Lecture 33 – Experimental Genetics

I. Experimental genetics – one of main tools for study of biology
   A. General approach:
      1. 
      2. 
      3. 
   
   B. Often use “model” organisms
      1. model organism – experimentally tractable organism
      2. underlying assumption – what we learn from study of model organism is relevant to human biology

II. Common characteristics of model organisms
   A. short generation time
   B. large # of offspring
   C. easy, inexpensive culture
   D. small size
   E. easy storage
   F. carry out process of interest
   G. relatively simple organisms (generally)
   H. Common model organisms:
      1. *Escherichia coli* – bacterium
         - simple, small
         - short generation time
         - genome sequenced
         - major contributions: basic cellular processes, egs:
            - DNA replication
            - DNA repair
            - chemotaxis
      2. *Saccharomyces cerevisiae* – budding or brewer’s yeast, eukaryote
         - simple, small
         - short generation time
         - genome sequenced
         - major contributions:
            - cell cycle
            - cell differentiation
            - cell-cell signaling
      3. *Caenorhabditis elegans* – nematode
         - small, fairly simple animal
         - short generation time
         - genome sequenced
         - transparent
         - large broods
         - easy storage
         - major contributions:
            - development
            - programmed cell death
            - cell-cell signaling
4. *Drosophila melanogaster* – fruit fly
   - small
   - short generation time
   - genome sequenced
   - many offspring
   - major contributions:
     - development
     - body plan
     - cell-cell signaling

5. *Danio rerio* – zebra fish
   - easy culture, storage
   - genome being sequenced
   - vertebrate
   - transparent embryos
   - major contributions
     - development

   - genome sequenced
   - mammal
   - major contributions:
     - development
     - model for human diseases

7 *Arabidopsis thaliana* – mustard plant
   - easy culture, storage
   - genome sequenced
   - plant model
   - major contributions:
     - plant development and physiology

I. some advantages and disadvantages of each model organism

<table>
<thead>
<tr>
<th>name</th>
<th>advantages</th>
<th>disadvantages</th>
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<tbody>
<tr>
<td><em>E. coli</em></td>
<td>easy growth, storage, short generation</td>
<td>prokaryote</td>
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<tr>
<td><em>S. cerevisiae</em></td>
<td>easy growth, storage, short generation, eukaryote</td>
<td>single cell</td>
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<tr>
<td><em>C. elegans</em></td>
<td>easy growth, storage, short generation, simple</td>
<td>simple</td>
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<td></td>
<td>multicellular, transparent</td>
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<tr>
<td><em>D. melanogaster</em></td>
<td>easy growth, short generation, more complex</td>
<td>difficult storage, opaque</td>
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<td></td>
<td>multicellular</td>
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<td><em>R. danio</em></td>
<td>easy growth, storage, transparent embryo,</td>
<td>larger, longer generation time</td>
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<td></td>
<td>vertebrate</td>
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<td><em>M. musculus</em></td>
<td>mammal</td>
<td>few offspring, longer generation time, larger</td>
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<td><em>A. thaliana</em></td>
<td>plant, small, short generation time</td>
<td></td>
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<tr>
<td><em>H. sapiens</em></td>
<td>what we want to understand</td>
<td>too numerous to list</td>
</tr>
</tbody>
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III. How to use genetics to study a process.
   A. Generate mutants in order to identify genes required – forward genetics
      1. Design mutant screen

      2. Genetic characterization

      3. Phenotypic characterization

      4. Clone genes
B. examples:
  eg 1: cell cycle in yeast
  eg 2: nervous system development in *C. elegans*

C. How to choose a model organism?
  1. ease of growth, maintenance, etc.
  2. complexity
  3. suitability for intended study