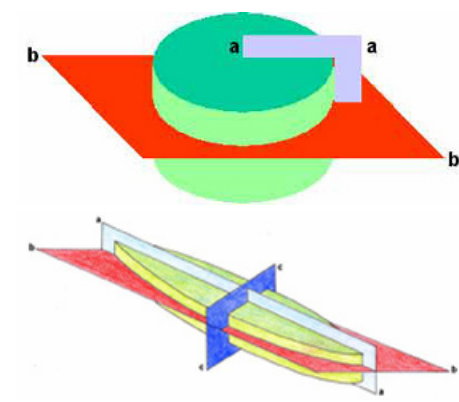
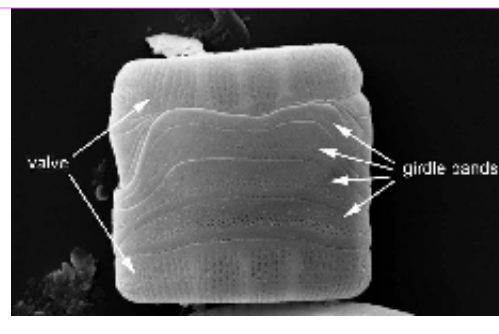


**A basic guide to diatom morphology and biology from: Common Freshwater Diatoms of Britain and Ireland, <http://craticula.ncl.ac.uk/EA/DiatomKey/html/index.html>**

Diatoms (Bacillariophyta) are one of the most distinctive and successful groups of unicellular algae, occurring throughout the world in marine, brackish and fresh waters, as well as in damp subaerial habitats. They are usually estimated to contribute about 25-35 % of the world's productivity (in terms of carbon fixation) and to be represented by 50 – 200 thousand species depending upon one's species concept. Their most distinctive characteristic is the possession of elaborate, siliceous cell walls, features of which are used to define and classify species. Because silica resists degradation, diatoms are regularly preserved in both freshwater and marine sediments, and in conjunction with knowledge of their ecological specificity, such records have been used to infer lake or ocean histories. In particular, diatoms in lake sediments have been used to deduce changes in pH and nutrient status, as well as climate change. They are also used extensively to infer water quality in contemporary aquatic systems.



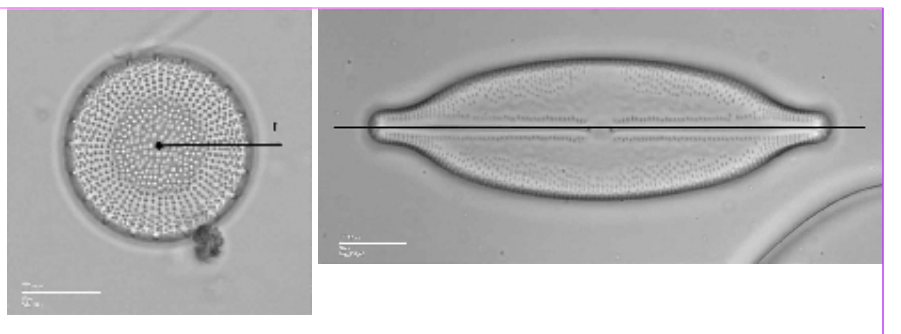
**Morphology**

The diagram of frustule, shows valves and bands. Diatom cell walls (frustules) are essentially bipartite structures, with an older and a younger half (valve), each with a series of linking bands (girdle bands or cingula), often likened to a petri dish or pill-box. Once formed, the siliceous components are rigid and cell expansion is only possible by the addition of extra girdle bands associated with the younger valve. Valves vary in shape and symmetry, as well as in the type and arrangement of pores, slits and other processes of the silica wall, and these features have formed the basis of their identification and classification. Diatom cells are often approximated to geometric shapes and described in relation to their major axes and planes, radial, apical, transapical and valvar. Because they are three-dimensional structures, shape will differ depending on the aspect presented to the viewer, either valve or girdle view. Occasionally cells are seen end-on, but this is unlikely in fixed or cleaned material, since cells tend to lie with their largest face on the slide.

