CONCEPT: MODEL ORGANISMS

Theory of model organisms

● **Model organisms** are organisms commonly used to _____ biology

□ They typically have certain features that make them exceptionally useful for study

- Examples include: fast division, transparent bodies, easy to genetically manipulate

□ Every organism is descended from an ancestral cell

- Pro: Genome comparisons reveal diverse sizes, but similar genes – include conservation

- Con: **Genetic redundancy** describes the presence of multiple gene versions within an organism

- Complicates study because mutants may have no effect because of redundant proteins

EXAMPLE: Protein sequence conservation of Histone H1 protein

Histone H1 (residues 120-180)

HUMAN	KKASKPKKAASKAPTKKPKATPVKKAKKKLAATPKKAKKPKTVKAKPVKASKPKKAKPVK
MOUSE	KKAAKPKKAASKAPSKKPKATPVKKAKKKPAATPKKAKKPKVVKVKPVKASKPKKAKTVK
RAT	KKAAKPKKAASKAPSKKPKATPVKKAKKKPAATPKKAKKPKIVKVKPVKASKPKKAKPVK
COW	KKAAKPKKAASKAPSKKPKATPVKKAKKKPAATPKKTKKPKTVKAKPVKASKPKKTKPVK
CHIMP	KKASKPKKAASKAPTKKPKATPVKKAKKKLAATPKKAKKPKTVKAKPVKASKPKKAKPVK

Main Model Organisms List

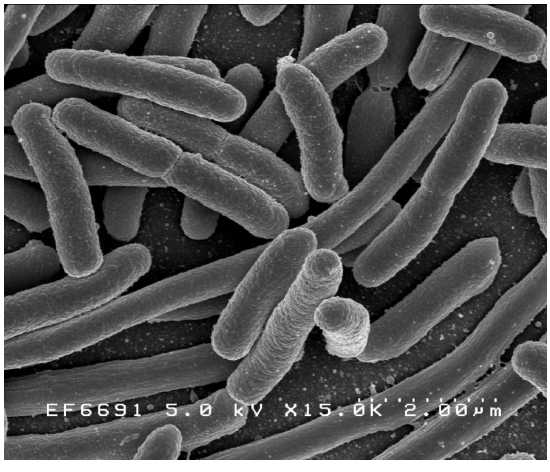
● ***E*scherichia *coli*** is used to study _____ biology

□ Has same basic genetic mechanisms as all other organisms

□ Rapidly divides every 20 minutes when grown in special broths

□ Scientists can use *E.coli* to replicate DNA and grow proteins for experimental use

EXAMPLE: *E. coli* cells



● **Yeast**, or *Saccharomyces cerevisiae,* is used to study basic _____ biology

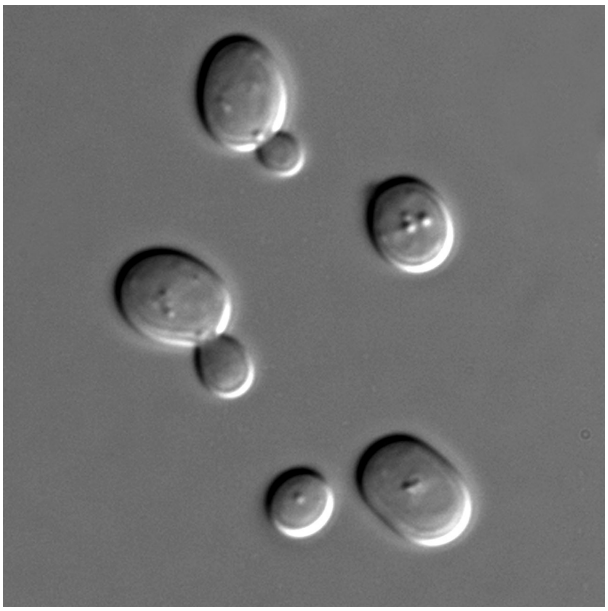
□ Single Eukaryotic cells with a small genome that can be grown in a laboratory

□ Yeast division occurs once every 2 hours

□ **Genetic Screens** are performed by mutagenizing yeast cells to look for *phenotypes* (physical attributes)

- These are able to identify specific genes that cause certain phenotypes

EXAMPLE: Yeast cells



● **Drosophila melanogaster** (fruit fly) has been used to study the mechanisms of _____

□ These includes: chromosomal biology, formation of multicellular structures, and body patterning

□ Has a 2 week reproductive cycle

□ Mainly used for gene identification and function

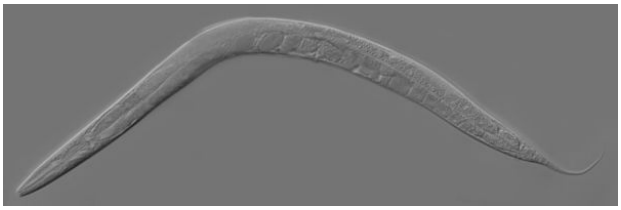
●***Caenorhabditis elegans*** has been used to study cell differentiation and _____

