Lab.1:
Practical Ecology

By

Ass.Lec. Alaa W. Abbas

Introduction:

- **Ecology:** is the study of an organism or organisms and their relationship to the environment.
- **An organism's environment:** consists of the physical, chemical and biological components.
- **Abiotic factors:** are the non-living components of the environment which include:

1. Temperature
2. Pressure
3. Soil/substrate
4. Wind
5. Sunlight
6. Water

Measurement of a biotic factors:

➢ First: Temperature measurements

- Temperature is a physical property of matter that quantitatively expresses the common notions of hot and cold.

➢ temperature scales:

- Celsius scale (°C):Used for most temperature measurements.
- Fahrenheit scale: on which water freezes at 32 °F and boils at 212 °F.
- Kelvin scale: in which water freeze at 273.15 and boils at 373.15 K.

For purpose to convert one temperature scale to another we can used the following equations

Convert Fahrenheit to Celsius	$t_C = \frac{5}{9}(t_F - 32)$
Convert Celsius to Fahrenheit	$t_F = \frac{9}{5}t_C + 32$
Convert Celsius to Kelvin	$t_K = t_C + 273.15$

Example 1

- **Convert 26° Celsius (A nice warm day!) to Fahrenheit**

- First: $26° \times 9/5 = 234/5 = 46.8$
- Then: $46.8 + 32 = 78.8°$ F

Example 2

- **Convert 98.6° Fahrenheit (Normal Body Temperature!) to Celsius**

- First: 98.6° - 32 = 66.6
- Then: 66.6× 5/9 = 333/9 = 37° C

Example 3

- **Convert 27° C to Kelvin.**

- K = 27 + 273
- K = 300
- 300 K

Temperature is commonly measured by using the different types of thermometers such as:

a. Liquid thermometer:

- **principle:** relation between temperature and volume of a liquid.
- **How to use it:**
  - Put the thermometer in the ground or water and leave for the heat to take effect.
  - Read the scale and carefully, wipe the thermometer and repeat a number of times for the area.

b. Maximum and minimum thermometer:

- **The purpose of use:**

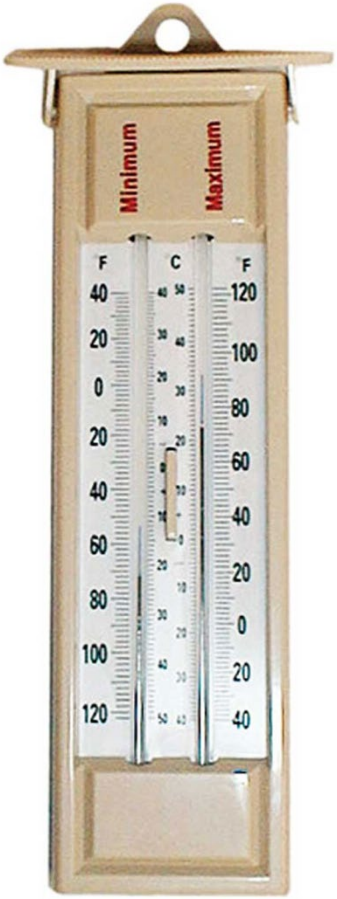
Thermometer that records the highest and lowest temperatures reached during a period of time.

- **How maximum and minimum thermometers work?**

Typically U-shaped parallel tubes of glass. One side registers the minimum temperature, while the other registers the maximum temperature since its last reading.

Liquid thermometer

Maximum and minimum thermometer



Thank you

Lab.1:
Relative humidity

By

Ass.Lec. Alaa W. Abbas

Second : Atmospheric pressure

- sometimes also called barometric pressure, is the pressure exerted by the weight of air in the atmosphere of Earth .
- Low pressure areas have less atmospheric mass above their location
- high pressure areas have more atmospheric mass above their location.

