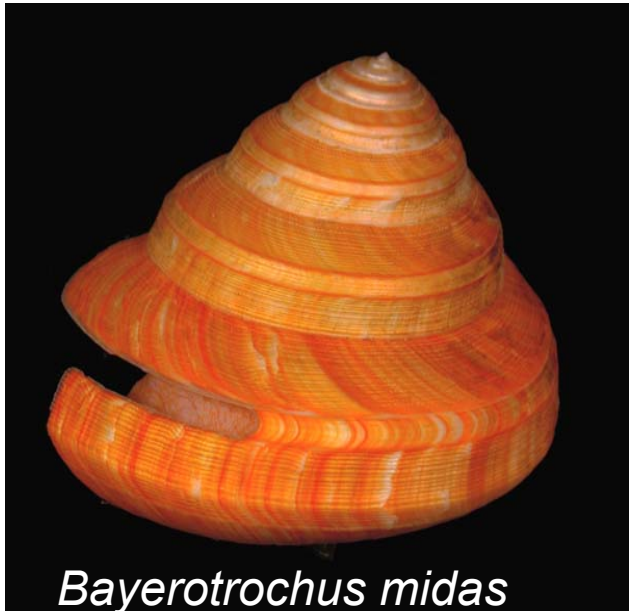
Gastropoda - more

Lec 12
FISH310

Class Gastropoda



Bayerotrochus midas

www.abdn.ac.uk/.../gastropoda/index.html

http://www.passportscollection.com/ProductImages/Gallery25.jpg

Importance

RESEARCH ARTICLE

Repeated cocaine effects on learning, memory and extinction in the pond snail *Lymnaea stagnalis*

Kathleen Carter[1], Ken Lukowiak[2], James O. Schenk[1,3] and Barbara A. Sorg[1,*]

+ Author Affiliations

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Accepted September 4, 2006.

Weird Science drugs its snails, keeps its zebras on the beach

By John Timmer | Last updated 10 months ago

Defining Characteristics (Text)

- Torsion – counter clockwise twisting of the visceral mass and nervous system by 90-180^{o} relative to the head and foot during larval development
- Operculum - proteinaceous shield on foot

Defining Characteristics (Text)

- Torsion – counter clockwise twisting of the visceral mass and nervous system by 90-180^{o} relative to the head and foot during larval development
- Operculum - proteinaceous shield on foot

Defining Characteristics: 1) Visceral mass and nervous system become twisted 90–180° (exhibiting torsion) during embryonic development; 2) proteinaceous shield on the foot (operculum)

Gastropoda

Torsion unifying character but
Most

- **Coiled**
- **Asymmetrical, anterior mantle cavity**
- **Single mantle retractor muscle**
- **Single atrium***
- **Single nephridium***
- **Left gonad lost**

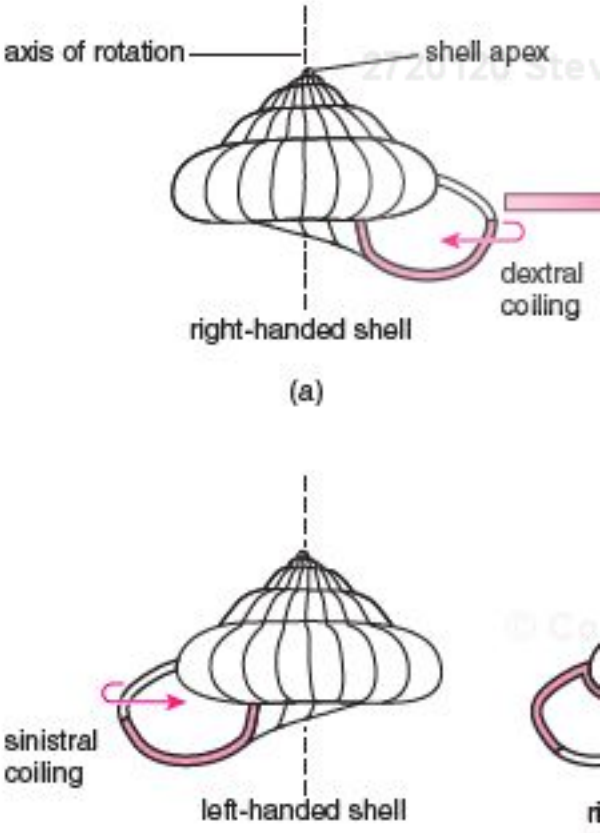
– Gut U-shaped
– Operculum usually present

– *primitive often with two

Gastropoda

Torsion unifying character but
Most
Coiled
<u>Asymmetrical, anterior mantle cavity</u>
Single mantle retractor muscle
Single atrium*
Single nephridium*
Left gonad lost

– Gut U-shaped
– <u>Operculum</u> usually present



right handed (dextral) - shell clockwise right

loss on right side

Sinistral vs. dextral coiling

Almost all <u>dextral (right handed)</u>

- **No known advantage**
- **Coiled shells of gastropods- both ways**

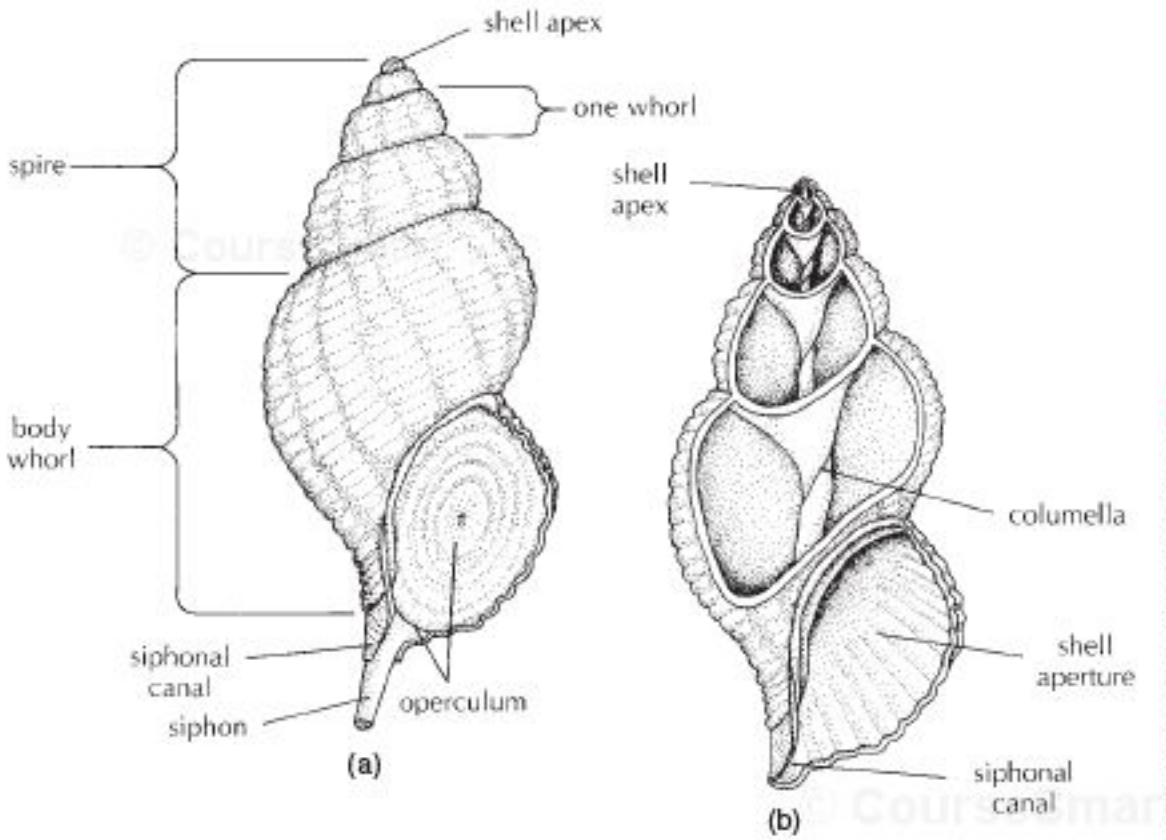
or is there?

Hoso said these events represent the "*hopeful monster*," an idea put forward by geneticist Richard Goldschmidt, who said small genetic changes could result in large evolutionary change.

Defense

?

