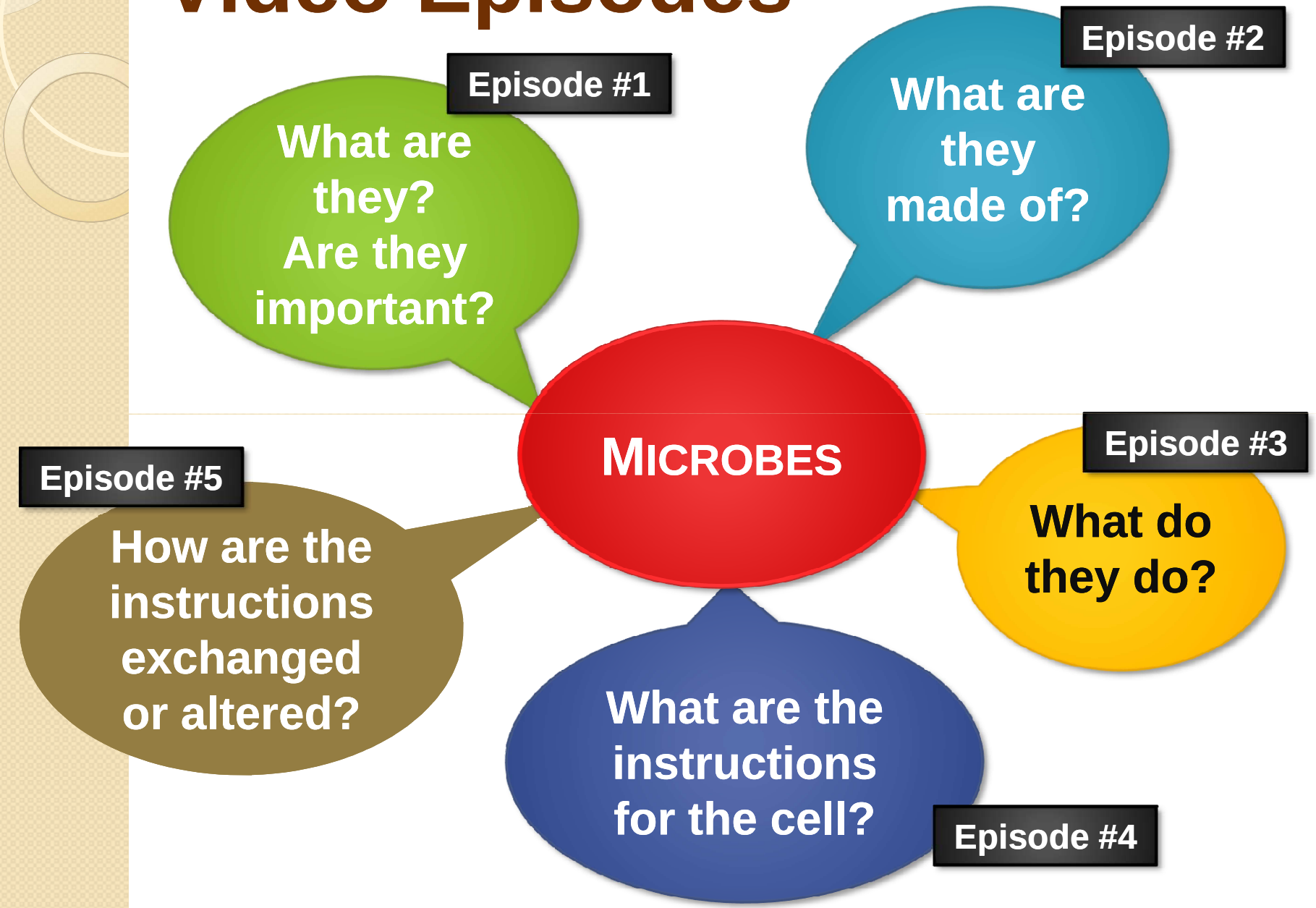
Unseen Life on Earth Exam 1

- **Unit overview for each**
  - Episodes 1 – 4
- **Readings**
  - Help to explain/expand upon videos
  - Text – know the major concepts
  - Will be pulled into next pages as appropriate
- **Review Quizzes**
  - Quizzes 1 – 4
  - Correct answers should be available on Moodle once everyone has completed each quiz

Video Episodes



Episode 1: The Microbial Universe

- **Microbes are unseen—but essential**
  - **Role in carbon and other cycles**
  - **Produce 50% of oxygen**
- **Many not known, not all can be grown in the laboratory**
- **They outnumber us on our own bodies – 10:1**
- **Microbiology diverse field:**
  - **Medical**
  - **Environmental**
  - **Industrial**

