Heat and Energy

- The measure of degree of hotness of a substance is called its temperature.
- The device that is used to measure the temperature of a substance is called thermometer.
- Thermometers are of two types - clinical (used for measuring temperature of human body) and laboratory (used for measuring temperature of common objects).
- The temperature range of clinical thermometer is 37- 42 °C and that of laboratory thermometer is -10 ^{o}C to +110 ^{o}C. The unit for temperature is °C.
- The normal temperature of human body is 37 °C or 98.6 °F.
- There are three commonly scales used in temperature
- Celsius scale of temperature
- Fahrenheit scale of temperature
- Kelvin scale of temperature
- Kelvin is the SI unit of temperature.
- The SI unit of heat is joule (J)
- Other common units of heat are calorie (cal) and kilocalorie (kcal).
- 1 kcal = 1000 cal
- 1 cal = 4.2 J

Expansion of Solids

When a solid is heated, it expands.

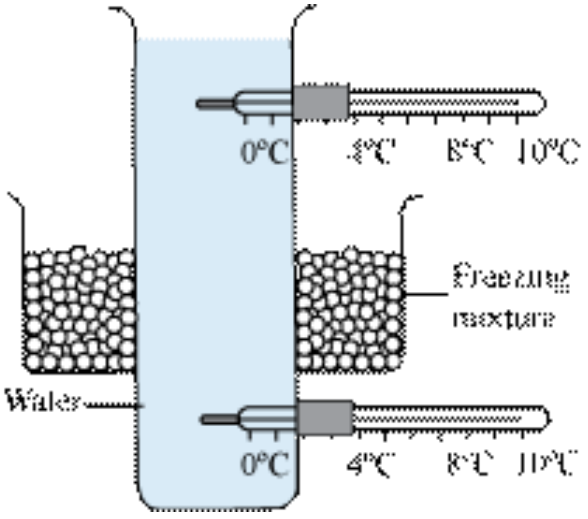
Type of expansion	Amount of expansion	Coefficient of expansion
Cubical Expansion	$V_t = V_0 (1+ \gamma \Delta t)$	γ = Coefficient of volume expansion
Superficial expansion	$A_t = A_0 (1+\beta \Delta t)$	β = Coefficient of area expansion

Linear expansion	$L_t = L_0 (1 + \alpha \Delta t)$	α = Coefficient of linear expansion

Application of thermal expansion—Riveting, bimetallic strips, thermostat, space between railway lines

Expansion of liquids

- **Hope's experiment** proves anomalous expansion of water.



1. Lower thermometer reading—Stops at 4°C
2. Upper thermometer reading—Falls till 0°C
3. This happens because on cooling, water decreases in volume and sinks down whereas warmer water expands and rises up.

Water shows compression when cooled and has maximum dsensity at 4°C, below 4°C water expands and its density increase.

Expansion of Gases

- Increase in volume for different gases for the same rise in temperature is same.