Defense

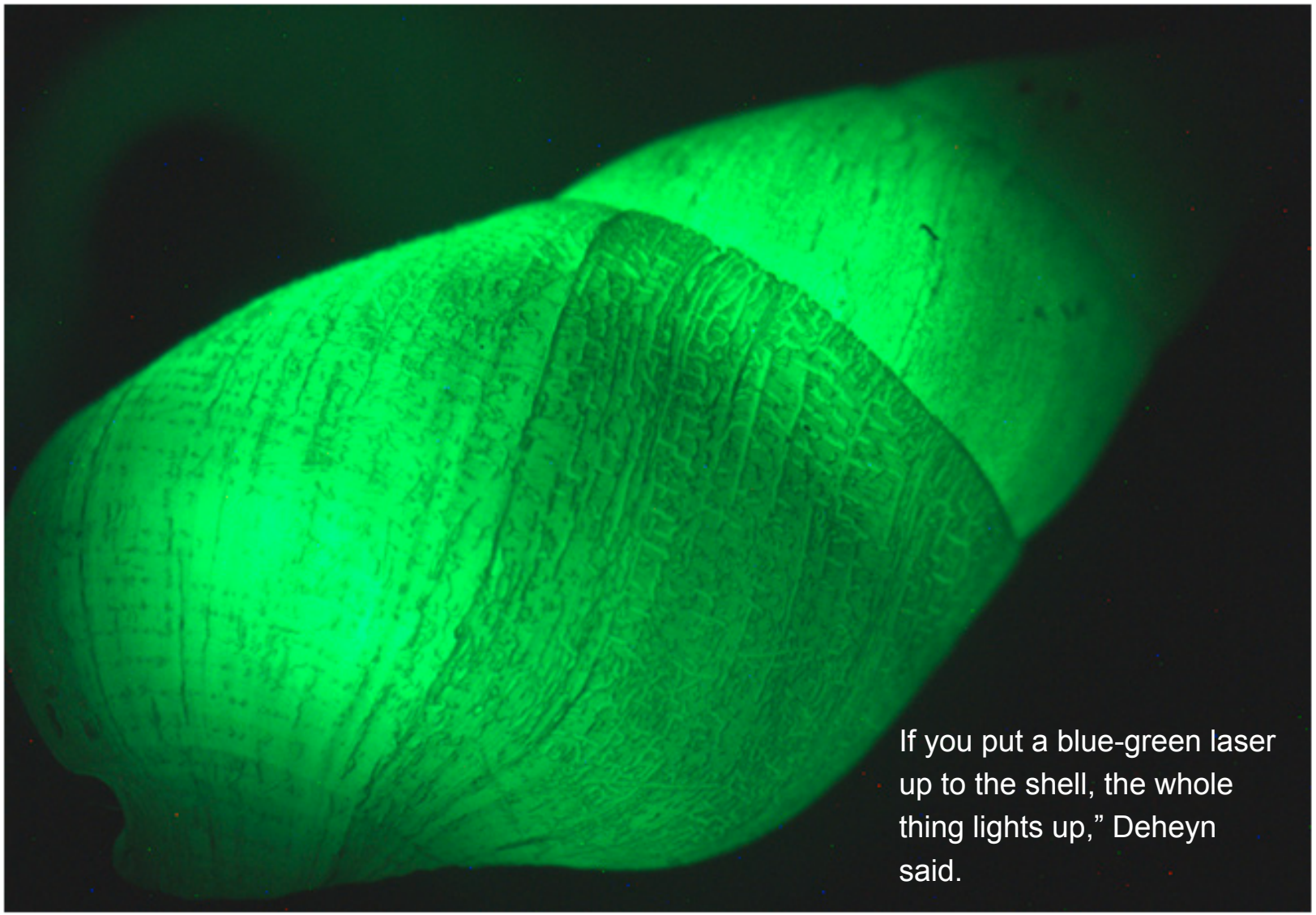

shell apex
one whorl
spire
body whorl
siphonal canal
siphon
operculum
(a)
shell apex
columella
shell aperture
siphonal canal
(b)

Defense

- senses predator* and alters behavior to escape, avoid, deter.
- senses injured conspecific and acts
- accumulates noxious compounds in tissues ...

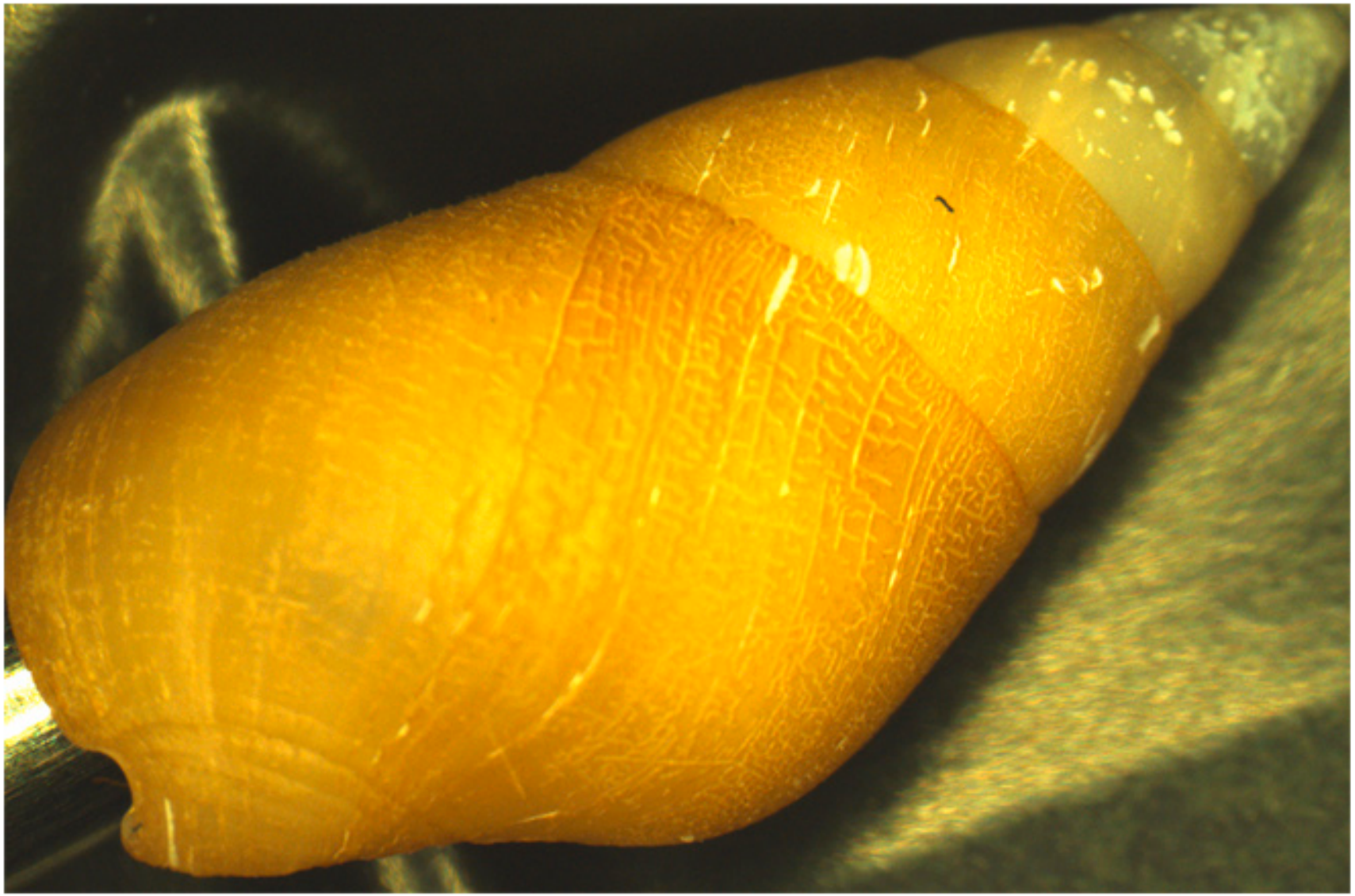
Clusterwink Snails Defend Themselves With Superfast Flashing Shells

By Dave Mosher ✉ December 15, 2010 | 2:21 pm | Categories: Biology, Biotech



If you put a blue-green laser up to the shell, the whole thing lights up," Deheyn said.

"The problem there is that it's flashing is too fast," Deheyn said. "We'd need a piece of equipment called an electron-amplified low-light digital camera. It's high-def and high-speed, but it costs $50,000. It's a lot of money."



Torsion and shell coiling

NOT related

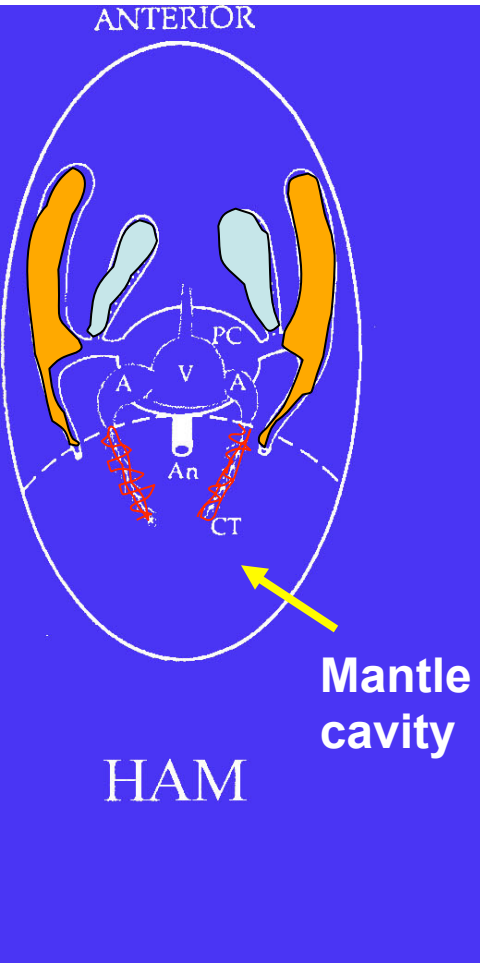
Torsion and shell coiling

NOT related

Torsion

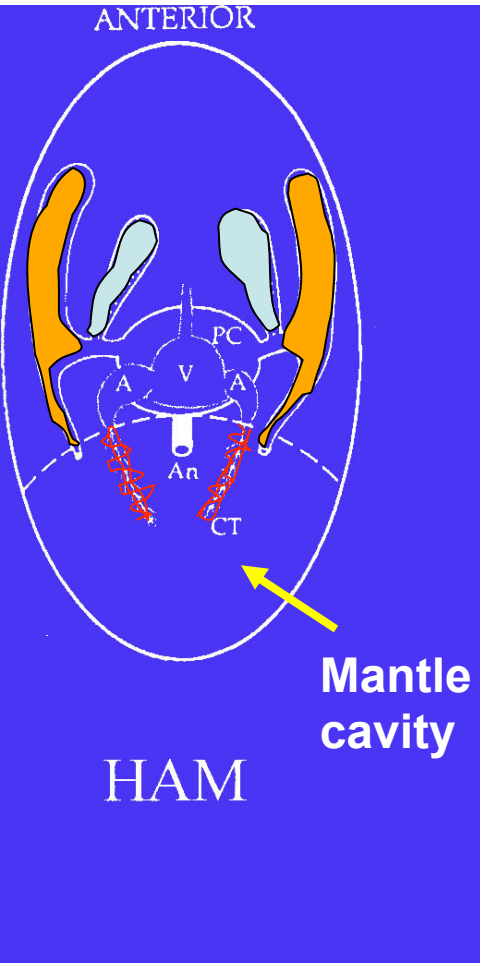
Gill (ctenidia) gonad kidney

180° counterclockwise twisting of the head and foot relative to shell, mantle, rest of body.



Torsion

Gill (ctenidia) gonad kidney



180^{o} counterclockwise twisting of the head and foot relative to shell, mantle, rest of body.

Results

1) nervous and digestive systems twisted.