Types of Microbes

- **Prokaryotes (no nucleus)**
  - **Bacteria**
    - **Know the basic shapes of bacterial cells**
  - **Archaea**
- **Eukaryotes (have a nucleus and organelles)**
  - **Algae**
  - **Fungi**
  - **Protozoa**
  - **Helminthes (Worms)**
- **Non-living/not cells**
  - **Viruses**

Types of Microbes

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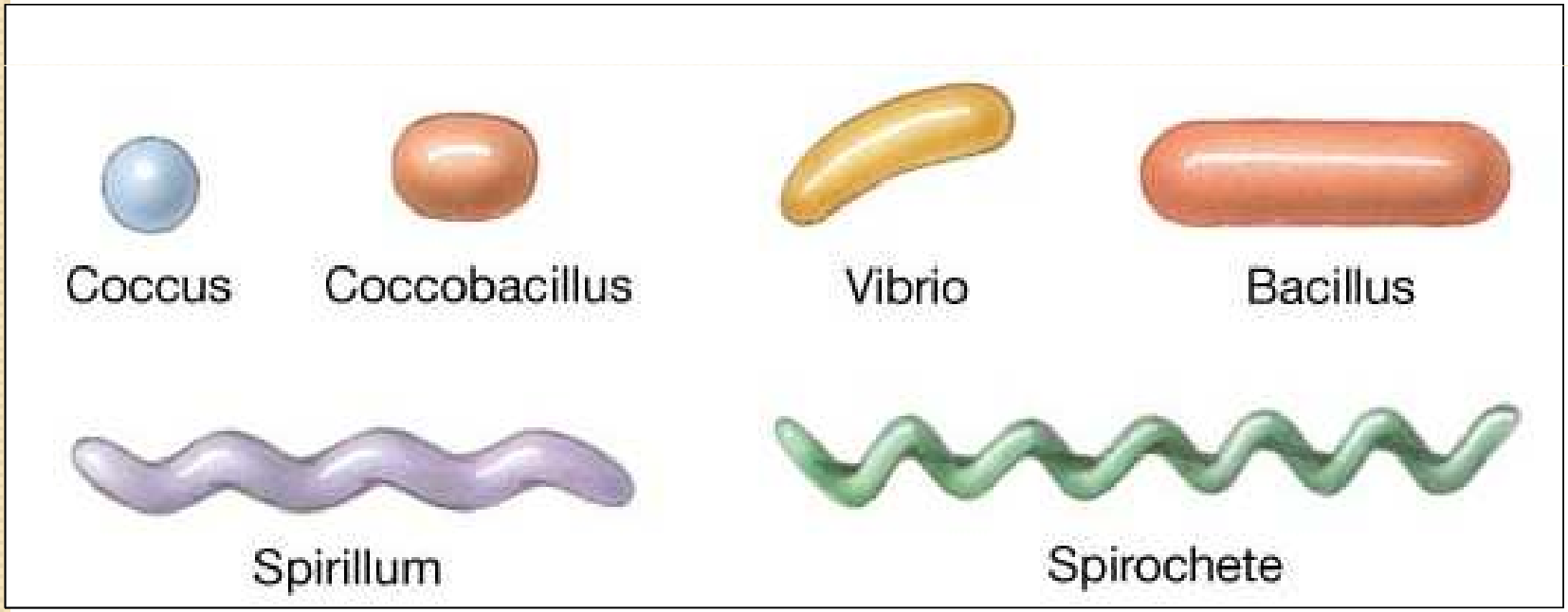


Past and Present

- **Important Scientists**
  - Bruce
  - Fleming
  - Hooke
  - Jenner
  - Koch
  - Leeuwenhoek
  - Ogata
  - Pasteur
  - Reed
  - Ricketts
  - Ross

Microbiology today

- Genetic Engineering
- Bioremediation
- Discovering unknown microbes and their role in maintaining ecosystems

Episode 2: Unity of Living Things

- **The cell: all include same fundamental building blocks**
  - **Amino acids**
  - **Nucleotides**
  - **Lipids**
- **Important features of prokaryotes and eukaryotes**
  - **Proteins = enzymes (amino acids)…perform tasks of cell**
  - **Nucleic acids (DNA and RNA): instructions**
  - **Cytoplasm**
  - **Cell membrane**
  - **ATP = energy molecule**
  - ****made of carbon**

