Histology of a Freshwater Mussel

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Outline

• Shell morphology
• Gross morphology of soft tissues
• Processing tissue for histology
• Histology of major tissues
Shell morphology of *Villosa nebulosa*

- Posterior
- Ventral
- Dorsal
- Umbo
- Anterior
- Lateral teeth
- Pseudocardinal teeth

Scale: 10 mm
Processing Tissue for Histology

- Transport mussels to the lab in aerated cooler or in wet towels with freezer packs, do not use store-bought ice
- Cut adductors or prop shell open or anesthetize
- Fix whole mussels in 10% formalin for at least 48 hr
- After 48 hr in formalin, shell will start to dissolve forming a precipitate
- Immerse tissues or whole mussels in a graded ethanol series
- Can leave mussels in 70% ethanol indefinitely
- Process whole mussels for paraffin embedding
- Cut 4 μm sections from each block
- Stain slides with hematoxylin and eosin
Gross Morphology of Mussel Tissues

- outer gill
- inner gill
- mantle
- foot
- anterior adductor
- posterior adductor
Brooding Mussels

Villosa nebulosa

Fusconaia cerina

Mussels brood using: 1) Part of one gill, 2) The entire outer gill or 3) The entire outer and inner gills

glochidia

outer gill

mantle lure

10 mm
Histology of a Whole Mussel
## Most Significant Organs and Tissues

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<td>Middle mantle</td>
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<td>Mantle isthmus</td>
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<td>Ovaries and testes</td>
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Types of tissue
• Epithelial tissue
• Connective tissue
• Muscle tissue
• Nervous tissue
Animal Histology: Epithelial tissue

• Epithelial tissue lines or covers bodily surfaces, secretes chemical substances

• Tissue types:
  1. Squamous epithelium (flat cells)
  2. Cuboidal epithelium (cubed shaped cells)
  3. Columnar epithelium (column-shaped cells)

• Epithelial tissue further classified as either a simple or stratified epithelium

• Simple epithelium has only one cell layer

• Stratified epithelium has more than one cell layer
Microvilli are shorter than cilia and may not show up as well with light microscopy.
Animal Histology: Connective tissue

- **Connective tissue** provides structural or physiological support.

- **Tissue types:**
  1. Connective tissue proper (fibrous)
  2. Special connective tissue (adipose tissue, blood, bone, cartilage)

- Connective tissue proper includes dermis layer of skin, tendons, ligaments, elastic tissue, mesentery.

- CTP mostly consists of fibroblasts and different types of collagen fibers.
Connective tissue proper

Dermis

Note the irregular arrangement of collagen fibers

Tendon

Note the parallel arrangement of collagen fibers
Animal Histology: Connective tissue

- Special connective tissue include adipose tissue (fat), blood, bone, cartilage

- Adipose tissue
- Bone (non-decalcified bone)
- Blood
- Cartilage
Animal Histology: Muscle tissue

- Muscle tissue is contractile and muscular contractions are based on the sliding filament mechanism.

- Tissue types:
  1. Skeletal muscle
  2. Cardiac muscle
  3. Smooth muscle

- Skeletal muscle contractions based on conscious control.

- Smooth muscle and cardiac muscle contractions generally occur automatically.

- Muscle fibers may be organized into bundles in different orientations (longitudinal, transverse, oblique).
Animal Histology: Nervous tissue

- Nervous tissue consists of neurons that generate or conduct nerve impulses, and glial cells (supporting cells)
- Central nervous system consists of brain and spinal cord
- Peripheral system generally consists of nervous tissue throughout the rest of the body
- Difficult to distinguish nervous system cell types mainly because of complex composition of nervous and other tissues
connective tissue and hemolymph

inner epithelium

Mantle cavity

outer epithelium

Middle Mantle

Shell
empty marsupial gill of *V. nebulosa*

interbranchial septum

empty water tube

Gill

filled marsupial gill of *V. nebulosa*

membrane

glochidium
Foot

subepithelial glands

furrows

muscle
adhesion glands or mucus glands?

cilia

Foot

adhesion glands or mucus glands?
Anterior end of the visceral mass

foot

digestive gland

stomach
Digestive gland

- Primary tubules have plicae and cilia
- Secondary tubules have microvilli, vesicles

Digestive tubule 1

Digestive tubule 2
Stomach

ventral
dorsal

“gastric shield” (mucus?)
mucus
cilia
Crystalline style sac (first limb of the intestine)

rotation of style may pull food matter into intestine forming a bolus
stiff cilia

wispy cilia

Crystalline style sac

stiff cilia

wispy cilia

goblet cell
Digestive tract

- stomach
- digestive gland
- intestine

Gutheil, (1912)
intestinal limbs 2, 3 (loops through visceral mass)

plicae
intestinal limbs 2, 3

Intestine

cilia

goblet cells

intestinal limbs 2, 3
fourth intestinal limb (along the hinge)
Pedal Ganglia

- neuron cell bodies
- glial cell or neuron cell body?
- axons
- cortex
- medulla
Heart

- ventricle
- pericardial cavity
- AV valve
- Auricle (atrium)
Nephridium (kidney)
dorsal limb
ventral limb
hemolymph vessel
intracellular granules
nephridial lumen
cuboidal epithelium
Nephridium
sperm morula
spermatids
Testes
testicular acinus during the winter
testicular acini during the summer
spermatocytes
spermatozoa
Ovarian acini during the winter

Ovarian acinus during the summer

Mature ovum

Vitelline

Cell body

Ovary
References

• www.Histologyguide.org