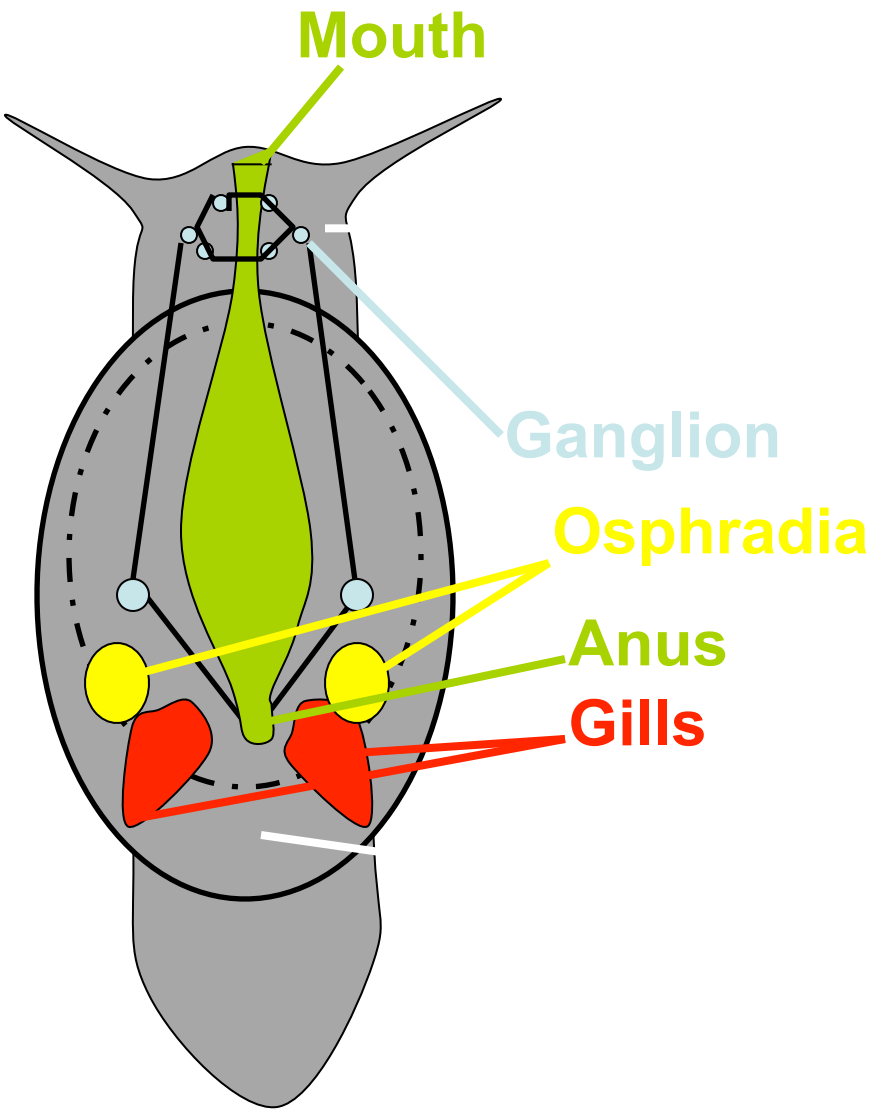
.....

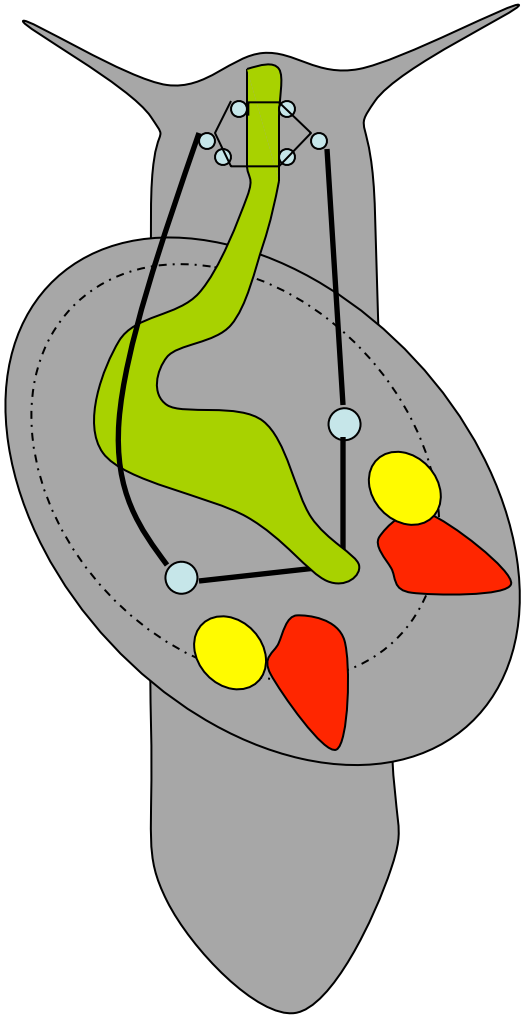
Torsion - how?

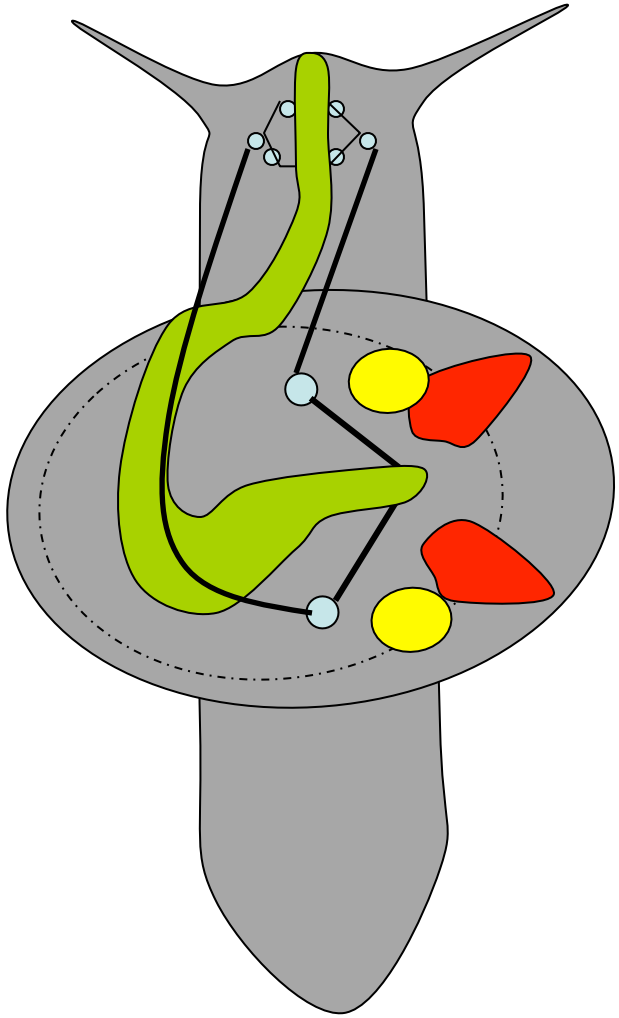
asymmetric development of muscle attaches head and foot with shell

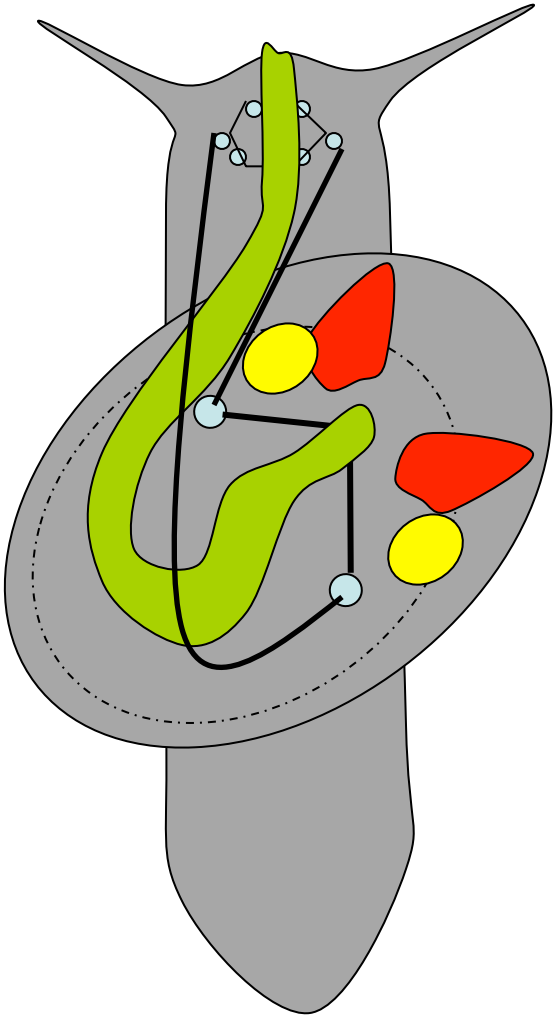
Torsion - when?

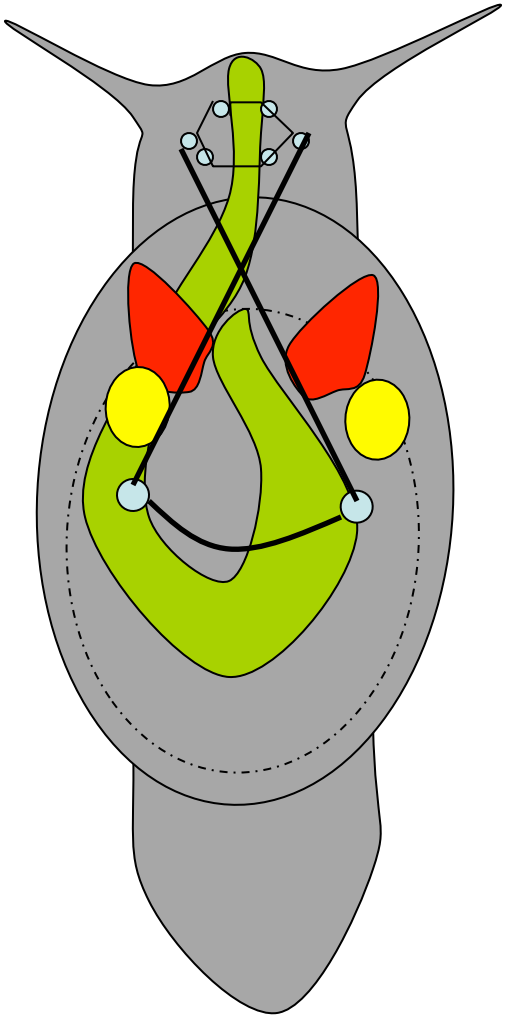
Larval development - can occur within hours to minutes