Distinguishing Characteristics
(note readings, video, and lab #2, too)

- **Architecture**
  - **Prokaryotes**
    - **No organelles**
    - **Have DNA and ribosomes in cytoplasm**
  - **Eukaryotes**
    - **Have organelles (i.e., mitochondria to make energy)**
    - **Ribosomes, too, for protein synthesis**
  - **Appendages**
    - **Pili**
    - **Flagella**

Distinguishing Characteristics
(note readings, video, and lab #2, too)

- **Cell wall**
  - **Bacteria**
    - **Almost all have a cell wall**
  - **Eukaryotes**
    - **Only some have a cell wall (plants and fungi)**
    - **Animal = no cell walls**
- **Nucleus**
  - **Prokaryotes**
    - **No nucleus**
  - **Eukaryotes**
    - **Possess a nucleus**

Viruses

- DNA, RNA in a protein coat
- May or may not have “cell” membrane
  - If it has a membrane it stole it from a host cell
- VERY SMALL and dependent on living cells
- Cannot reproduce on its own – not a cell
- Do not have ribosomes for protein synthesis
- Not living

Episode 3: Metabolism

- All biochemical reactions in a cell
- Why is this important?
  - How nutrients are cycled through an organism / the environment
  - How cells make and use energy to survive and reproduce
- Metabolic categories for organisms
  - Autotrophs: CO_2 is the carbon source
    - Energy source: sun (phototrophs) or inorganic chemical (chemolithotrophs)
  - Heterotroph: organic molecules for carbon source
    - Chemoheterotroph: energy source also from organic molecules
    - Via fermentation or respiration turn organic molecules into ATP
  - To know: examples of each (i.e., book and video)
- Food source determines environmental niche

Metabolic Reactions

- **Catabolism: break down of nutrients**
  - **Glycolysis**
  - **Krebs cycle**
- **Use for**
  - **Making ATP (storage form of energy)**
  - **Making building blocks for growth and reproduction**
- **If use oxygen to make ATP: aerobic respiration**
- **If no oxygen: anaerobic metabolism**
  - **fermentation (heterotrophs) or anaerobic respiration (i.e., in deep sea vents)**
- **Fermentation used in food, wine, and beer production**

Anabolic Reactions

- Use to produce macromolecules of the cell
- Must occur for cells to grow and divide
  - DNA replication
  - Transcription
  - Translation
- Bacteria asexual reproduction – called binary fission
- Growth curve phases
  - Lag, log or exponential, stationary death
  - Need to give new nutrients and other things to keep growing

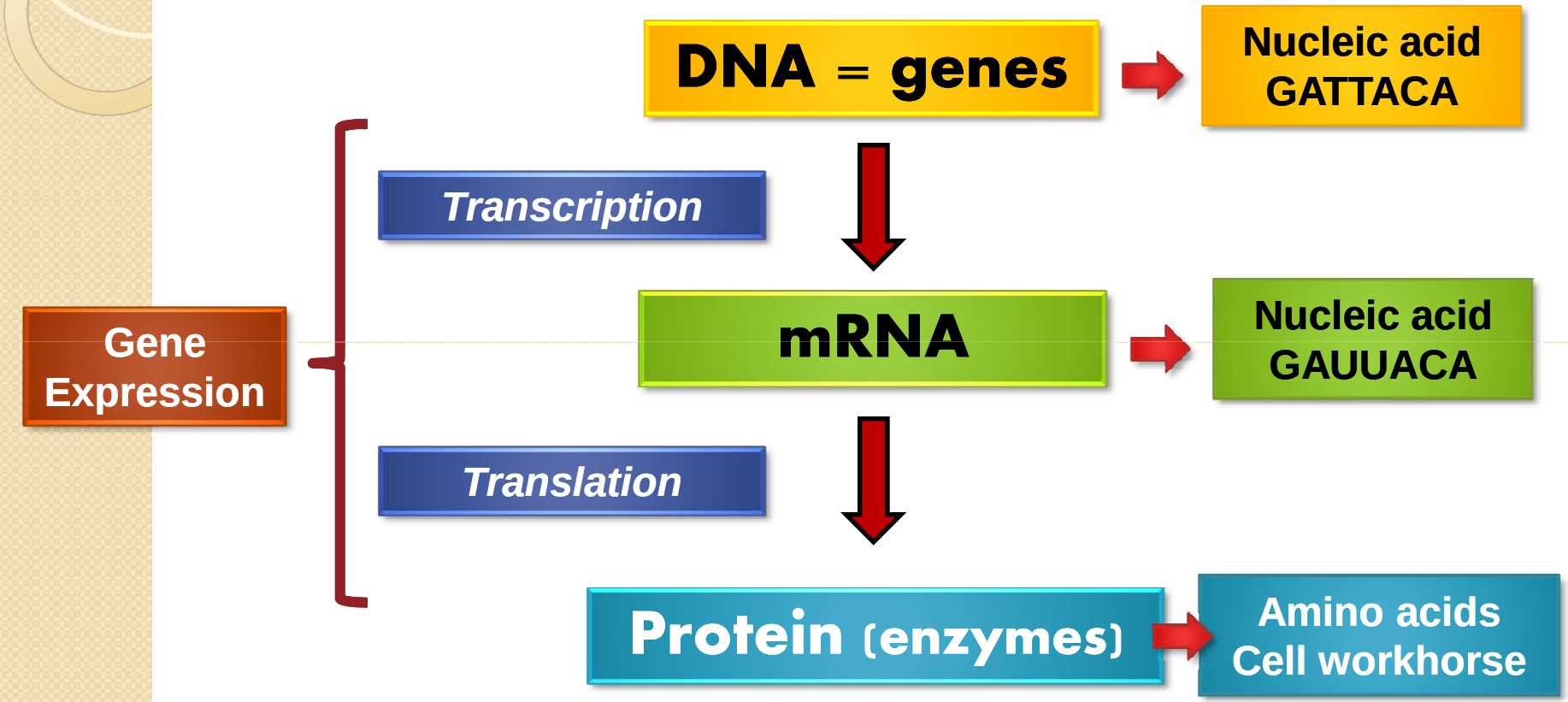
“– philes”