**Identifying diatoms**

Identification seeks to put the correct name to a specimen. It does not depend upon any knowledge of the evolutionary or systematic relationships of the species, and can use any feature that is helpful in discriminating between specimens, regardless of its distribution across the group. Therefore the taxa selected by choosing a particular character state are not necessarily closely related. Correct identification on this chart rests on the unique combination of character states of the species in question. Conventionally diatoms are identified based on the morphology of the siliceous wall (frustule) although protoplasmic features can also be used. For both, however, it is first essential to establish which view of the diatom is visible. Cells will normally lie in either valve or girdle view, depending upon which has the larger and/or flatter surface. Girdle views can usually be recognised by being more or less rectangular, with the girdle bands being thinner in cross-section than the valves. Some girdle views are curved, biconvex or occasionally undulate, but all are usually "squared-off" in some way. There are very few diatoms whose valve view has right angles (or is approximately right-angled). This poster describes characteristics as they are seen in Light Microscope, to make the key accessible to those who lack knowledge of diatom ultrastructure. There has therefore been no attempt to describe all the structural details of different taxa. For the purposes of this chart, elongate valve shapes are first considered without reference to the apices. Apex shape is considered independently. Similarly, shapes of axial and central areas are considered independently, the former extending as far as the central raphe endings in raphe diatoms, the latter being positioned the gap between the central raphe endings. In diatoms without a raphe system, the axial area is along the apical axis and the central area is in the middle of the valve. The presence, absence and position of features such as raphe slits are important. It should be noted that some diatoms have a raphe system on one valve only (non-raphe diatoms), so the valves of a cell differ. This key is designed so that the raphe and araphid valves can be identified independently. Diatoms have been well studied both in their natural habitat and in cultures by biologists and there is therefore a wealth of knowledge on their biology and ecology. The protoplasm of diatoms consists of a cytoplasmic layer that lines the interior of the frustule and surrounds a large central vacuole, within the cytoplasmic layer there is a diploid nucleus and two to several pigment-bearing plastids (the site of photosynthesis). The diatom frustule is often likened to a pill-box or agar dish with an epitheca (larger upper valve), and a hypotheca (smaller lower valve). The vertical lip or rim of the epitheca is called the epicingulum, and the epicingulum fits over (slightly overlaps) the hypocingulum of the hypotheca. The epicingulum and hypocingulum with one or several connective bands make up the girdle. Many diatoms are heterovalvate, i.e., the two valves of the frustule are dissimilar. This is most obvious within the family Actinocyclusaceae where one valve has a raphe and the other does not, and the Cymatosiraaceae where one valve has a tubular process and the other does not. Chain-forming species with cells linked together by siliceous structures may, in addition, have separation valves. These valves are morphologically different from the valves within the chain. Therefore, one species may have four morphologically distinct types of valves.

Diatoms may be divided into two major groups based on valve symmetry, those that are circular with essentially radial symmetry, the centric diatoms, and those that are more elongate, with primarily bilateral symmetry, the pennate diatoms. The latter group is further sub-divided on the presence or absence of a paired slit system (the raphe) in the valve, associated with motility, into the araphid and raphe diatoms. Raphe diatoms are subdivided into biraphid and monoraphid taxa. Monoraphid diatoms have a functional raphe system on one valve only, the R valve. The other valve (P valve) has a solid raphe stem since the raphe slit has been filled in with silica during morphogenesis. From the point of view of identification, these are useful groupings, however, they do not necessarily reflect the phylogenetic relationships of the diatoms; neither the centric, araphid nor monoraphid diatoms are now considered monophyletic.



The position and path of the raphe slits, and the presence or absence of associated ribs or struts are important features by which taxa can be identified and classified. In some groups of diatoms, e.g. Nitzschia, Hantzschia, the raphe slits are positioned along one edge of the valve face, often raised along a ridge (keel) and spanned internally by struts (fibulae), which may appear as refractive lines or dots. In another group of diatoms, Surirellales, the fibulate raphe slits are positioned such that one runs along each long margin of the valve face, interrupted at both poles by "nodules" (e.g. Surirella brevissonii). Ontogenetically, one corresponds to the central nodule (the origin of the raphe system), the other to two fused polar nodules.

In addition to being perforated by pores and / or slits, some diatoms are ornamented with spines, often around the margin of the valve at the junction of the valve face and the valve mantle, or they may possess hollow processes (struts or labiate processes) associated with the production of chitin fibres or mucilage furoporula. These features may facilitate the formation of colonies. Specialised areas of simple pores (apical pore fields) often allow the secretion of mucilage pads or stalks (for attachment to a substratum or to other cells in a colony. Some species have the ability to live as motile individuals or to attach to a substratum, depending on the circumstances.