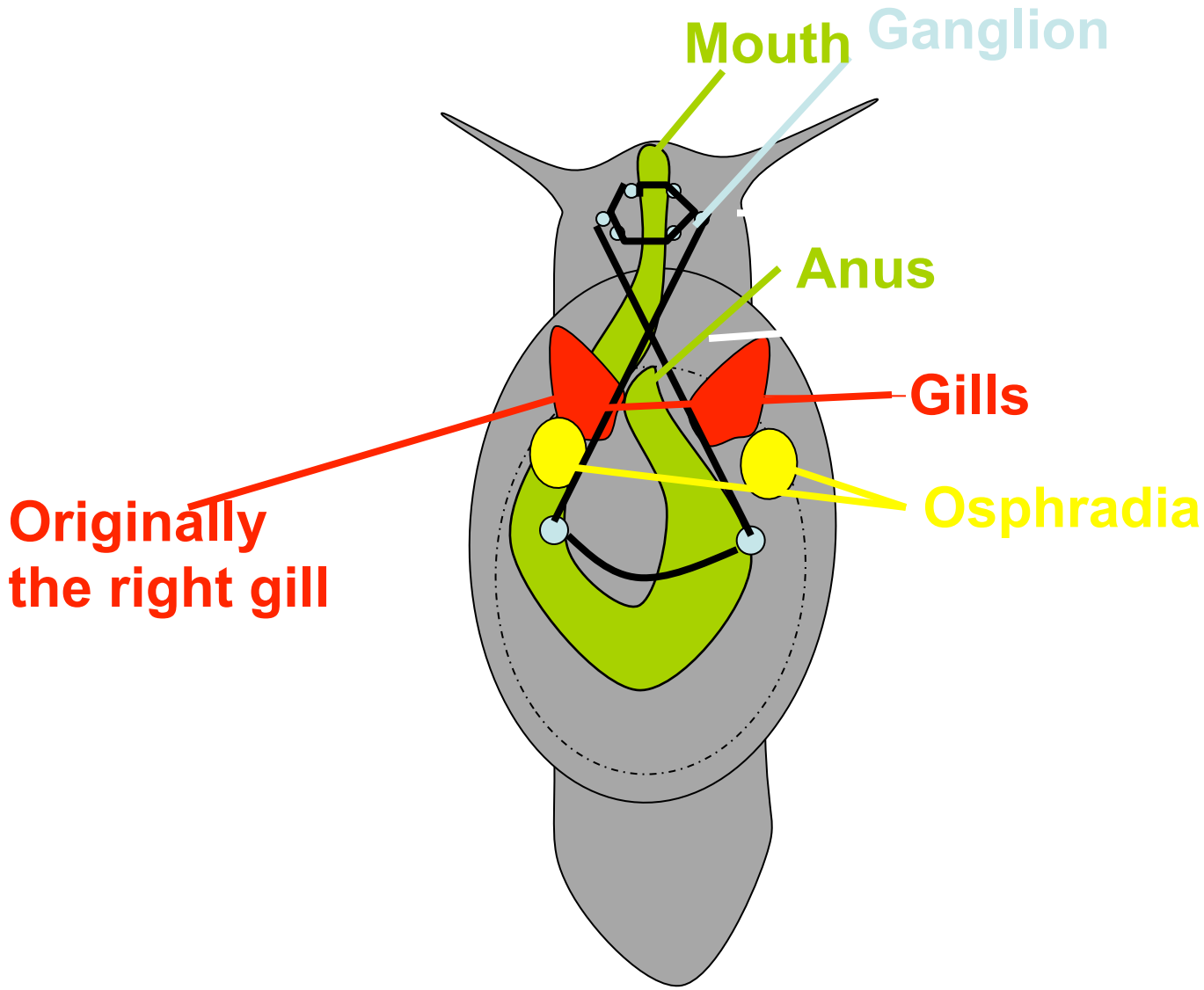

Mouth
Ganglion
Osphradia
Anus
Gills










Mouth
Ganglion
Anus
Gills
Osphradia
Originally
the right gill

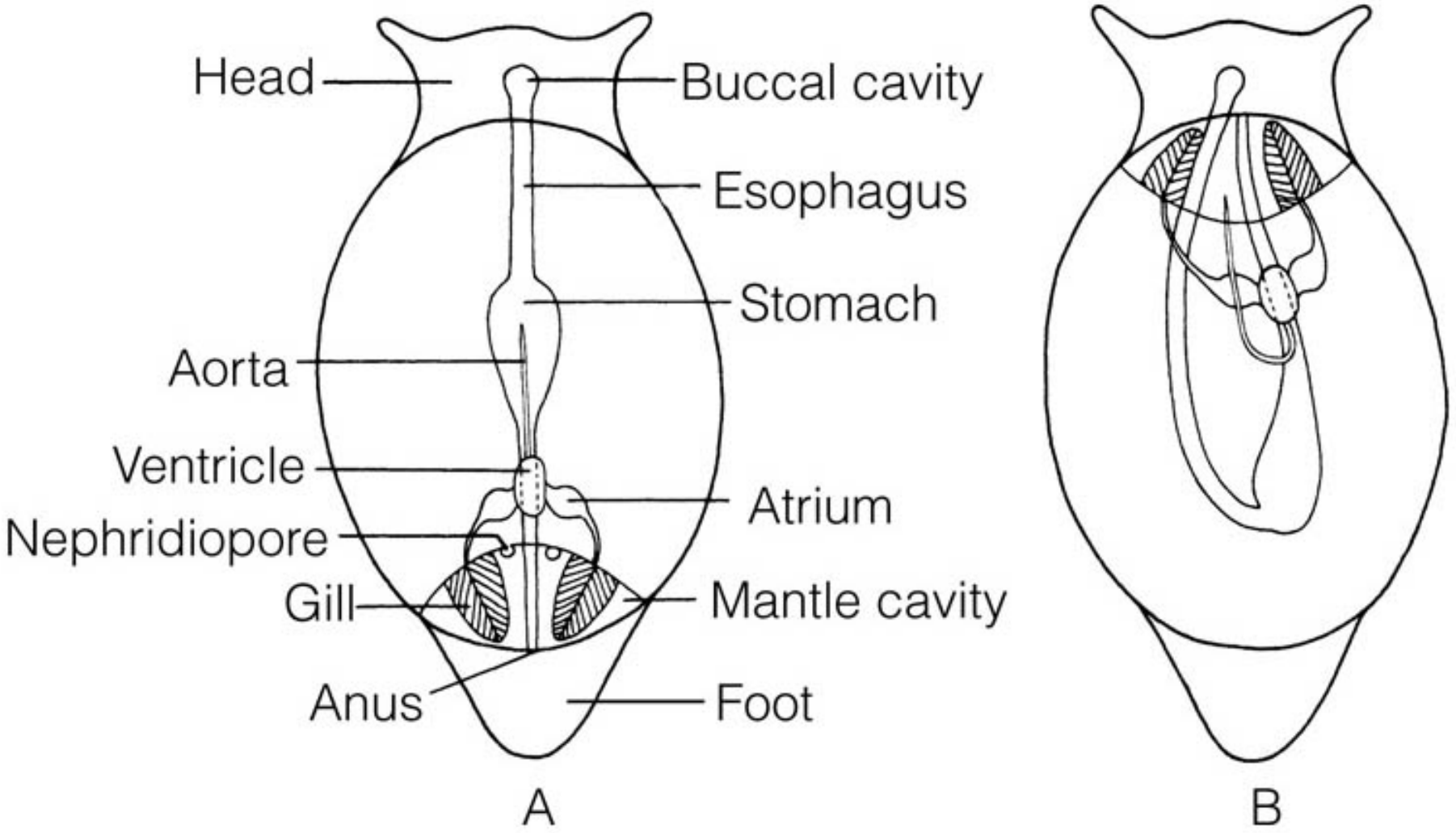
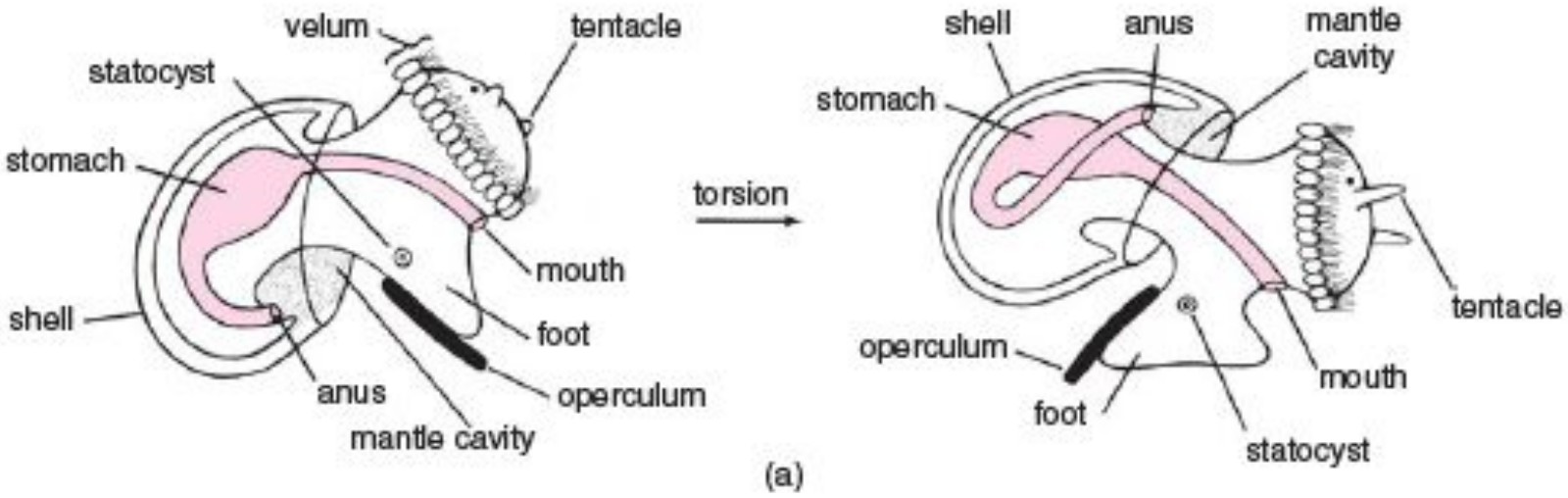


