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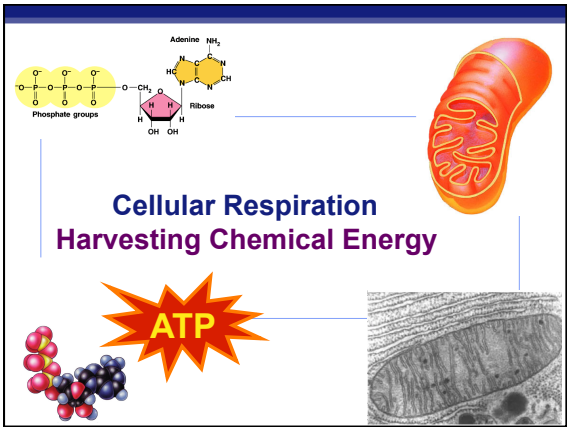

"Burn fuels" to make energy

combustion
making heat energy by burning fuels in one step

fuel (carbohydrates) + O_2 → $CO_2 + H_2O$ + heat

aerobic respiration
making ATP energy (& some heat) by burning fuels in many small steps

food (carbohydrates) + O_2 → ATP + $CO_2 + H_2O$ (+ heat)

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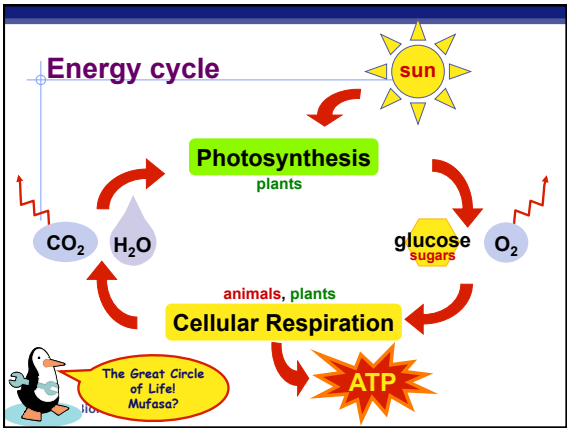


Energy needs of life

- Animals are energy consumers
  - What do we need energy for?
    - synthesis (building for growth)
    - reproduction
    - active transport
    - movement
    - temperature control (making heat)




Where do we get energy?

- Energy is stored in organic molecules
  - carbohydrates, fats, proteins
- Animals eat these organic molecules → food
  - digest food to get
    - fuels for energy (ATP)
    - raw materials for building more molecules
      - carbohydrates, fats, proteins, nucleic acids

ATP

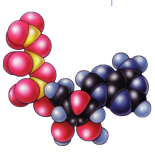


What is energy in biology?

ATP

Adenosine TriPhosphate

Whoa! HOT stuff!



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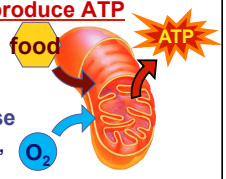
Harvesting energy stored in food

- Cellular respiration
  - breaking down food to produce ATP
    - in mitochondria
    - using oxygen
      - "aerobic" respiration
  - usually digesting glucose
    - but could be other sugars, fats, or proteins

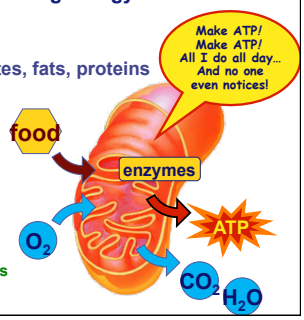


glucose + oxygen → energy + carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow ATP + 6CO_2 + 6H_2O$

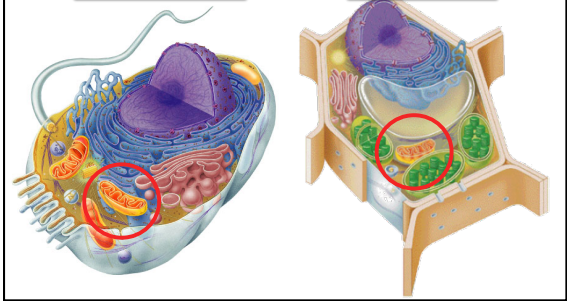
What do we need to make energy?

- The "Furnace" for making energy
  - mitochondria
- Fuel
  - food: carbohydrates, fats, proteins
- Helpers
  - oxygen
  - enzymes
- Product
  - ATP
- Waste products
  - carbon dioxide
    - then used by plants
  - water



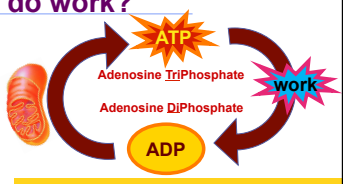
Mitochondria are everywhere!!

animal cells | plant cells



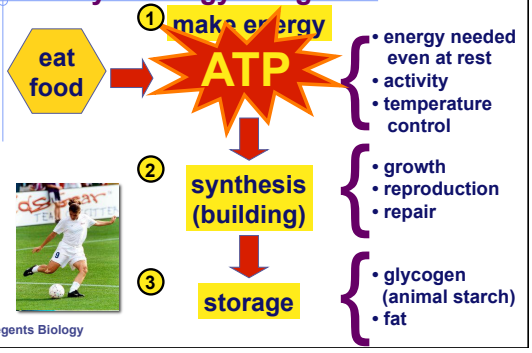
Using ATP to do work?

Can't store ATP
- too unstable
- only used in cell that produces it
- only short term energy storage
  - carbohydrates & fats are long term energy storage



A working muscle recycles over 10 million ATPs per second

A Body's Energy Budget



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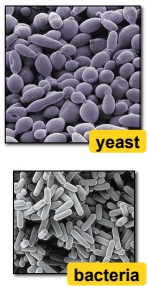
What if oxygen is missing?

- No oxygen available = can't complete aerobic respiration
- Anaerobic respiration
  - also known as fermentation
    - alcohol fermentation
    - lactic acid fermentation
  - no oxygen or no mitochondria (bacteria)
  - can only make very little ATP
  - large animals cannot survive



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