**Diatoms as Environmental Indicators**

Living diatoms often have specific salinity, temperature and other environmental tolerances, this together with the fact that a high proportion of fossil genera and species are still extant, makes it possible to use transfer functions to produce accurate palaeoenvironmental reconstructions. This type of work has been used extensively and very successfully, particularly in palaeolimnology and the Environmental Change Research. Diatoms are particularly advantageous for biostratigraphic studies of high latitude sediments where calcareous microfossils are often poorly preserved, sparse, or of low diversity. The following charts indicate ranges within five measurable environmental parameters. The diatom chart provides relationships to these charts

**Sensitivity to nutrients**

Phosphorus is seen as the nutrient that most likely to limit primary production in freshwater systems. In many situations nitrogen may well be the limiting nutrient. These trophic indices describe diatom distribution in relation to either "dissolved" (= "orthophosphate") or "total" phosphorus. Phosphorus and nitrogen concentrations are often highly correlated. Recommendation: these indices are treated as broad indicators of trophic status.

| Trophic class | Description              | Median total P (mg l-1) |
|---------------|--------------------------|-------------------------|
| 1             | Oligotrophic             | <0.015                  |
|               | Mesotrophic              | 0.015-0.030             |
| 2             | Eutrophic                | 0.030-0.055             |
|               | Eu-poly-trophic          | 0.055-0.090             |
| 3             | Polytrophic              | 0.090-0.155             |
|               | Polytrophic-hypertrophic | 0.155-0.300             |
| 4             | Hypertrophic             | >0.300                  |

**Sensitivity to organic pollution**

Saprobity values link dissolved oxygen levels and BOS with water quality class and gives a numerical value with these parameters.

| Value | Description           | Water quality class | O <sub>2</sub> saturation(%) | BOD(mg l <sup>-1</sup> O <sub>2</sub> ) |
|-------|-----------------------|---------------------|------------------------------|---|
| 1     | Oligosaprobous        | I, I-II             | >85                          | <2                                      |
| 2     | β-mesosaprobous       | II                  | 70-85                        | 2-4                                     |
| 3     | α-mesosaprobous       | III                 | 25-70                        | 4-13                                    |
| 4     | α-meso/poly-saprobous | III-IV              | 10-25                        | 13-22                                   |
| 5     | Polysaprobous         | IV                  | <10                          | >22                                     |

**Sensitivity to acidification**

The table below presents the common classification of diatom occurrences related to water pH

| Class            | Occurrence                            |
|------------------|---------------------------------------|
| 1, Acidobiontic  | Optimal occurrence at pH < 5.5        |
| 2, Acidophilous  | Mainly occurring at pH < 7            |
| 3, Circumneutral | Mainly occurring at pH values about 7 |
| 4, Alkaliphilous | Mainly occurring at pH > 7            |
| 5, Alkalibiontic | Exclusively occurring at pH > 7       |
| 6, Indifferent   | No apparent optimum.                  |

**Salinity**

Salinity is a key to freshwater diatoms. Several of the taxa can survive in brackish water. Diatoms are placed into one of four classes, which are related to chloride concentration and salinity as follows:

| Class | Description    | Cl <sup>-</sup> (mg l <sup>-1</sup> ) | Salinity (‰) |
|-------|----------------|---------------------------------------|--------------|
| 1     | fresh          | <100                                  | <0.2         |
| 2     | fresh brackish | <500                                  | <0.9         |
| 3     | brackish fresh | 500-1000                              | 0.9-1.8      |
| 4     | brackish       | 1000-5000                             | 1.8-9.0      |

Use caution when using this classification, as the 'fresh-brackish' class includes many taxa that can thrive in hard water (i.e. where conductivity is derived from calcium and magnesium, rather than sodium and potassium salts).

**Sensitivity to desiccation**

This classification indicates the role water plays in diatom development

| Class | Description   |
|-------|---|
| 1     | Never, or only very rarely, occurring outside water bodies                      |
| 2     | Mainly occurring in water bodies, sometimes on wet places                       |
| 3     | Mainly occurring in water bodies, also rather regularly on wet and moist places |
| 4     | Mainly occurring on wet and moist or temporarily dry places                     |
| 5     | Nearly exclusively occurring outside water bodies.                              |

**The following diatom ecology and morphology glossery have been selected from the more extensive NRCAN Diatom glossery and Common Freshwater Diatoms of Britain and Ireland. These terms will help in the study of paleolimnology**