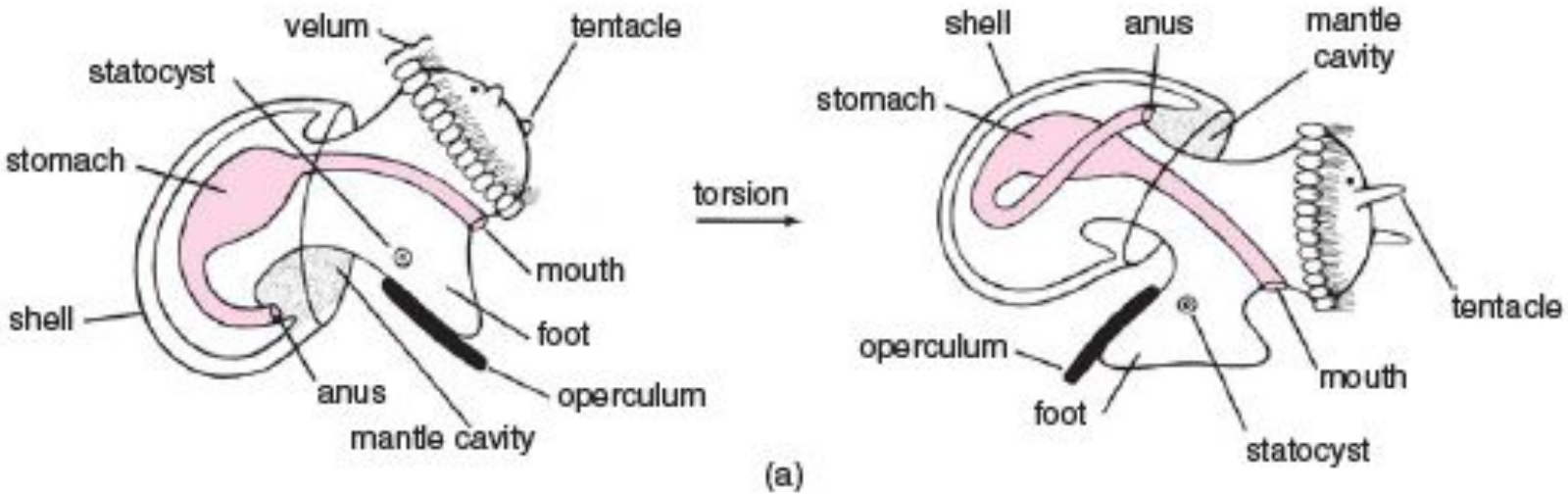
Figure 12-16A, B: **The effect of torsion on spatial relationships in gastropods. A and B, Dorsal views. A, The monoplacophoran ancestor prior to torsion. B, The early gastropod after torsion.**

Ruppert, Fox and Barnes, 2004

Patella

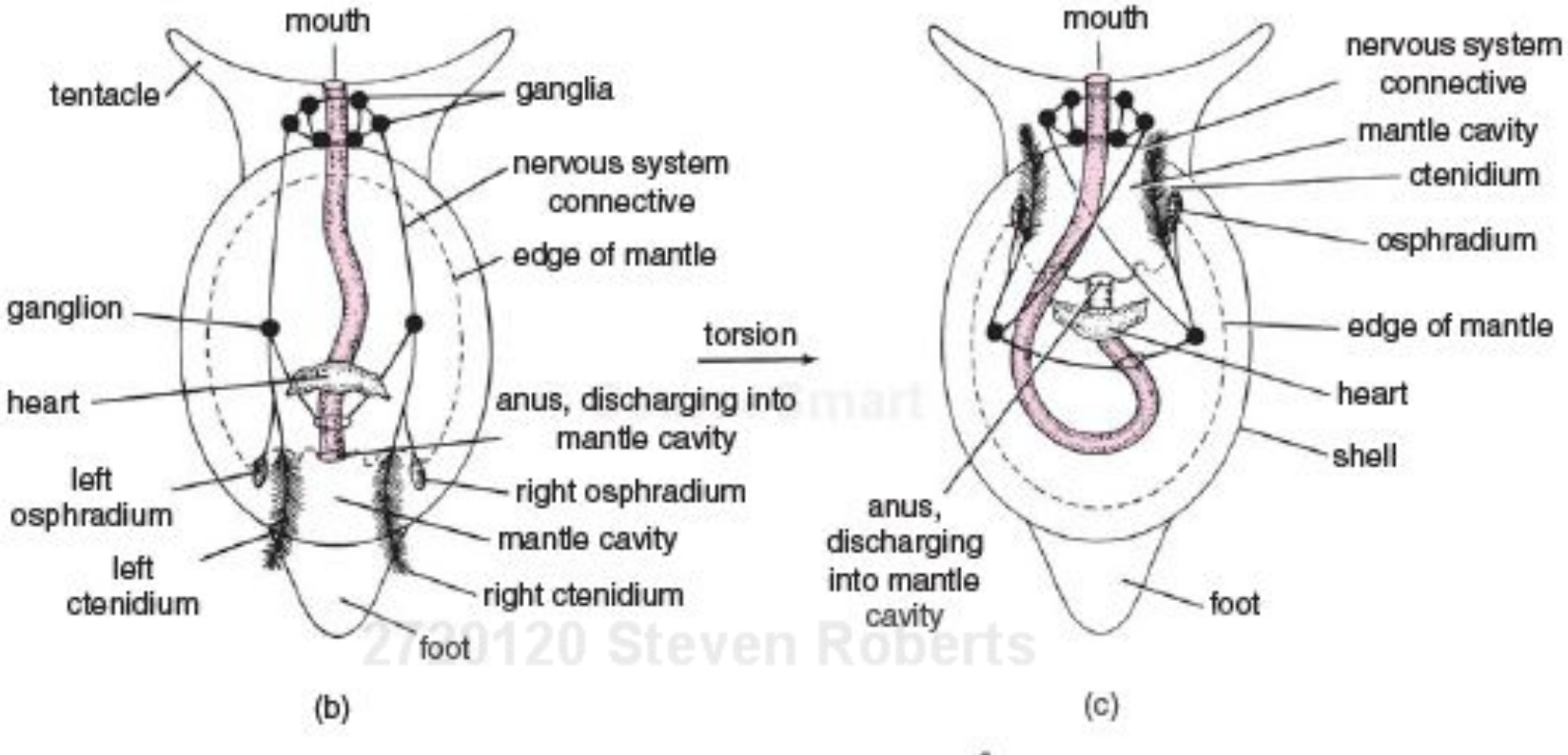

velum
tentacle
statocyst
stomach
mouth
shell
foot
anus
operculum
mantle cavity
torsion
shell
anus
mantle cavity
stomach
tentacle
operculum
mouth
foot
statocyst
(a)

Patella



Examine - what do you notice?

Examine - what do you notice?



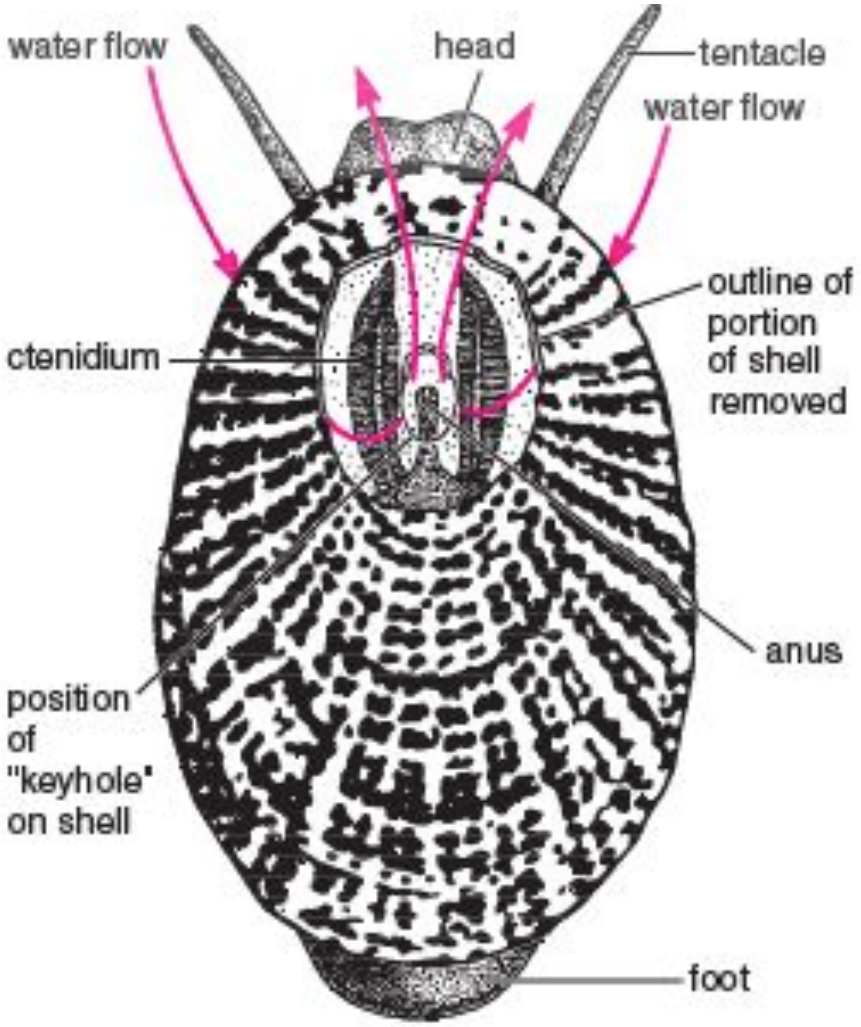
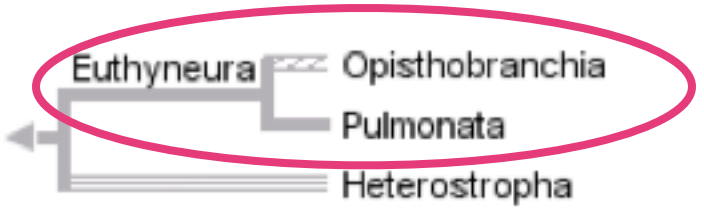


Figure 12.13

(a) Torsion in the free-swimming larva of a primitive prosobranch gastropod, *Patella* sp. Note that the mantle cavity is moved, along the right side of the animal, from the posterior to the anterior of the larva. Following torsion, the head and foot can be fully retracted into the mantle cavity and the aperture tightly sealed by the rigid operculum. (b, c) The consequences of torsion to the adult gastropod. (b) The untorted state of a hypothetical ancestral gastropod-like mollusc. (c) The rearrangement of internal anatomy following torsion. Note that the primitive gill has leaflets extending from both sides of the central axis. As will be discussed later, this is termed a bipectinate gill. (d) Pathway of water circulation through the mantle cavity of a primitive gastropod—a keyhole limpet, order Archaeogastropoda—with paired gills. Water enters on both sides of the head and leaves through a circular opening (the "keyhole") in the shell.

Minimize degree of torsion & Detorsion

- Eogastropoda (true limpets & relatives)
- Vetigastropoda & relatives (e.g., abalone, top-snails, keyhole limpets, turban shells)
- Cocculinoidea
- Neritopsina
- Caenogastropoda (winkles, whelks, balers, heteropods, c
- Heterobranchia (seaslugs, bubble shells, pulmonates etc.)