Ecosystem

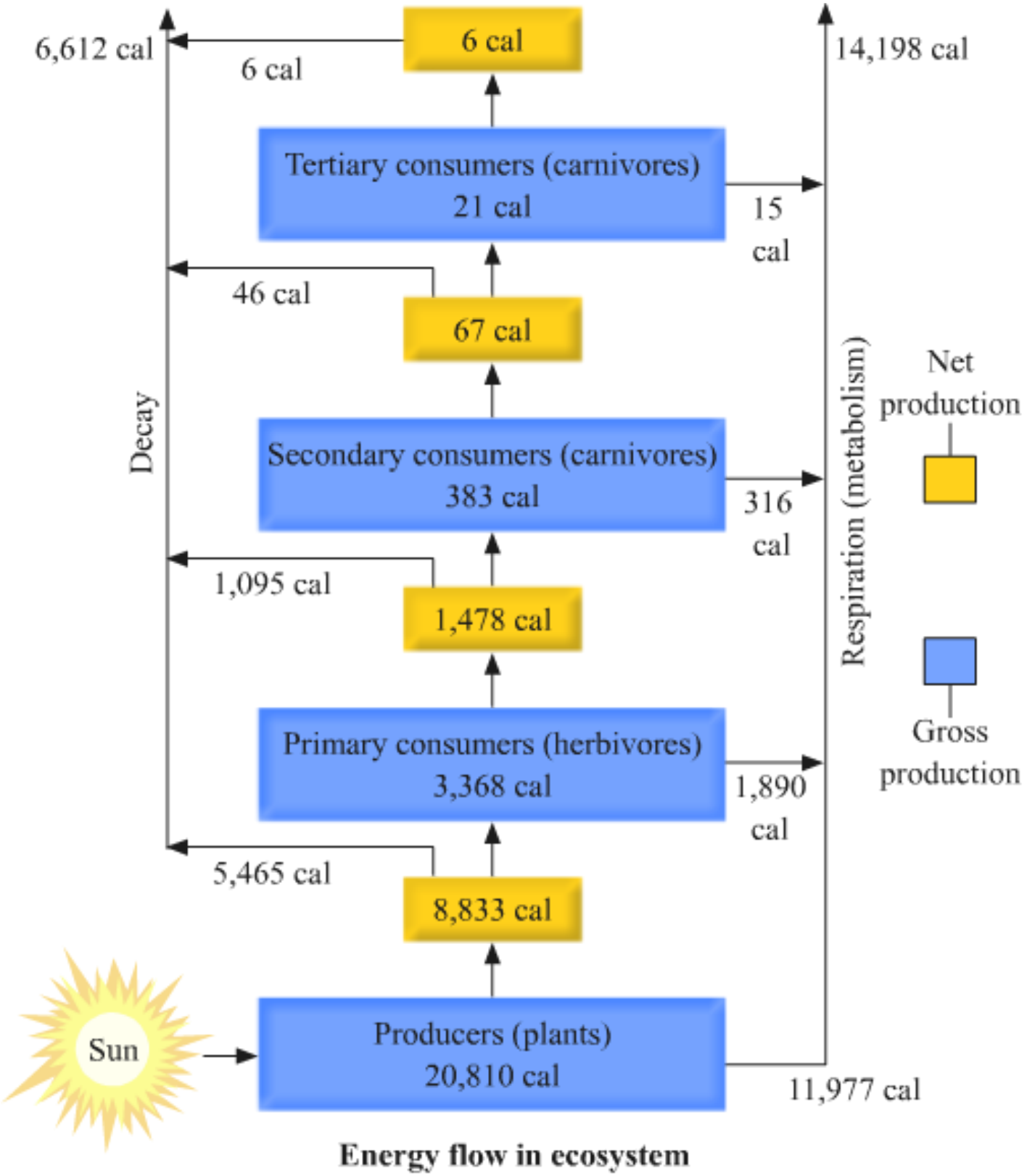
An ecosystem is composed of biotic and abiotic components. Biotic components are producers, consumers and decomposers. Abiotic components are light, heat, rain, humidity, inorganic and organic substances.

Sun is the most significant source of energy for all ecosystems.

Food Chain

Food chain is a link in which unidirectional flow of food energy takes places from producers to different consumers.

Energy Flow in Ecosystem



Energy flow in ecosystem

- **A good fuel/source of energy**
  - That would do a large amount of work per unit volume or mass
  - Easily accessible
  - Easy to store and transport
  - Economical

- **Factors to be considered for choosing fuel**
    - How much heat it produces
    - Less smoke generation
    - Easy availability
- **Calorific valu**e is defined as the amount of heat energy obtained by burning one gram of a substance. The unit of calorific value is kJ/g.
- The **ignition temperature** of a substance is defined as the temperature at which the substance starts burning. It is measured in °C, °F, or K.