- **Psychrophile** – cold-loving
- **Mesophile** – middle temperature range loving
- **Thermophile** – heat-loving
- **Barophile** – pressure-loving
- **Halophile** – salt-loving
- **Acidophile** – acid-loving

Other topics – Episode 3

- **Waste-water**
  - **O_2 rate-limiting, so it is added to process**
  - **Anaerobic digester – wastes reduced to organic acids**
  - **Methanogens – produce methane in the anaerobic digester**
- **Volcanic vents**
  - **Chemolithotrophs use sulfur as source of energy**
  - **Serve as food for larger organisms**

Episode 4: Reading the Code of Life



Mutations happen in the DNA, which can change the gene expression and what the organism is capable of doing

DNA

- **Composed of nucleotides**
  - **Four different bases**
  - **Differs from RNA; 3 types of RNA molecules**
- **Sequence of bases determines amino acid sequence in protein**
- **Double stranded: sequence on 2 sides determined by base-pairing**
  - **Held together by weak hydrogen bonds**
- **Replication: goal is to make an exact copy so makes cells with identical DNA**
  - **Occurs before cells divide**

Useful videos on DNA replication

- http://www.youtube.com/watch?v=rpwjZX_z5rg
- http://www.youtube.com/watch?v=hfZ8o9D1tus
- http://www.youtube.com/watch?v=4jtmOZaIvS0

Protein synthesis

- Gene expression = making proteins from DNA instructions
- Two processes:
  - Transcription
  - Translation
- Translation on ribosomes
  - Requires mRNA, tRNA, and rRNA
- Useful video on process:
  - http://www.youtube.com/watch?v=NJxobgkPEAo

Mutations

- Change in sequence of DNA
  - May give rise to altered proteins and altered ability
  - Heritable: passed on to daughter cells when parent cell divides
- May occur at the time of DNA replication (vs. physical, chemical cause)
  - DNA replicates before cells divide
  - Microbes divide rapidly so more mutations in population
- Rarely an advantage for organism
  - Antibiotic resistance
  - Able to adapt to new environment

Mutations

- **Substitution mutations**
  - One base is substituted for another
  - Reading frame is maintained
  - Change in 3rd base often does not result in a change in the amino acid of the resulting protein
  - Change in the 1st base mostly results in a change in the amino acid of the resulting protein
  - Change in the 2nd base always results in a change in the amino acid of the resulting protein
- **Frameshift mutations**
  - A base is either added or deleted
  - Results in a change in the reading frame
  - In the resulting protein, everything after the mutation will be different – always very bad!

Gene Expression

- Gene expression is regulated – involves transcription and translation
- Energy used to make proteins
- Thus many genes are expressed only when needed
- Not all genes are transcribed and translated into proteins on an ongoing basis
  - Inducible
  - Repressible
  - Constitutive