Torsion - why?

Evolutionary Significance?

Gastropod Torsion

Pennington, J. T., and F. S. Chia. 1985. Gastropod torsion: A test of Garstang's hypothesis. *Biol. Bull.* 169:391–96.

Evolutionary Significance?

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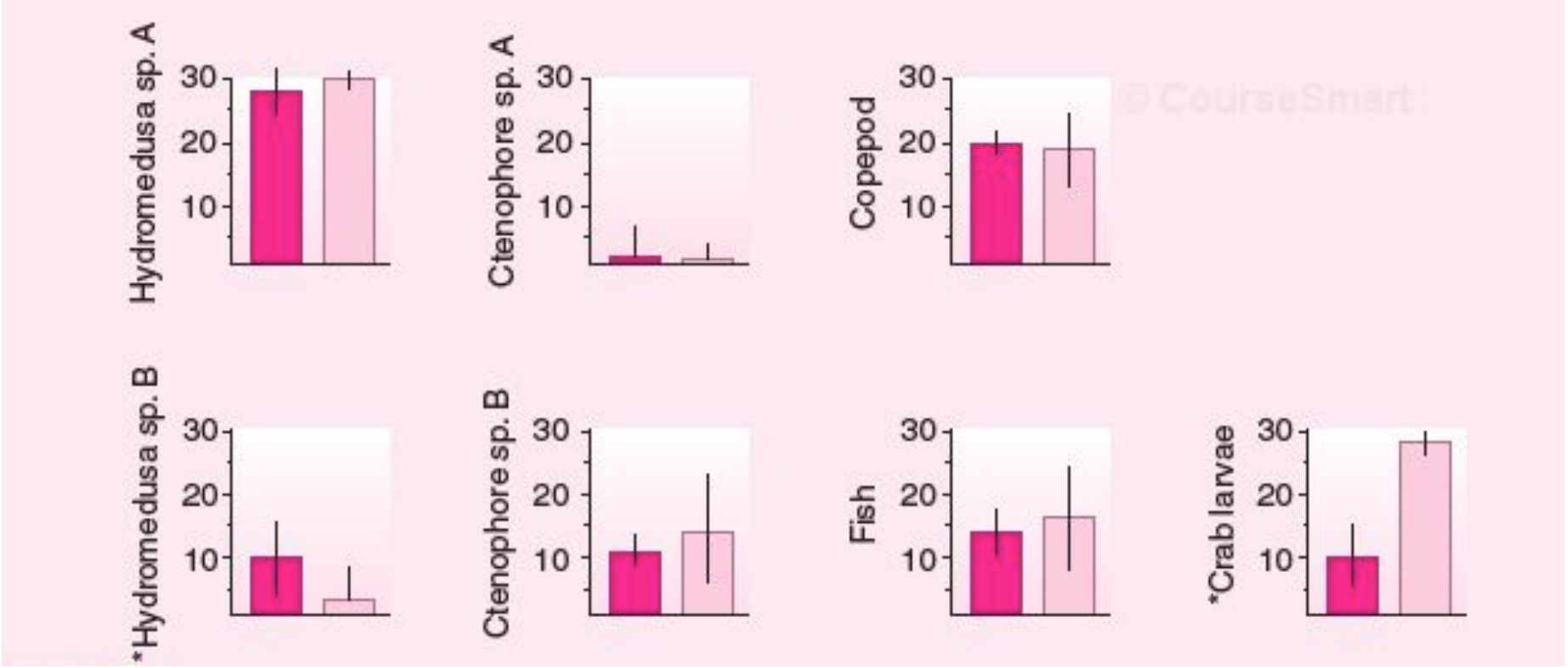
Evolutionary Significance?

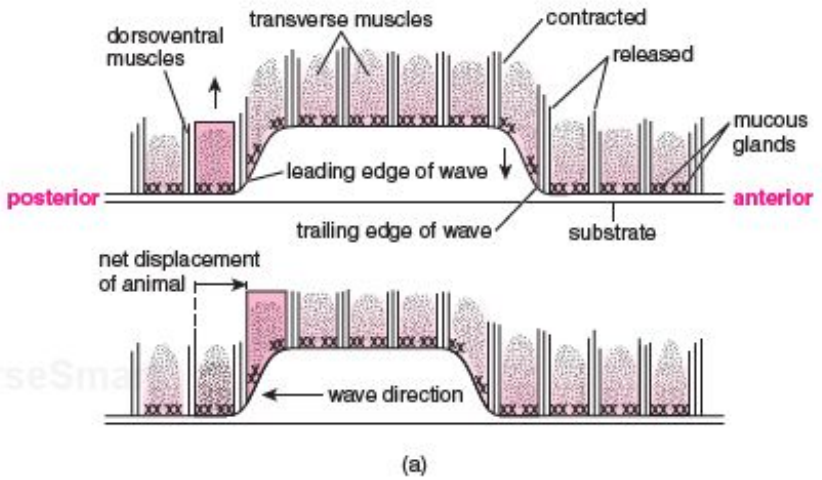


Locomotion

- small gastropods?
- bigger - pedal waves

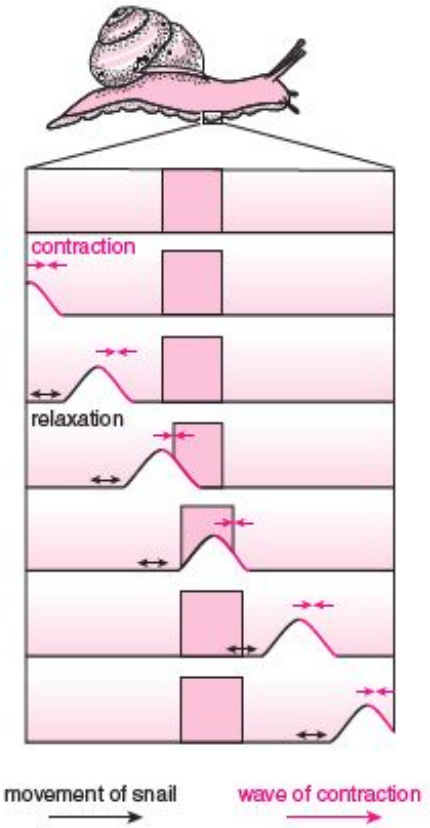
Locomotion

retrograde



(a)

direct



see videos

Gastropod reproduction

Reproductive anatomy highly variable

Prosobranchs (patello-, veti-, meso- and neogastropods) usually dioecious

www.arnobrosi.com/pomatia2.html

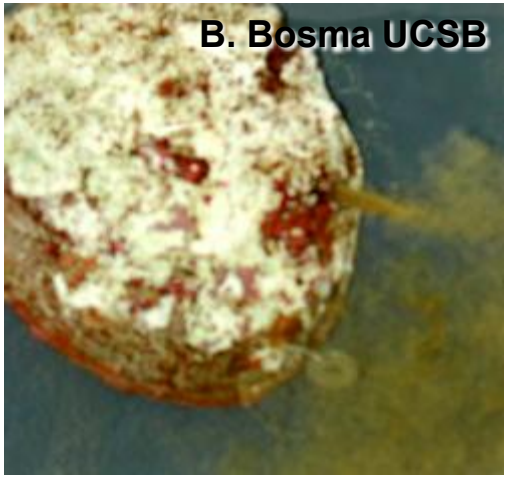
Gastropod reproduction

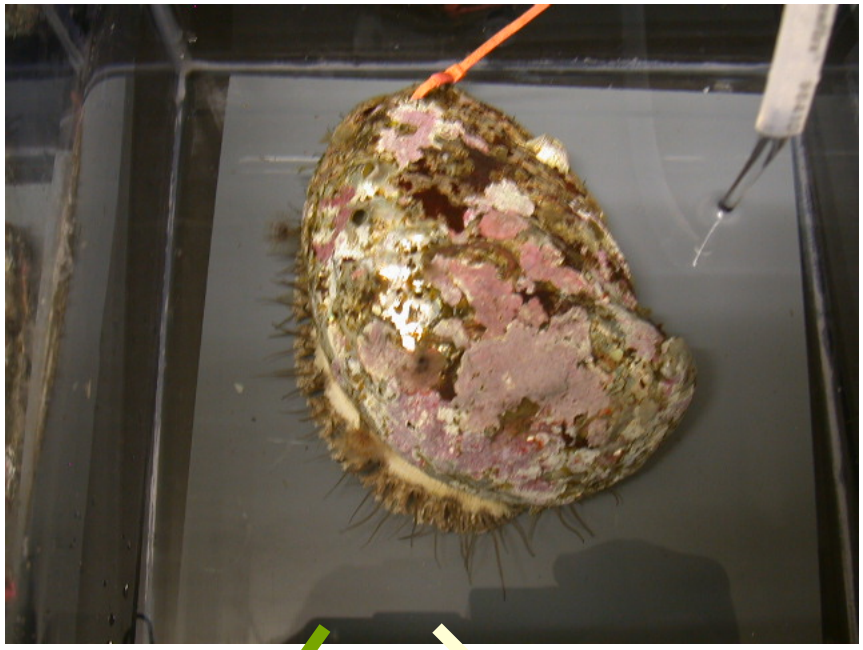
- Reproductive anatomy highly variable
- Prosobranchs (patello-, veti-, meso- and neogastropods) usually dioecious
- Opisthobranchs (nudibranchs, sea hares, bubble shells) hermaphrodites
- Pulmonates (land snails & slugs) hermaphrodites

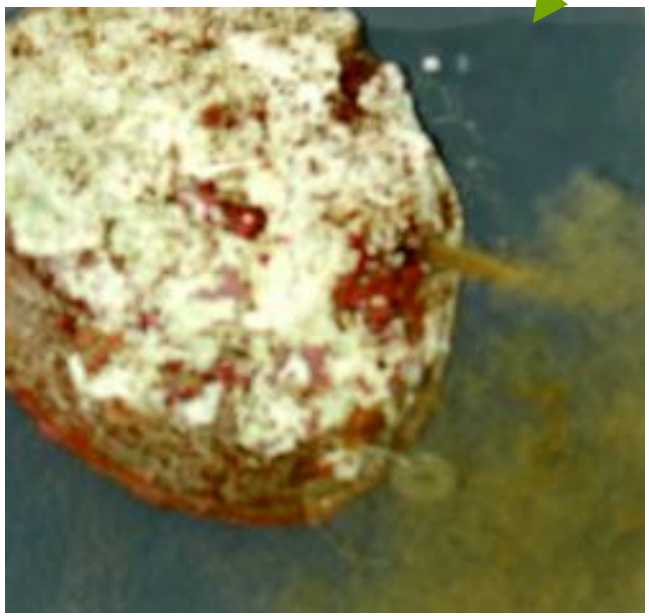
www.arnobrosi.com/pomatia2.html

Gastropod reproduction

- **Prosobranchs**
  - **Patello and Veti (Archaeo) gastropods**
    - **mostly free-spawning**
  - **Meso- and Neogastropods**
    - **copulatory structures**
    - **wide range of reproductive strategies**



