Echinoderms

1) Phylum: Echinodermata
   a) Up to this point all the organisms we have discussed have been **Protostome**s (the mouth forms first in development), but echinoderms are lumped in with the chordates in that they are **deuterostomes** (anus forms first in development).
   b) Includes star fish, brittle stars, sea urchins, sea cucumbers, and sand dollars.
   c) Closely related to chordates/vertebrates
   d) They all share 5 characteristics not in any other phylum
      i) A calcium endoskeleton
      ii) Water vascular system
      iii) Pedicellariae (small pincer organs used to clean skin or grab small prey)
      iv) Dermal branchiae (basically underwater lungs)
      v) Pentaradial symmetry (five sided)
   e) Taxonomically very confusing for zoologist
   f) All marine
   g) Some filter feed but many are predators
   h) Sea stars
      i) External structures
         (1) Called star fish but not really fish
         (2) Range from about a centimeter to over a meter in size
         (3) Typically five arms (sometimes there are more)
         (4) All arms merge with the central disk where the mouth/anus/and medreporite is
         (5) On the underside there are rows of tube feet going down each arm, these help manipulate food into the mouth.
      ii) Water vascular system
         (1) Set of canals and specialized tube feet that form the hydrostatic skeleton
         (2) The **madreporite** is the main opening that regulates water going into and out of the star fish
         (3) The madreorite dumps into the stone canal which descends toward the ring canal around the mouth and eventually into the radial canals that go into the arms.
         (4) From the radial canals there are smaller tubes that connect to the tube feet to fill them individually with water.
      iii) Feeding
         (1) The mouth leads into a two part stomach in the central disk.
         (2) The larger **cardiac stomach** can be inverted outside the body to absorb food, the smaller **pyloric stomach** breaks down the food with help from the attached digestive gland called the **pyloric ceca**.
         (3) From the pyloric stomach broken down food is passed through a small intestines for absorption then out the anus.
         (4) Many sea stars are predators of mollusks, crustaceans, other echinoderms, and so forth.
         (5) In many cases they are **keystone species** increasing the diversity when present

iv) Nervous system
    (1) Very underdeveloped, no brain just a few sets of nerve cords with eye spots are the end of each arm
v) Reproduction
    (1) Most have separate sexes and have external fertilization
    (2) They can regenerate lost arms
    (3) If they are cut with about 1/5 of the central disk intact they can regenerate into a new organism.
        (a) Oyster fisherman didn't understand this and instead of killing sea stars they actually increased populations on oyster beds.

i) **Brittle stars**
    i) Largest group of echinoderms
    ii) Very similar to sea stars but with a few exceptions
        (1) No pedicellaria
        (2) Tube feet have no suckers
        (3) Madreporite located on underside of body
        (4) Locomotion is by arm movement
        (5) No anus
        (6) No intestine

j) **Sea urchins, sand dollars**
    i) Very different looking all are enclosed in a shell
    ii) The five areas are connected together
    iii) Pedicellariae are modified to spines in urchins and in many contain venom pouches
    iv) Its digestive system is simple with a mouth containing **Aristotle's lantern** (a comples mechanism for shredding food in the mouth.)

k) **Sea cucumbers**
    i) Resemble the vegetable which there name comes from
    ii) They have a respiratory tree not seen in other echinoderms called a **cloaca**, which pumps water in and out for respiration as well as excretion of waste.
    iii) Most trap suspended food on their mucus skin and then use there tube feet to move it into the mouth
    iv) When threatened these species self mutilate. They discharge part of their respiratory system called **cuvierian tubules** which stick and entangle predators and some even are toxic.

2) **Hemi chordates**
    a) Once thought to be true chordates these are our closest non-chordate relatives
    b) They have gill slits like all chordates
    c) However there notochord (a characteristic that defines vertebrates) is not homologous to chordates, it is just an extension of the mouth
    d) All are small wormlike bottom dwellers that typically filter feed