measure the pressure by the following

a. Barometer

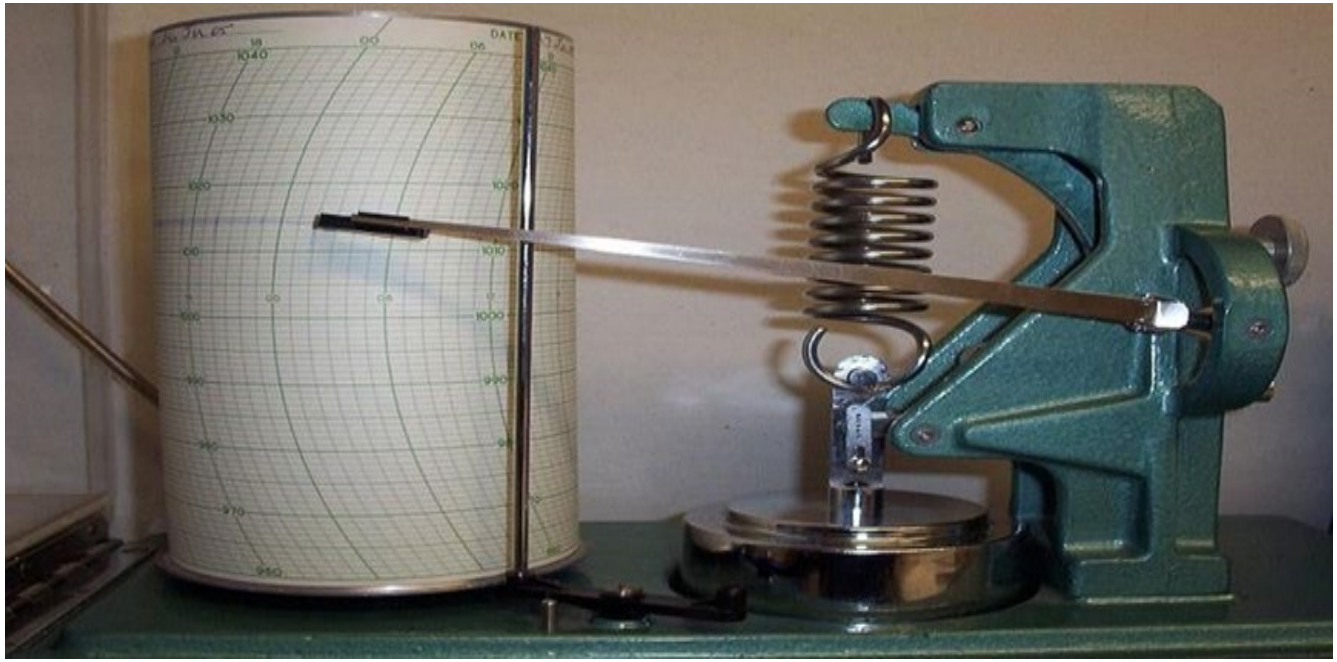
- A barometer is a scientific instrument used in ecology to measure atmospheric pressure.
- It can measure the pressure by the atmosphere by using water, air, or mercury.
- Numerous measurements of air pressure are used such as Water-based barometers, Mercury barometers and aneroid barometer .

- **Water-based barometers** **Mercury barometers** **aneroid barometer**

b. Barograph

- A barograph is a recording aneroid barometer.
- It produces a paper or foil chart called a barogram that records the barometric pressure over time.
- Barographs use one or more aneroid cells acting through a gear or lever train to drive a recording arm that has at its extreme end either a scribe or a pen.
- The recording material is mounted on a cylindrical drum which is rotated slowly by clockwork.

Barograph



Third: Density

- The mass density or density of a material is defined as its mass per unit volume. In some cases density is also defined as its weight per unit volume;
- If the average density (including any air below the waterline) of an object is less than water (1000 kg/m3) it will float in water and if it is more than water's it will sink in water.

- The mass density of a material varies with temperature and pressure.
- Increasing the pressure on an object decreases the volume of the object and therefore increase its density.
- Increasing the temperature of a substance decreases its density by increasing the volume of that substance.

a. Hydrometer

- A hydrometer is an instrument used to measure the specific gravity (or relative density) of liquids; that is, the ratio of the density of the liquid to the density of water.
- The principle

  Operation of the hydrometer is based on Archimedes' principle that a solid suspended in a fluid will be buoyed up by a force equal to the weight of the fluid displaced. Thus, the lower the density of the substance, the farther the hydrometer will sink.