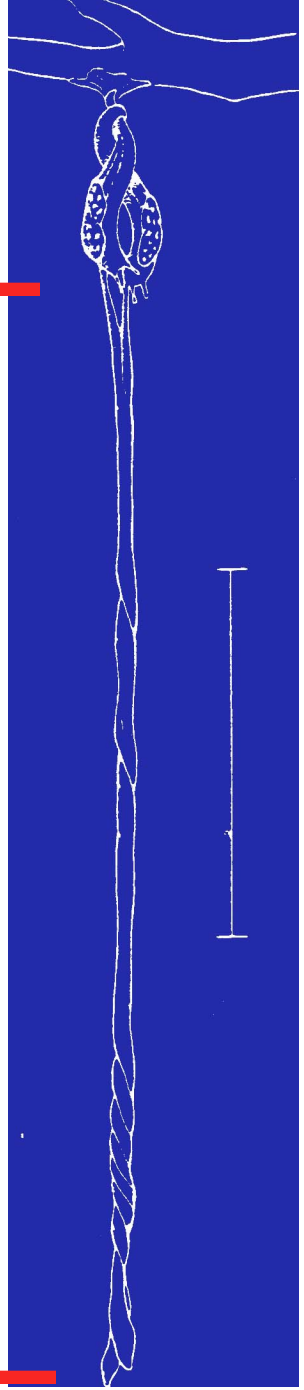




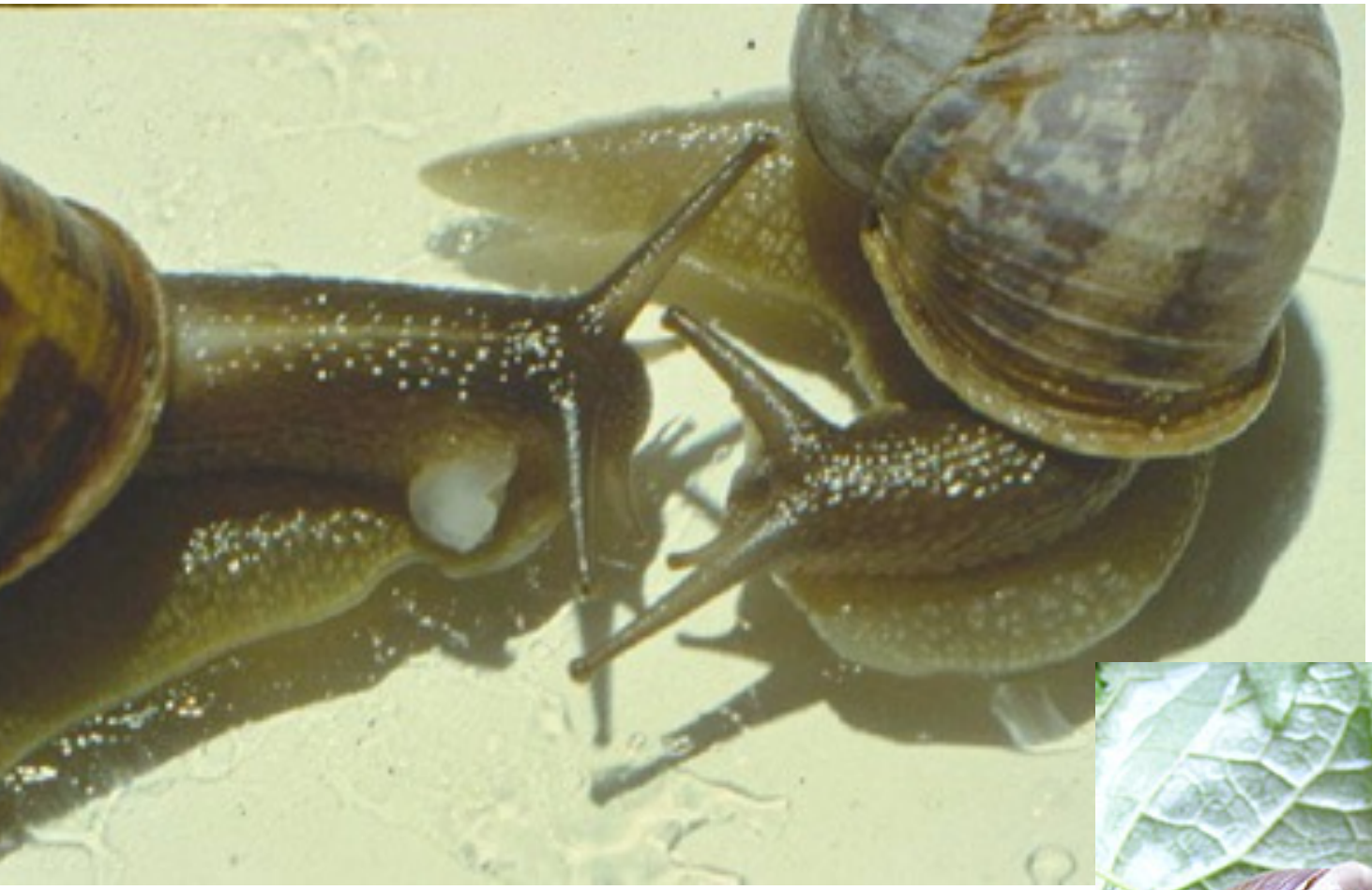
Slug sex

Slugs

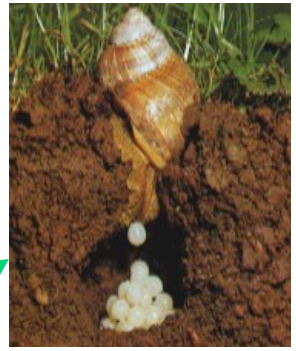
penises



Helix



Helix body piercing



www.arnobrosi.com/pomatia2.html

www.weichtiere.at/.../weinberg/reproduction.html

Helix body piercing

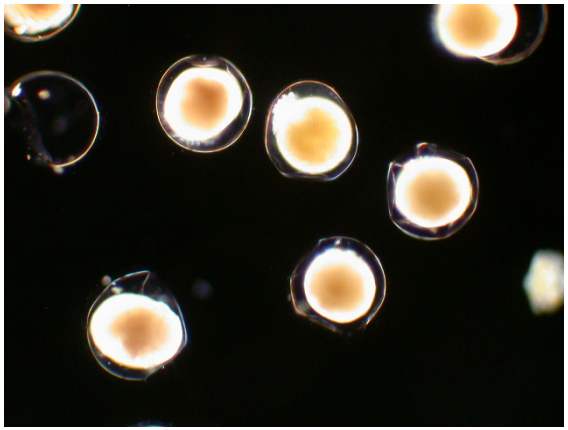
- **dart** covered w/ gland-derived mucous that enters blood of recipient
  - causes muscular contractions in partners female repro tract
    - helps uptake of sperm
    - closes off opening to sperm digestive organ
- good shooting helps male success

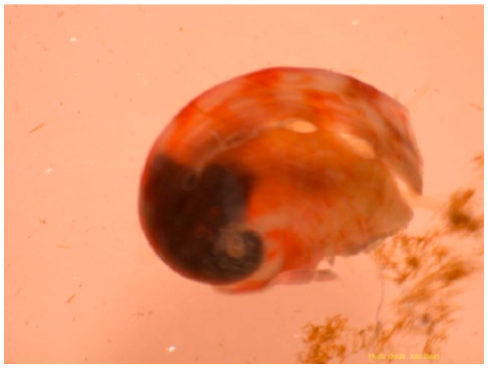
Opisthobranch Reproduction

Aplysia (sea hare) – simultaneous and functional hermaphrodites

– Eggs leave ovotestis via hermaphroditic duct, receive an albumin coat, are fertilized then receive thick layers of mucus and jelly to form spaghetti-like strings extruded from common gonopore and attached to substrate

