Chem

Clausius-Clapeyron equation: relates vapor pressure of a substance at different temperatures to its heat of vaporization

* + R will usually be 8.314 J/(mol\*K) and ∆Hvap will come out in J/mol
  + Natural log of vapor pressure is inversely proportional to temperature
* Practice
  + Camping fuel: portable lanterns and stoves used for camping and backpacking often use a mixture of C5 and C6 hydrocarbons known as white gas.“ the figure below shows the carbon-skeleton structure of pentane, c5h12, along with its normal boiling point and heat of vaporization. Determine the vapor pressure of pentane on a morning when the temperature is 5˚C. Pentane: boiling point is 36˚C and ∆Hvap is 27.6kj/mol
    - =.3atm (have to change kj/mol ∆H to j/mol)

Solutions of volatile components

* Raoult’s law: total vapor pressure of an ideal solution depends on how much the partial pressure of each volatile components contributes to total vapor pressure of solution
  + Ptotal = X1P1o + X2P2o + X3P3o + X4P4o + …
  + Example for a mixture of water and ethanol (Ptotal=PH2O+PEthanol)
  + A solution contains 100.0 g of water (MW = 18.0 g/mol) and 25.00 g of ethanol (MW = 44.0 g/mol). What are the mole fractions of water and ethanol, and the vapor pressure of the solution at 25°C? (Pwater = 23.8 torr; Pethanol = 58.7 torr)
    - Convert mass of water and ethanol to moles (5.556mol of water and .5682 moles of ethanol)
    - Moles by sum of moles (.907 water and .093 ethanol)
    - Multiply by their individual vapor pressure
    - Add together
    - (see slides on pilot if confused)

Bio

Mechanisms of evolution

* Before Darwin, people looked into nature to try to understand god
  + William Paley, Natural Theology (1802)
    - Something looks designed? Someone must have designed it.
    - His example was walking seeing a watch and thinking that it looks like it was designed to tell time, and was probably designed by a person
  + Lamark’s hypothesis of evolution (1744-1829)
    - Species evolve through use and disuse of body parts and the inheritance of acquired characteristics (giraffe stretches its neck to reach higher leaves and passes a longer neck onto its offspring)
    - Has been discredited but is coming back a little with epigenetics
  + Charles Darwin (1809-1882)
    - Observed organisms and natural phenomena and he collected a lot of specimen
    - At the Galapagos islands he saw a whole variety of birds and was thinking about how science could explain biodiversity
    - He knew about William Paley’s ideas and knew about artificial selection and was learning about how old the world is (people thought that the earth was thousands of years old)
      * He appreciated deep time (world was old)
    - Thomas Malthus, principal of population
      * Had the idea that with massive population growth, there would be massive competition for resources and there would be many people who would lose that competition
      * Charles Darwin applied that idea to animals
    - His natural selection (how he understands what farmers did (artificial selection) applies to nature)
      * Observation 1: members of a population often vary in their inherited traits
      * Observation 2: all species can produce more offspring than the environment can support, and many of these offspring fail to survive and reproduce (based off Thomas Malthus)
        + Inference 1: individuals whose inherited traits give them a higher probability of surviving and reproducing in a given environment tend to leave more offspring than other individuals (higher “fitness”) (based on observations 1&2)
        + Inference 2: this unequal ability of individuals to survive and/or reproduce will lead to (select for) the accumulation of “favorable” traits in the population over generation (over long periods of time, this process can lead to change in form and function of organisms) (based on observations 1&2)
        + These lead to individuals being really good as either surviving or reproducing (see sharks vs peacocks)

Induced variation (artificial selection)

* People select individuals and breed them together to try to get specific traits
  + Like how kale, brussels sprouts, cabbage, broccoli, kohlrabi are all from the same plant with various parts exaggerated

Natural selection tl;dr

* Natural selection does not create new traits, but edits or selects for traits already present in the population
* The local environment determines which traits will be selected for or selected against
* (missed)

Consequences of this model of natural selection

* Individuals with certain heritable characteristics survive and reproduce at a higher rate than other individuals
* Over time, organisms will acquire traits that better suit them to their environments (adaptations)
* Organisms share ancestors and retain evidence of that relatedness (decent with modification)
  + Organisms have a history, they used to be more related, traits have changed over time
  + Just because one evolved, it does not mean the separate branch went extinct
* Patterns of relatedness can be determined by comparing features that have changed (or not) with evolution
  + The traits used to define the “family tree” (phylogeny) can be features of morphology (appearance)
  + Or of molecular biology like protein structure or DNA sequence (accepted as more accurate than with traits)
  + By combining other evidence (like fossil record, and knowledge about how fast DNA changes) the similarity of DNA between species can be converted from relatedness to time (rough estimate of how long ago they diverged)
* Structures of organisms reflect their evolutionary history (evolution only works on what is already there)
* Individuals do not evolve; populations evolve over time
* Natural selection can only increase or decrease heritable traits that vary in a population
* Adaptations vary with different environments; if the environment change, then the forces of selection will change

Evidence for evolution

* The fossil record
* Homology: similarity (in anatomy or molecular biology) resulting from common ancestry (similar base bone structure in the hand of a person, the leg of a cat, fin of a whale, wing of a bat) (or similarities in the molecular structures of hemoglobin in various animals)
* Comparative embryology: common structures in various species when they are embryos that are not seen when grown
* Biogeography: the geographic distribution of species (how are there marsupials in both Australia and America? The land was connected in the past)