|                 |   |                 |  |                   |   |                   |   |                    |  |                   |  |                              |  |
|-----------------|---|-----------------|--|-------------------|---|-------------------|---|--------------------|--|-------------------|--|------------------------------|--|
| Acidobiontic    | Occurring below pH 7 with optimum development below pH 5.5.   | Dinoflagellates | Unicellular biflagellate algae with thick cellulose plates. May secrete toxins leading to occurrence or "red tides".   | Eutrophic         | Water of high nutrient level, usually poorly oxygenated. Characteristic of waters rich in dissolved inorganic or mineral nutrient materials. Rich in dissolved mineral nutrients and organic material (silty lakes), but frequently shallow and with seasonal oxygen deficiency in the hypolimnion. | Isopolar          | Both ends of the valve (or frustule) identical. Typical isopolar genera include <i>Diatoma</i> , <i>Synedra</i> and <i>Navicula</i> . (cf. Heteropolar).  | Metalimnion        | Zone of rapid temperature change in a stratified water body; marks the transition zone between the epilimnion and the hypolimnion.   | Polytrophic       | Characteristic of extreme rare eutrophic conditions.   | Sub-littoral zone            | Area which lies immediately offshore and extends up to extreme low water spring tides.   |
| Acidophyte      | Preferring an acid environment.   | Dorsal side     | The broader side of the valve in dorso-ventral genera such as <i>Cymbella</i> .  | Katharobic        | Characteristic of waters that have not been exposed to dissolved organic nutrients, or waters in which dissolved organic nutrients are very low or absent.  | Metathermal       | Occurring over a temperature range of from 5 °C to 15 °C.   | Microplankton      | Plankton between 20 and 60 microns in size.  | Profoundal        | The region occurring below the limnetic zone and extending to the bottom in lakes deep enough to develop temperature stratification.   | Subdominants                 | Species which though generally not numerous, are common in some horizons.  |
| Acrobic         | Any biological process occurring in the presence of molecular oxygen (CO <sub>2</sub> ); also applicable to organisms requiring oxygen for survival.  | Dystrophic      | Water poor in nutrients but rich in oxygen and humic content. Brownish in color, with high content of humic content; low pH; a small bottom fauna; low content of dissolved nutrients and oxygen; notably high oxygen consumption. | Lanceolate        | Shaped like the head of a lance, and tapering towards each end. Term relating to shape of valve or central / axial areas.   | Mixolimnion       | The upper, low-density, freely circulating layer of water in a meromictic lake. Also see: monimolimnion, chemocline.  | Mixolimnion        | The upper, low-density, freely circulating layer of water in a meromictic lake. Also see: monimolimnion, chemocline.   | Pseudoam-potiphil | Indifferent to tidal movement and occurring nearly exclusively on mud flats.   | Submerged aquatic vegetation | Submerged aquatic vegetation (SAV) is rooted in the substrate of a body of water (usually no deeper than 10 feet). SAV beds also enhance water quality by reducing turbidity and stabilizing sediments. seagrass.  |
| Algae           | Any of various primitive, chiefly aquatic, one- or multi-celled, non-flowering plants that lack true stems, roots, and leaves, but usually contain chlorophyll. Includes dinoflagellates, diatoms, seaweeds, and kelp.  | Eccentric       | Literally 'out of centre'. Refers to position of raphe is nearly always slightly (e.g. <i>N. dissipata</i> ) or totally displaced towards the edge of the valve.   | Lentic            | Still or standing water. Standing water can be subdivided into: lentic lakes, lentic ponds, and lentic bogs/swamps.   | Monimolimnion     | The deep, usually salty layer of a meromictic lake, of high density and perennially stagnant or non-circulating. Also see: mixolimnion, chemocline.   | Nano-plankton      | Very small plankton. It may be restricted to plankton less than 2 microns in size, with that from 2 to 20 microns termed ultramicroplankton, and that from 20 to 60 microns termed microplankton.                  | Pseudosepta       | (plural) Internal plates (best seen in girdle view) projecting into the cell from the valve, as in <i>Rhizosolenia</i> , cf. <i>septum</i> .                                     | Supra-littoral zone          | Intertidal or littoral waters. Region above the high tide line, which receives sea-water only from splashing waves. The area includes salt marshes, pans, ditches, streams, etc., where the highest tides may occasionally penetrate, violent changes of environmental conditions occur over short periods, and the diatom flora inhabiting it is strongly euryhaline. |
| Algal bloom     | A condition which occurs when excessive nutrient levels and other physical and chemical conditions facilitate rapid growth of algae.  | Eurythermal     | Tolerant to temperature changes.   | Lentic lake       | Characteristic of large inland bodies of water.   | Nitrogen fixation | The conversion of gaseous nitrogen to ammonia or nitrate.   | Neritic zone       | Zone extending from low tide to the edge of the continental shelf. Extend from the littoral zone to the edge of the continental shelf (from 0 to 50 m = inner neritic region; beyond 50 m = outer neritic region). | Psychrophilic     | Associated with low temperatures.  | Synpagi                      | With ice. General descriptive term used to refer to both benthic and pelagic faunas of the inner shelf fast-ice community, as well as the offshore ice community populated more by zooplankton.  |