□ The entire sequence of events from the **zygote** to the final 959 body cells is known

□ 70% of human genes have worm counterparts

□ Mainly used to study cell lineage and development through the creation of mutant worms

EXAMPLE: Images of *Drosophila* and *C. elegans*



● ***Arabidopsis thaliana*** is used to study _____ genetics and development

□ A weed that can be grown indoors with large numbers of offspring (thousands in 8-10 weeks)

□ Contains 26,000 genes, which is about the same as humans (25,000 genes)

EXAMPLE: *Arabidopsis* weed

● **Zebrafish** and **frogs** are used to study _____ biology

□ **Zebrafish** (*Danio rerio)* are transparent for the first two weeks of development

- Easy to inject genes into the embryo

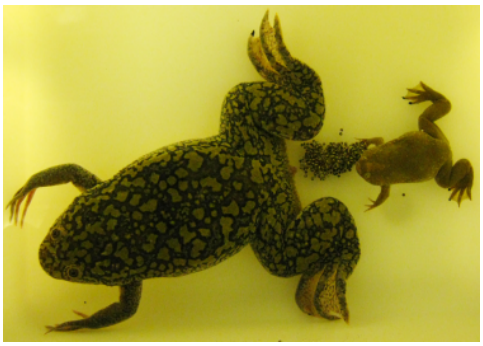
- Easy to maintain and reproduce rapidly

□ **Frogs** (*Xenopus laevis)* are used to study development because of their large eggs

- Easy to study cell division and development

- Also used to study *whole genome duplications*, which are common in *Xenopus* species

EXAMPLE: Images of laboratory a Zebrafish and frog



● **Mice** or *Mus musculus* are used to study _____

□ They reproduce quickly and share over 99% of protein coding genes with humans

- Also have similar immune systems

□ Used to mimic human disease through genetic mutations

- Mutations in similar disease causing genes cause similar developmental defects

EXAMPLE: Image of a laboratory mouse

● **Cell culture** grows human or other cells in a laboratory for study

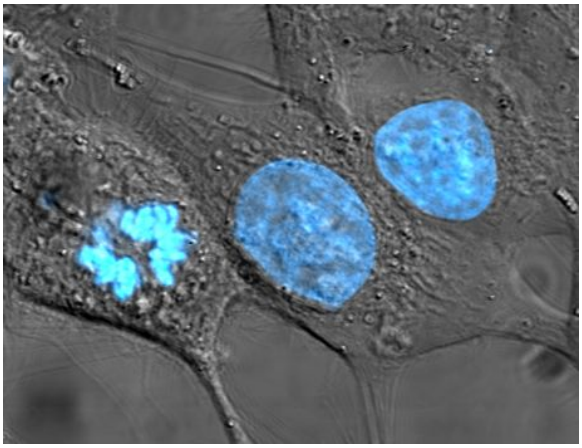
□ Used to study _____ mechanisms like signaling, growth, division, and gene expression

□ Certain cell types can be harvested and grown in culture (ex: neuronal cells vs. muscle cells)

- *In vitro* = *"in glass" and In vivo* = "in living"

□ Can be exposed to certain nutrients, proteins, or chemicals to see how they react

EXAMPLE: Image of cervical cancer cells (HeLa cells) in cell culture. The nuclei have been stained blue.



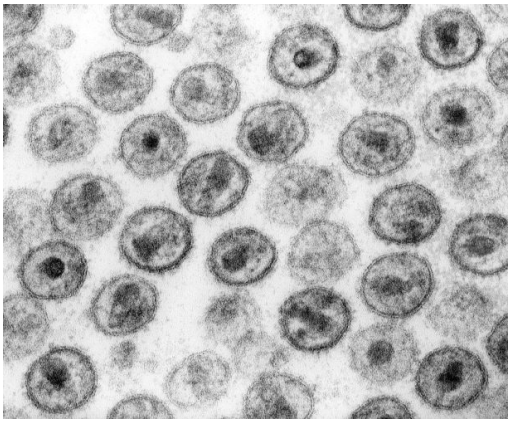
● **Viruses** are used to study _____ biology

□ Non-living infectious particles composed of a protein coat surrounding genetic material

□ Can be manipulated by scientists to add DNA to cells

- **Retroviruses** are RNA viruses that integrate their genetic material into the host cell's chromosome

EXAMPLE: HIV retrovirus image



PRACTICE:

1. Which of the following organisms is often used to study developmental biology?
    a. *E. coli*
    b. Yeast
    c. *C. elegans*
    d. Retroviruses

2. Frogs are often used to study development because why?
    a. They have unusual genetic systems
    b. Their eggs are large enough to see with the naked eye
    c. Their embryos are transparent
    d. They contain a small number of chromosomes

3. Which of the following organisms would be the most difficult to use when performing a genetic screen?
    a. Yeast
    b. *E. coli*
    c. Zebrafish
    d. Mice