Use the text and figures in Exercise 16 (The Echinoderms) and Exercise 17 (Phylum Chordata) to aid your study of the preserved specimens and prepared slides; examine the additional specimens as indicated.

**Exercise 16 (The Echinoderms)**

Things to know for Phylum Echinodermata:
- Identify parts of the *ambulacral system*. Where is the madreporite?
- Does the mouth face the substrate, the water column, or other?
- Is the gut straight or U-shaped? Complete or incomplete?
- Structures and their functions

**Phylum Echinodermata**
- radial, pentameric symmetry is derived; larvae are bilateral
- free swimming larvae; benthic adults
- endoskeleton of dermal calcareous plates with spines or spicules
- *water vascular system* - allows for locomotion by tube feet (*podia*)
- exclusively marine water

**Class Asteroidea**, sea stars
- arms (rays) taper gradually from central disc
- oral side (where mouth is) is directed toward substrate
- anus and madreporite on aboral side

Sea star – text pp. 248-253
1. Preserved specimen – Figs. 16-2, 16-3, 16-4
   - examine the parts of the water vascular system
   - **LABELS:**
     - *Aboral*: madreporite, spines
     - *Oral*: podia (=tube feet), ambulacral groove, mouth

2. Slide of *pedicellaria*
   - Pincer-like structures; prevent fouling
   - found in Class Asteroidea and Class Echinoidea

**Observation**: *Luidia clathrata*, lined sea star (drawing not needed)

**Class Ophiuroidea**, brittle stars, basket stars
- arms distinctly set off from central disc
- madreporite on oral side (unlike Asteroidea); oral side toward substrate
- tube feet lack suckers (used in feeding); locomotion by arm movements
Brittle star – text pp. 255-257
- **bursae**: pouches used in respiration; gonads located there

3. Preserved specimen – Figs. 16-5, 16-6
- **LABELS**: jaws, madreporite

**Class Echinoidea**, sea urchins, sand dollars
- spherical or disc shaped, with no arms
- oral side toward substrate; oral surface expanded toward aboral

*Mellita quinquiesperforata*, sand dollar
- spines used in locomotion; tube feet used in respiration
- anus of sand dollars has moved to “posterior” margin of aboral or to oral side

4. Preserved specimen

Sea urchin – text pp. 257-260
- spines movable, used in locomotion

5. Preserved specimen – Figs. 16-7, 16-8
- **LABELS**: spines, mouth, teeth

6. Aristotle’s lantern
- mouthparts of echinoids: 5 jaws, each with 1 tooth

Ambulacral system - sea urchin and sand dollar **tests**

7. Sea urchin test
- hold test up to light and see holes of **ambulacra**
- largest opening is mouth
- ossicles of **periproct** often fall out; **anus** not easily visible even if periproct is present

8. Sand dollar test
- tube feet emerge via **petaloids** on aboral surface

**Class Holothuroidea**, sea cucumbers
- body elongate along oral/aboral axis
- oral tentacles (retractable, modified podia) used in feeding
- madreporite internal
- **evisceration**: respiratory tree and digestive tract are expelled through anus/cloaca; used as diversion tactic, internal organs regenerate

*Cucumaria*, sea cucumber – text pp. 260-262

9. Preserved specimen – Figs. 16-9, 16-10
- **LABELS**: podia, tentacles
Class Crinoidea, sea lilies, feather stars
- attached during all or part of life
- oral surface faces upward, toward water column
- short, U-shaped gut; anus on oral surface
- lack madreporite, spines
- tube feet used in food capture (they are hard to see)

Sea lily – text pp. 263-264
10. Preserved specimen – Fig. 16-11 is a feather star (similar to a sea lily, except without a stalk)
- notice the cirri, arms, pinnules

Exercise 17 (Phylum Chordata)

Things to know for Phylum Chordata:
- Be able to identify the five chordate characters, if applicable, in adult specimens
- Structures and their functions

Phylum Chordata
- notochord; skeletal rod for muscle attachment
- dorsal, tubular nerve cord; anterior enlarged to form brain
- pharyngeal pouches; in aquatic spp., these develop into gill slits
  - 1° for particle feeding
  - 2° modified to true gills for respiration – post-anal tail; 1° for locomotion in water
- endostyle (secretes mucus and traps small food particles) OR thyroid gland (the vertebrate derivative of the endostyle)

Subphylum Urochordata
- body enclosed in a cellulose-like tunic (body covering)
- only the larval forms have all 5 chordate characters

Class Ascidiacea, tunicates
- adults sessile, benthic
  Ciona - a solitary sea squirt – text pp. 269-271
  - two siphons: incumbent (distal) and excurrent (lateral)
  - filter seawater for feeding and respiration

11. Preserved specimen – Figs. 17-2, 17-3
- LABELS: tunic, incumbent siphon, excurrent siphon

Aplidium, sea pork - a colonial sea squirt
- the zooids are embedded in the tunic

12. Preserved specimen
Ciona larva, an ascidian “tadpole larva” (DO NOT confuse this with a frog tadpole!!!)
- has all 5 chordate characters
13. Slide – Fig. 17-4
- **LABELS**: perforated pharynx (branchial basket), endostyle, tail

Class Thaliacea, salps
- gelatinous plankton, barrel-shaped
- incurrent and excurrent siphons on opposite ends

Unidentified salps
14. Preserved specimen

**Subphylum Cephalochordata**

- all five chordate characters persist throughout life stages – gill slits used for feeding; respiration is by diffusion

*Branchiostoma*, amphioxus, lancelet
15. Slide (w.m.) – text p.273; Fig. 17-6A
- **LABELS**: cirri (=tentacles), gill slits, gill bars, notochord, atrio pore, anus
16. Slide (x.s.) – text p. 271; Fig. 17-6B; 17-6C
- **LABELS**: dorsal, hollow nerve cord, notochord, myotomes, intestine, gonads

Observation: preserved specimen (no drawing required) – text pp. 272-274; Figs. 17-5, 17-6A and 17-7.

**Observations**: Examine Echinoderms, Sea Star Dissection, and Tunicates Biosmounts.
(Not necessary to draw.)

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FOR NEXT LAB MEETING:
- download handout for Lab #11 and read Exercise 18 (The Fishes)
- write out each taxonomic summary in your Laboratory Specimen Notebook BEFORE lab
PDF to Word