Fourth: Wind speed

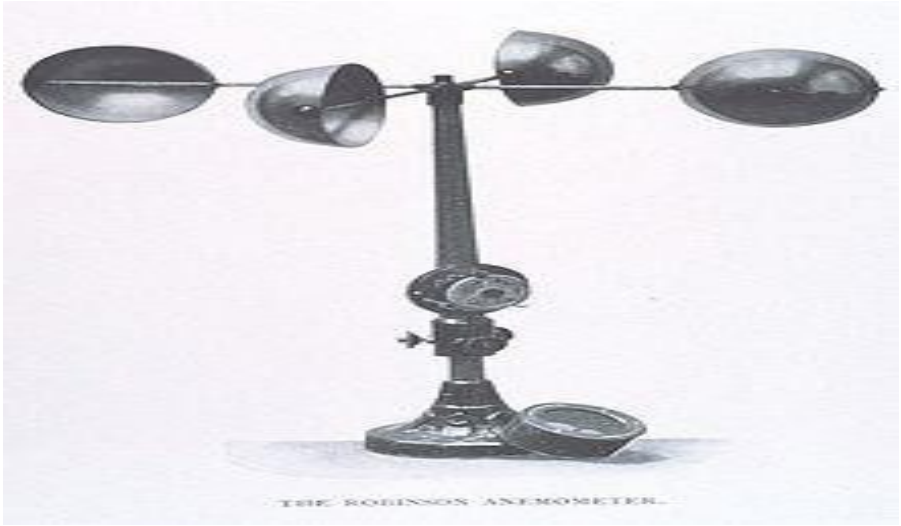
- Wind speed usually mean the movement of air in an outside environment. The wind speed are commonly measured by following

a. Anemometer

- Anemometers can be divided into two classes: those that measure the wind's speed, and those that measure the wind's pressure
- but as there is a close connection between the pressure and the speed, an anemometer designed for one will give information about both.

Cup anemometers

- A simple type of anemometer consisted of four hemispherical cups each mounted on one end of four horizontal arms, which in turn were mounted at equal angles to each other on a vertical shaft.
- The air flow past the cups in any horizontal direction turned the cups in a manner that was proportional to the wind speed.



THANK YOU

Lab.3

By

Ass.Lec. Alaa W. Abbas

Other instruments and devices are used in ecology for different purpose

➢ pH meter:

- A pH meter is an electronic instrument used for measuring the pH (acidity or alkalinity) of a liquid.
- A typical pH meter consists of a special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the pH reading.

➢ Sunshine recorder:

- A sunshine recorder is a device that records the amount of sunshine at a given location. The results provide information about the weather and climate of a geographical area.

➢ The Secchi disk:

- It is a circular disk used to measure water transparency in oceans and lakes. The disc is mounted on a pole or line, and lowered slowly down in the water. The depth at which the pattern on the disk is no longer visible is taken as a measure of the transparency of the water. This measure is known as the Secchi depth and is related to water turbidity.