- **Non-renewable sources** of energy are those that are consumed at a rate faster than that at which they are replenished. Example: Fossil fuels.

- **Fossil fuels –** Coal, petroleum and natural gas
    - **Coal**: It is a non-renewable source of energy made up of complex compounds of carbon, hydrogen and oxygen along with some free carbon and compounds of nitrogen and sulphur.
    - **Petroleum**:It is a dark coloured viscous liquid also known as crude oil or black gold. It is a complex mixture of many hydrocarbons with water, salt, earth particles and other compounds of carbon, oxygen, nitrogen and sulphur.We obtain petroleum by drilling oil wells into earth's crust at its reservoirs. The petroleum extracted from wells has to be purified to obtain different useful components.The process of separating useful components from the crude oil is called refining and this process is done by fractional distillation in big refineries.
    - **Natural Gas**: The main constituents of natural gas are methane (upto to 95%), ethane and propane. It easily burns to produce heat.
        - **Advantages –**
            - Easy availability
            - Generate heat that is easily converted into electricity
- **Renewable sources of energy** are those that are replenished at a rate faster than that at which they are consumed. Example:
    - **Solar energy** – Solar cooker, solar water heater (very efficient for small scale electricity production)
    - **Tidal energy, wave energy, ocean thermal energy**
    - **Geothermal energy** – Heat energy inside the earth
    - **Nuclear energy** – Not dependent on solar energy, never-ending source, very efficient source, more environment friendly.

Sources of energy:

- **Bio-mass – Charcoal, cow-dung, vegetable waste, sewage**
- **Wind energy –** Environment friendly, renewable
- **Solar energy** – Solar cooker, solar water heater (very efficient for small scale electricity production)
- **Geothermal energy** – Heat energy inside the earth
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- **Greenhouse effect**
  - Trapping of heat by gases (CO_2) in the atmosphere.
  - Gases that cause the greenhouse effect are responsible for increasing the temperature of the Earth and thus contributing to the phenomenon called **global warming**.
- **Causes of Green house effect**
  - A part of solar radiations cause warming of the earth's surface.
  - A part of solar radiation is reflected back, which is trapped by the earth's atmosphere. This phenomenon is called green house effect.
- **Green house gases**
  - These are the gases, which trap the solar radiations, and in this way, are responsible for the increase in the temperature of Earth.
  - The examples include carbon dioxide, methane, nitrous oxide, and water vapours.
- **Global warming**
  - The CO_2 level in atmosphere is increasing due to various human activities such as deforestation and burning of fossil fuels.
  - Build up of CO_2 in the atmosphere will result in a rise in the average temperature of earth's atmosphere, leading to global warming.
  - Global warming will lead to melting of glaciers and increase in the sea level.

Judicious Use of Energy

1. Wastage of energy must be minimised.
2. Encourage reforestation and discourage deforestation.
3. Efforts must be made to make use of energy in groups.
4. Coal, petroleum, etc. should be consumed only when no other alternative sources of energy is available
5. Research and efforts should be made to develop nuclear energy by the controlled nuclear fusion of deuterium nuclei present in heavy water available in sea. This can become an endless source of energy.

Energy Degradation

The conversion of energy to some undesirable form is known as energy dissipation and since this undesirable form of energy cannot be used by us to do any productive work, so it is regarded as the degraded form of energy. The rate of generation of degraded form of energy increases with more and more use of energy.

Few examples of degraded form of energy:

- In bulbs, only 25% of electrical energy converts into the light energy and remaining portion of energy is either wasted in heating the filament and or gets converted to other invisible radiation.
- In vehicles, a small part of the energy obtained from the burning fuel is used up in running the vehicle while the major part of the energy is wasted in heating the moving parts of the vehicles, in overcoming friction between the ground and its tyres, etc.
- While cooking food, a significant part of energy is radiated in the atmosphere. This energy is of no use to us.