

Advanced Cell Biology. Lecture 3

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Outline

Model organisms

Chemistry of life

Chemical elements and atoms

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Chemistry of life

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Previous final question: the answer

Which organelle is present in most prokaryotic cells and absent in all eukaryotic?

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Which organelle is present in most prokaryotic cells and absent in all eukaryotic?

- ▶ Bacterial flagella
- ▶ Nucleoid
- ▶ Tylacoid

Diversity of life and model organisms

- ▶ *Escherichia coli*, or *E. coli*: proteobacteria
- ▶ *Saccharomyces cerevisiae*: fungal protist
- ▶ *Arabidopsis thaliana*: flowering plant from cabbage family
- ▶ *Drosophila melanogaster*: fly (Diptera) insect
- ▶ *Caenorabditis elegans*: round worm (Nematoda)
- ▶ *Mus musculus*: common mouse (rodent mammal)

Less common model organisms

- ▶ *Gallus gallus*: chicken (Aves, birds)
- ▶ *Danio rerio*: zebrafish (Pisces)
- ▶ *Strongylocentrotus purpuratus*: purple sea urchin (Echinodermata)
- ▶ *Hydra vulgaris*: freshwater hydra (Cnidaria)
- ▶ *Trichoplax adhaerens*: basal animal (Placozoa)
- ▶ *Neurospora crassa*: orange bread mold (fungal protist)
- ▶ and many others*

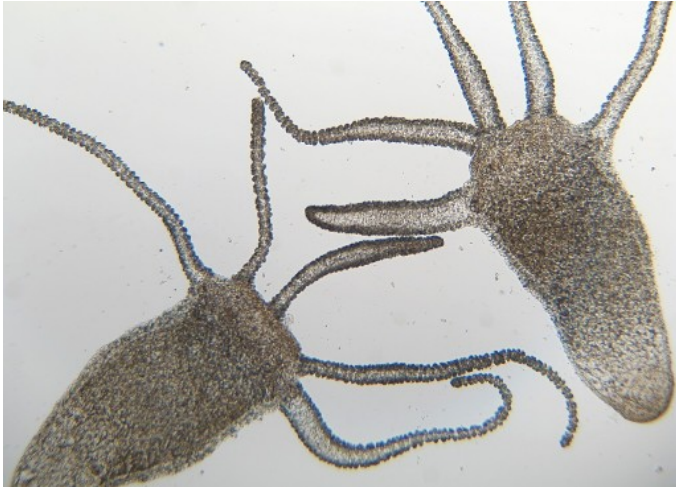
Zebrafish, *Danio rerio*



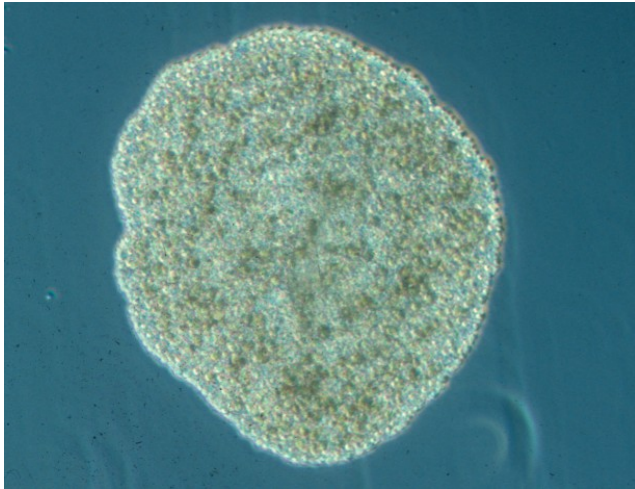
Sea urchin, *Strongylocentrotus purpuratus*



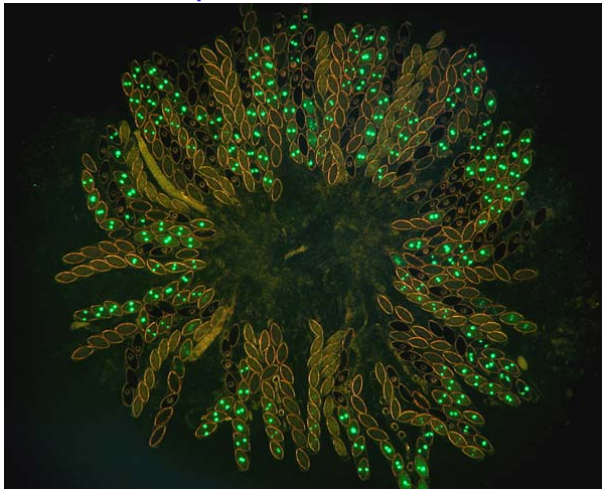
Hydra, *Hydra vulgaris*



Trichoplax adhaerens



Orange bread mold, *Neurospora crassa* under fluorescent microscope



Terms of atomic chemistry and physics

- ▶ Number of protons, neutrons, electrons and periodic table
- ▶ Isotopes, radioactivity
- ▶ Atomic weight, molecular weight
- ▶ Mole, molar solution, Avogadro's number

Primary (biogenic) elements

- ▶ Main three biogenic elements: carbon (C), hydrogen (H), oxygen (O)
- ▶ Slightly less important are nitrogen (N) and phosphorus (P)
- ▶ Potassium (K), sodium (Na), calcium (Ca), magnesium (Mg): as cations, e.g. K^+ or Ca^{2+}
- ▶ Iron (Fe), chlorine (Cl) and sulfur (S): also used as ions, but in less amounts

Microelements

- ▶ Play a lesser roles and used in lesser amounts
- ▶ These are: silicon (Si), iodine (I), fluorine (F), selenium (Se), vanadium (V), manganese (Mn), boron (B), molybdenum (Mo), copper (Cu), nickel (Ni), zinc (Zn) and chromium (Cr)

Ionic bonds

- ▶ Based on electrostatic attraction
- ▶ Requires electron transfer from one to another atom
- ▶ Molecules with ionic bonds are normally well dissolved in water

Covalent bonds

- ▶ Based on electron sharing
- ▶ Depending on strength, may be polar and non-polar

Hydrogen bonds

- ▶ Molecule-to-molecule bonds
- ▶ Normally occurs between molecules with polar covalent bonds and appropriate size

Water and its importance

- ▶ Universal solvent
- ▶ Water molecules are cohesive
- ▶ Water molecules are adhesive
- ▶ Water has high surface tension
- ▶ Water has high heat capacity
- ▶ Water is less dense than ice

Acids, bases and pH

- ▶ Molecules dissociates with hydrogen ion (or, in other model, hydronium ion) are acids
- ▶ Molecules dissociates with hydroxyl ion are bases
- ▶ Weak acids/bases have high frequency of reverse reaction
- ▶ pH represents the concentration of hydrogen ions, high pH (> 7) corresponds with bases, low pH (1–5) corresponds with acids

Final question (1 point)

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Name one chemical element which is NOT biogenic

Summary

- ▶ There are five main biogenic elements: carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and phosphorus (P)
- ▶ Ionic and covalent bonds are inter-atomic, hydrogen and hydrophilic bonds are inter-molecular
- ▶ Organic chemistry is a chemistry of carbon

For Further Reading



A. Shipunov.

Advanced Cell Biology [Electronic resource].

2011—onwards.

Mode of access: [http:](http://)

[//ashipunov.info/shipunov/school/biol_250](http://ashipunov.info/shipunov/school/biol_250)



B. Alberts et al.

Essential Cell Biology. 3rd edition.

Garland Science, 2009.

Chapter 1: Model organisms; *Chapter 2*: Chemical bonds.