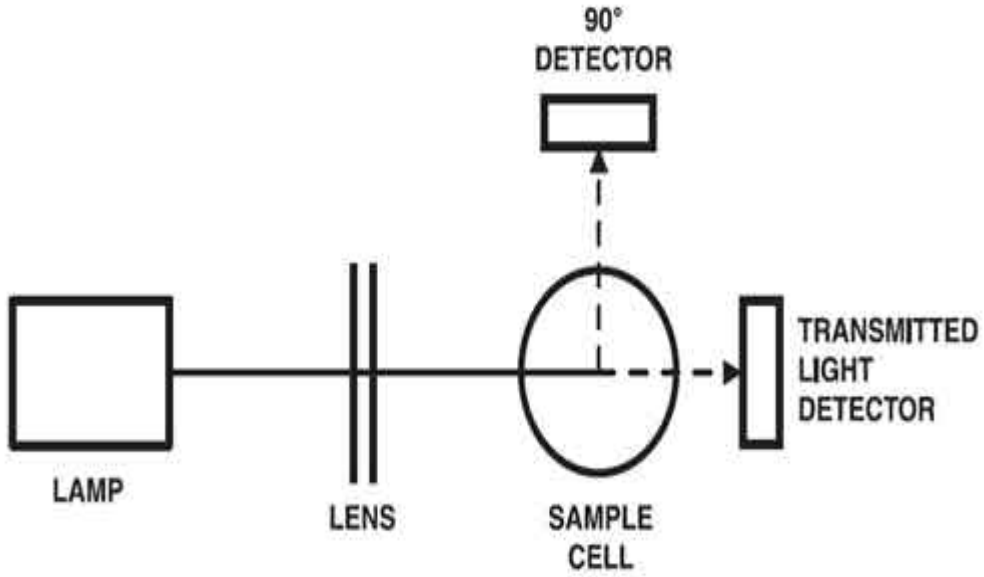
Turbidity and nephelometer

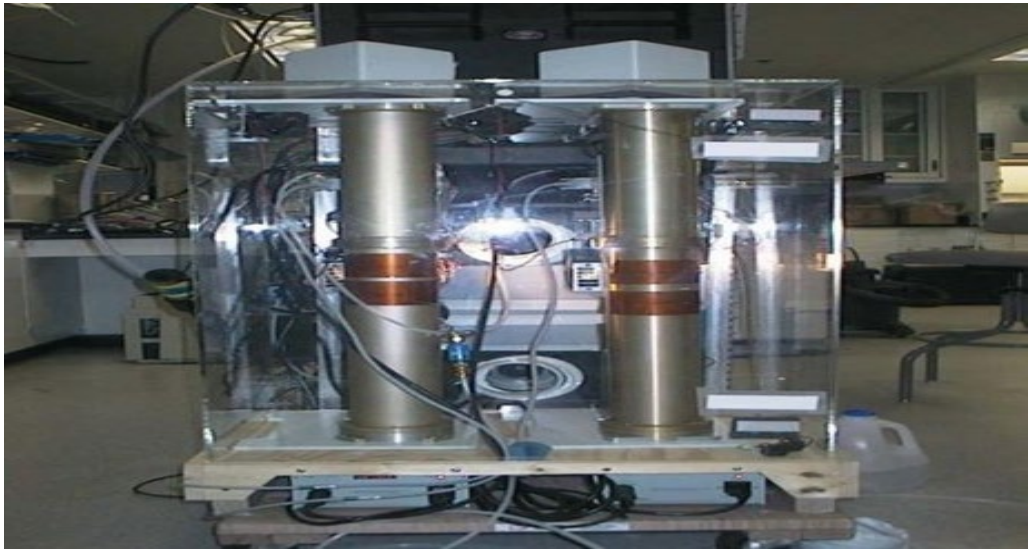
- Turbidity is the cloudiness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

- Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand (the settable solids), very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid.

➢ Nephelometer:

- A nephelometer is stationary or portable instrument for measuring suspended particulates in a liquid or gas colloid. A Nephelometer measures suspended particulates by employing a light beam (source beam) and a light detector set to one side (often 90°) of the source beam.


90°
DETECTOR
TRANSMITTED
LIGHT
DETECTOR
LAMP
LENS
SAMPLE
CELL



Thank you

Lab.5

2. Plants Sampling

The actual recording of the plant community is done by the use of small sampling units.These units may be in the form of area , line , or point, as has been employed in the quadrate, transect, and point sampling methods, respectively as follows:

2.1 Quadrate method

It is a technique which is used when only a part of a large area is sampled. On the basisof this information, the total population of the area is estimated .For example, if we want to know the number of pine trees in a forest , we can make a total count , but this may be too much time consuming , difficult and expensive. Instead , if we count the trees in several blocks of squares (Quadrates) of the forest and by extrapolating these results for the wholeforest area, we can make an estimate of the total number of trees. The quadrate method is used to measure the population density of organisms such as plants, planktons, earth worms, insects and also blood cell in the blood.

2.2 Transect method

A transect is a cross section of an area used as a sample for recording, mapping, or studying vegetation. Because of its continuity through an area, the transect can be used torelate changes in the environment. Line transect method is commonly used for sampling of the forest and it consists of taking observations on a line or lines laid out randomly or systematically over the study area.