Molluscan development





Molluscan development

Veliger larvae

- **Unique to mollusks**
- **Swim using ciliated velum**

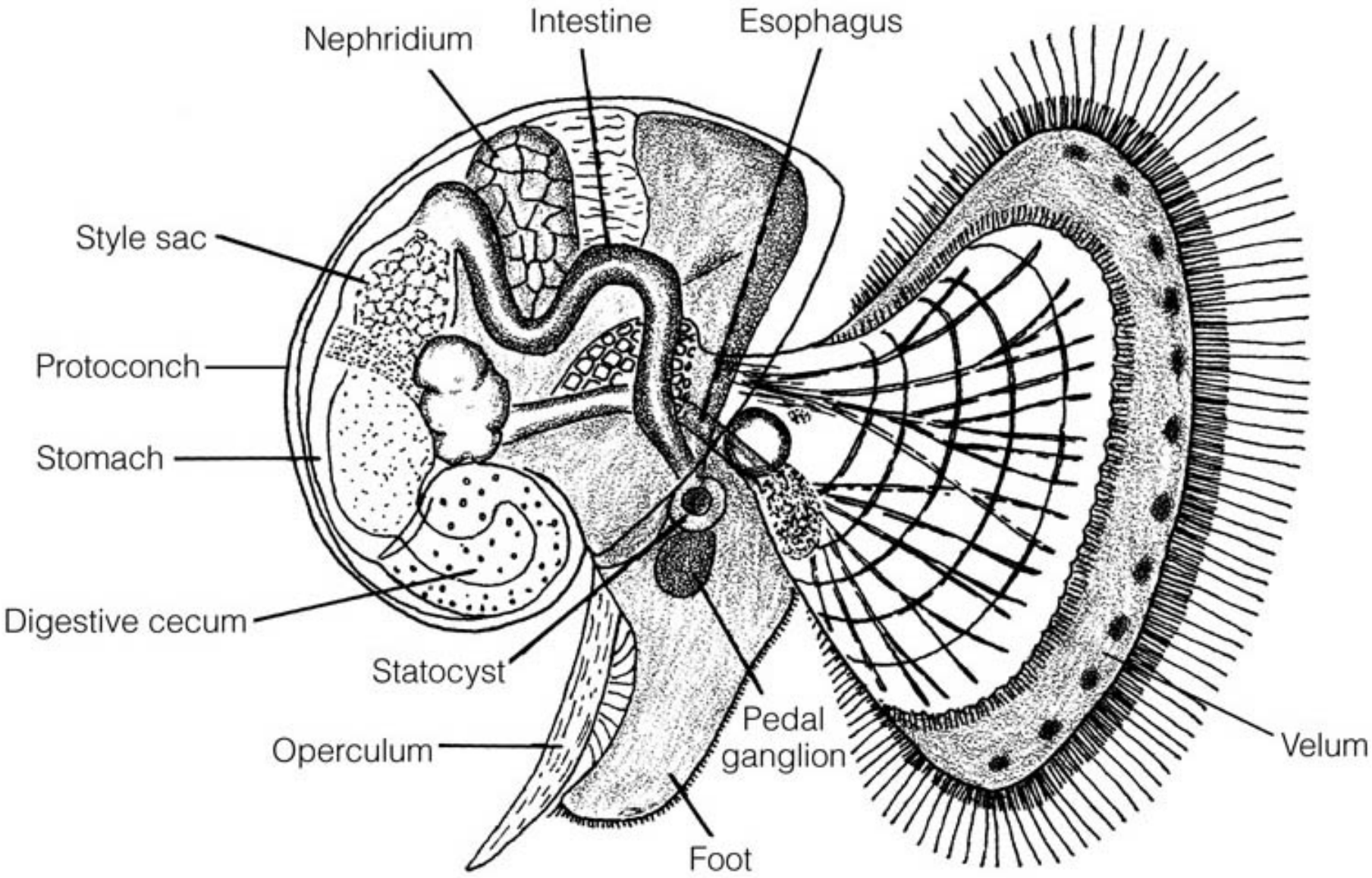
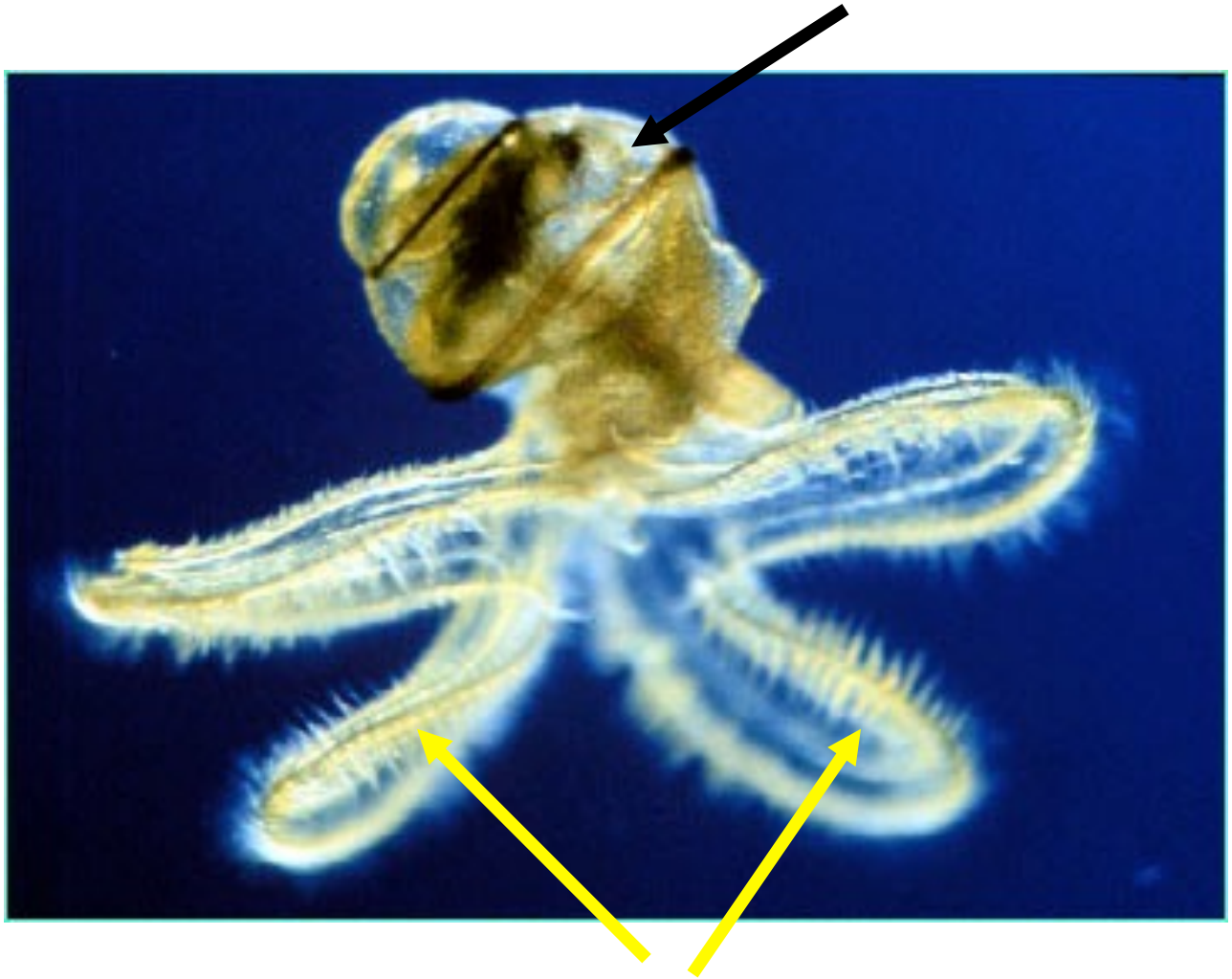


Figure 12-60A: **Veliger larva of the slipper snail *Crepidula*. A, Lateral view.**

Veliger larva – *Conus* sp.



Veliger – Gastropod

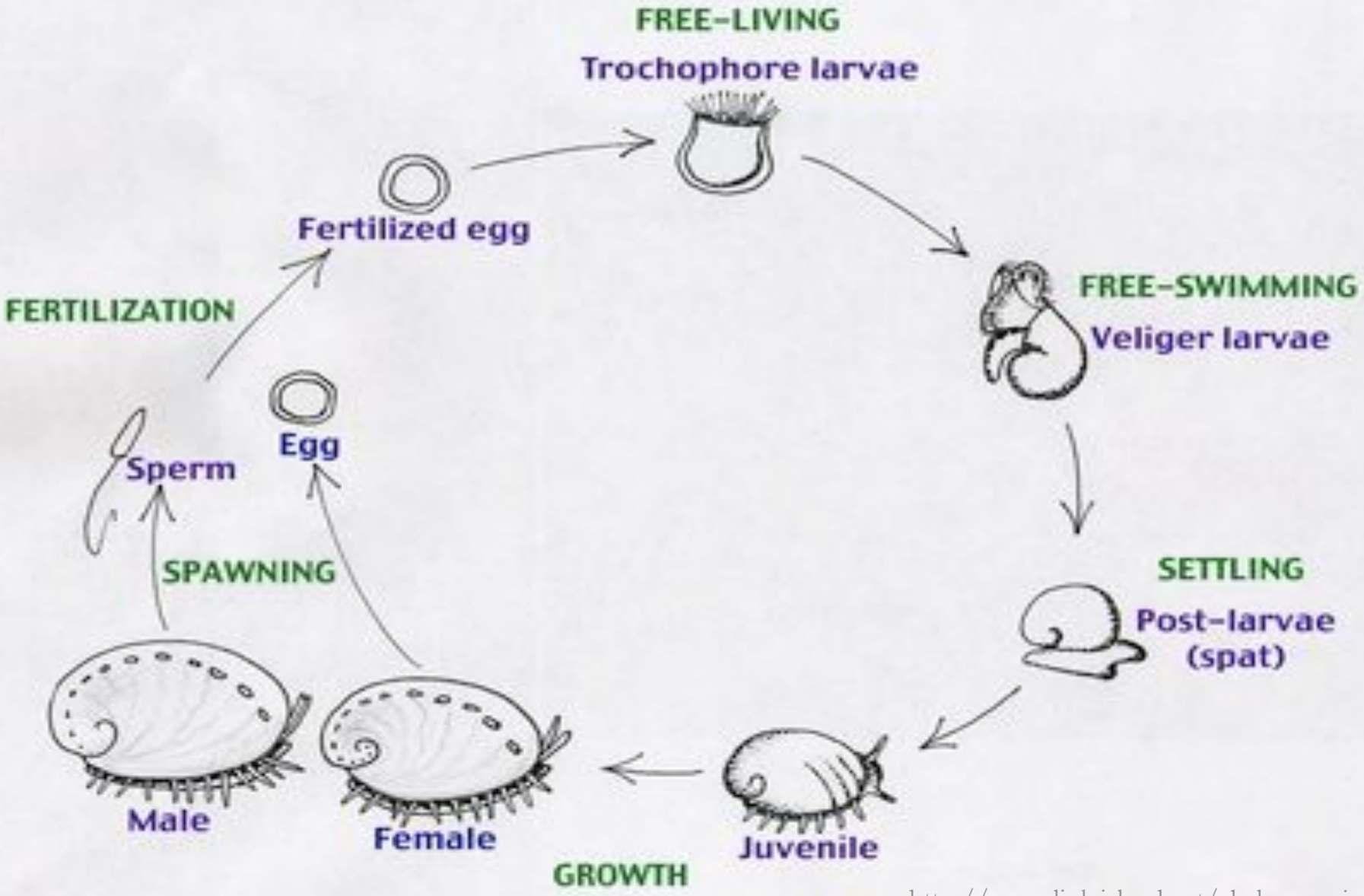
age Quest Marine

st3d.com

Veliger of snail

Veliger larva of snail

Abalone Life Cycle



http://oceanlink.island.net/abaloneproject/

Settlement

Precompetent period (developmental)

Competent period: capable of settlement

- **Larvae capable of selection and experience differential mortality → lead to settlement patterns**
- **“sampling” behavior**
  - **Many highly selective in lab**

Settlement

Endogenous triggers

Exogenous triggers

- **Facultative cues**
- **Obligate cues**

Settlement cues- abalone

Become competent to settle at 6-7 days in many species

Competence period lasts from 3-4 days up to ~1 month and varies with species

(until yolk supply used up)

- (semi-)**Obligate cue**

  Coralline algae

  Some will settle anywhere once reach end of competency

Settlement cues- abalone

Settlement cues- abalone

GABA: gamma-aminobutyric acid

-neurotransmitter

-coralline algae