3. Animal Populations Sampling

The ecological study of animal populations in the ecosystem involves considerably more problems than the study of plants. Animals are harder to see and most are not stationary—they arehere one minute and gone the next. The following methods furnish valuable information's regarding animal populations of different kinds:

3.1 Trapping and collecting animals:

The sampling of a population involves collecting animals, either alive for marking and release, ordead. For different types of animals different techniques are adopted which are as follows:

(I) Trapping and collecting flying insects:

Aerial nets or heavy nets when put through grass and woody vegetation, are used for the collection of diurnal insects. For nocturnal insects, traps containing ultra-violet light are used. Insects then picked off the sheet. For killing the insects, killing jars containing a layer of plaster ofparis and potassium cyanide (KCN) on the bottom are used.

(II) Trapping and collecting aquatic organisms:

For collecting aquatic organisms are used nets for organisms in the water bottom, and plankton nets for zooplanktons and phytoplankton. For aquatic collecting from the shore, aquatic throw nets are useful. For collecting bottom organisms in deep water, is used a bottom dredge (bag net) lowered from a boat. Fish, and large crustacean collected with seines (large vertical fishing-nets).

(III) Trapping and collecting soil organisms:

Different animals of soil are collected by following methods: Soil arthropods are extracted from the soil by means of a Tullgrcn funnel, an improved version of the Berlese funnel. It

consists of a heat source and a smooth funnel, preferably glass, and a shelf of hard-

ware cloth onwhich to place the sample.

Larger soil animals like spiders and beetles, can be taken in traps made from funnels and cans set in the soil to ground level. Boards placed on the ground may attract millipedes, centipedes and slugs. Meat bait in small wire traps will attract scavenger insects.

For the collection of earthworms, a dilute solution of formalin (25 ml of 40 per cent formalin to 4 541 litres) is applied to a quadrate 61 cm^2. Within a few minutes worms will come to the surface. After earthworm movement to the surface stops, a second application of dilute formalin solution is done.

When worms cease to come to the surface the second time, the quadrate is dig out as deep as necessary. The soil is hand-sorted for maximum recovery of earthworms. Soil nematodes can be collected by Tullgren funnel method .

(IV) Trapping and collecting birds and mammals:

Birds can be trapped for banding in specially constructed traps, cannon nets for larger game birds, and mist nets. For mammal live traps of wood or wire and snap traps are used. These traps can bebaited with natural foods, dripping water, etc.

3.2 Marking animals:

Marking individuals in an animal population is necessary if one wishes to distinguish certain members of a population at some future date, to recognize individuals from their neighbours, to study movements or to estimate number of animals in a population.

Arthropods and snails are best marked with a quick-drying cellulose paint. Aquatic insects and molluscs are marked by ship- fouling paint.

Fishes are usually marked by tagging in several ways. Strap tags of Monel metal (a nickle-base alloy) may be attached to the jaw, the operculum. Streamer or pennant (a long narrow flag) tags are sometimes attached to various parts of body,

usually at the base of the dorsal fin. A plastic tag can be inserted into the body cavity of fish by performing a minor operation. Fish can also be marked by clipping the fins.

Frogs, toads, salamanders and most lizards can be marked by some system of toe clipping which involves the removal of the distal part of one or more toes. Birds are usually marked either by serially numbered aluminium bands, by cellulose and aluminium coloured bands or by dyeing plumage by conspicuous or contrasting colour.

Small mammals may be marked by toe-clipping or by notching the ear. Bear, deer, elk, moose, rabbits and hares can be marked with strap tags or plastic discs attached to the ear. Aluminium bands similar to those used on birds can be attached to the forearm of bats.

- ✓ **Radioactive tracers:**

The use of radioactive tracers in marking of animals, is a particularly useful method for studying animals that are secretive in habits, live in dense cover, spend part or all of their lives underground, or that have radically different phases in their life cycle, such as moths and butterflies.

It is found that if animals are fed small traces of gamma-emitting radioactive material along with food, then the radio-active materials are metabolically incorporated into the tissues. The tracer becomes a part of the animal and is passed along to egg or offspring. This technique is useful for studying dispersal, for the identification of specific broods or litters, for obtaining data on population dynamics and natural selection.

Lab.6

3.3 Estimation of number of animals in population:

The numbers of animals in wild populations can be estimated by following three methods: 1. True census, a count of all individuals in a given area; 2. Sampling estimates, derived from counts on sample plots; and 3. Indices, in which the trends of populations from year to year or from area to area are obtained through roadside counts, animal signs, and the like.

(a) True census:

A true census implies a direct count of all individuals in a given area. Direct counts can be made only in large a conspicuous animals and in areas of their maximum concentration. Elephants, deer, etc., in open country, herds of elk, waterfowl on wintering grounds, rookeries, roosts, breeding colonies of birds and mammals permit direct counting usually either from the air or from aerial photographs.

(b) Estimates from sampling:

This involves following methods:

(i) Sample plots:

Relatively immobile forms such as barnacles and molluscs can be estimated by the quadrate method, similar to that used for plants. Arthropods may be sampled by a number of strokes with a standard sweep over a 10 = m^2 area. Estimates of zooplankton, obtained by pulling plankton net through a given distance of water at several depths, can be made by filtering a known volume of sample through a funnel using a filter pump.

The filter paper is marked off in equal squares and by the help of a hand lens or a binocular microscope, the organisms in each square are counted. The numbers are then related back to the total volume of water sampled.

Very small-sized zooplanktons are counted by Rafter plankton- counting cell. This consists of a microscope slide base plate ruled into ten 1 cm squares.

(ii) Mark-recapture method:

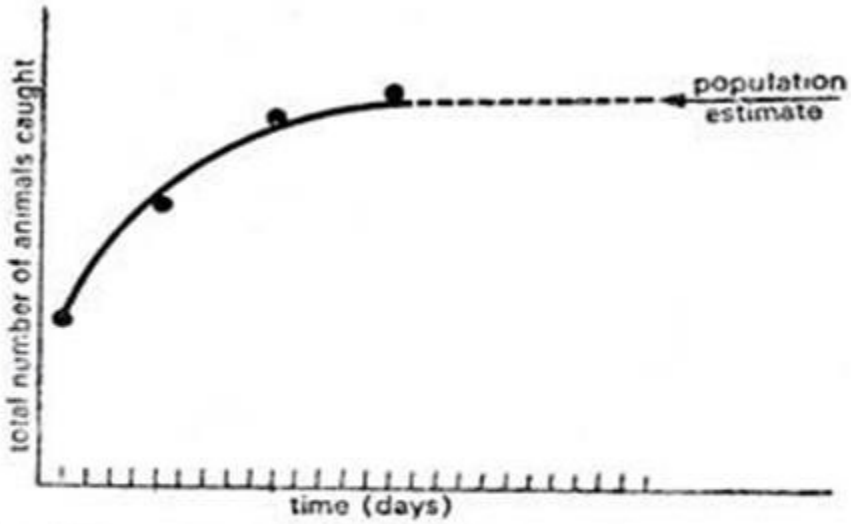
In this method, a group of animals in the population are captured and marked with a band or tag for some time. Then they are released back into the population, where they are distributed among unmarked individuals. Later another group of animals is captured, some of which will be marked and some of which are not.

The ratio of marked animals to the number in the sample is assumed to be similar to the ratio of the total animals initially marked to the total number of animals in the entire population.

(iii) Removal method:

This method involves capturing animals and removing them from the study area. If this technique is used over a short time, the number of animals removed per unit effort should get smaller and smaller.

By totaling the accumulative catch through time, it is possible to estimate the number in the area, even though we only remove some of the animals. This method is useful where one desires a relative measure or index figure for small-mammal populations in order to compare one habitat with another.



Removal method for population estimation. Animals are captured and removed from an area. The total accumulative catch is followed, allowing an estimate of the total number of catchable animals in the area.

3.4 Measuring mortality:

The measurement of mortality in natural populations is most earnestly required for various ecological aspects like construction of life tables, life equations, survivorship curves, growth curves, etc. The mortality in a wild population can be measured by following methods: (i) If a number of marked animals are found dead a known time after making, the percentage dying can be plotted against time and a curve drawn through the points. The probability of dying can be read directly from the chart, or it may be calculated by dividing the number of individuals that die during a period of time by the initial population. (ii) If the animals can be readily aged, as is true with deer, rabbits, mountain sheep, and others, and if sufficient lower jaws, eye lenses, or horns can be obtained, then mortality and the probability of dying can be expressed on an age basis.

I wish you all the best ☺