| Alkaliphilous   | Occurring at about pH 7, with optimum development above pH 7.   | Endopelon       | General term to describe all diatom species growing within the sediment.   | Lentic pond       | Characteristic of small bodies of standing water.   | Nitrification     | The oxidation of ammonia to nitrate and nitrite, yielding energy for decomposing organisms. Nitrogen is an element which in living organisms is a component of protein structures.  | Obligate anaerobes | Organisms that can survive only in anoxic environments.  | Radiate           | Condition where striae are directed towards the centre of the valve. Cf. convergent.   | Terminal fissure             | Extension of the raphe itself. Often curved or hooked towards one side.  |
| Alveoli         | Elongate chambers in the surface of the valve. The top surface of these is composed of punctae or similar structures, which may only be resolvable under the electron microscope. Often appear as thick 'ribs' under the light microscope.  | Epibiotic       | Living on the surface of other plants, parasitically or otherwise. Synonym: epiphytic.   | Lentic swamp      | Characteristic of soft, wet, or marshy ground. Synonym: lentic bogs.  | Nutrient spectrum | Like the saprobien spectrum, the nutrient spectrum present a reflection of nutrients in bodies of water. It has been developed over a number of years as one means of evaluating lakes for the purpose of classifying them. Nutrient spectrum can be subdivided into 5 categories: polytrophic, eutrophic, mesotrophic, oligotrophic, and dystrophic. | Oligohaline        | Waters characterized by many (mainly) freshwater diatoms. Tolerant of little salt.   | Raphe             | Longitudinal slit or furrow found in many pennate diatoms, through which mucus, for motility, is extruded. Divided into two parts, arranged end-to-end with a gap at the centre. | Temperature spectrum         | This spectrum includes both optimum temperature in centigrade degrees and ranges of temperature change tolerated by individuals. The temperature spectrum can be subdivided into 7 categories: eutermal, mesothermal, oligothermal, stenothermal, metathermal, and eurythermal.  |
| Anaerobic       | Any process that can occur without molecular oxygen; also applicable to organisms that can survive without free oxygen.   | Epilimnion      | Warm, oxygen-rich, upper layer of a stratified water body; usually a seasonal phenomenon.  | Limnobiocitic     | Forms restricted to standing water. Forms characteristic only of stagnant waters.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligohalobous      | Can tolerate a salinity of less than 0.5 ‰ (less than 500 mg/l).   | Rheobiontic       | Forms typical of running water. Characteristic of running water only.  | Total Kjeldahl nitrogen      | An oxidative procedure that converts organic nitrogen forms to ammonia by digestion with an acid, catalyst, and heat. Abbreviation: TKN.   |
| Anoxia          | The absence of oxygen or a pathological lack of oxygen.   | Epitheca        | The upper valve and associated girdle bands that, together with the (slightly smaller) hypotheca, forms the diatom frustule.   | Limnophilous      | Forms with their optimum development in stagnant waters, but which also may be found in running water.  | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Rheophilous       | Forms with their optimum development in running waters, but which may be found in standing waters also.  | Total Kjeldahl phosphorus    | An oxidative procedure that converts organic phosphorus forms to phosphate by digestion with an acid, catalyst, and heat. Abbreviation: TKP.   |
| Apical symmetry | Symmetrical about the apical (longitudinal) plane of pennate diatoms. May be isopolar (e.g. <i>Navicula</i> ) or heteropolar (e.g. <i>Gomphonema</i> ).   | Epipelagic      | Relating to the oceanic zone into which enough light for photosynthesis penetrates.  | Linear            | Of uniform breadth for most of the length of the valve. Term relating to shape of valve or axial area.  | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Apochlorotic    | Algae that lack photosynthetic pigments (some dinoflagellates, euglenids and diatoms).  | Epipelagic      | Relating to the oceanic zone into which enough light for photosynthesis penetrates.  | Linear-lanceolate | Between linear and lanceolate in shape. Term relating to shape of valve.  | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Astatic         | Ephemeral; the term usually applies to pools and puddles.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Apiculate       | Condition where end of valve is drawn out into a fine point. Cf. rostrate, where the valve end is broader.  | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Axial area      | Area between the two rows of striae. May be narrow (e.g. <i>Synedra ulna</i> ) or broad (e.g. <i>Pseudotaurosira brevisstrata</i> ) and is a useful diagnostic feature in some taxa. cf. stermum.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Bioindicators   | Organisms that are used to detect changes in environmental pollutant levels. Biomagnification: An increase in the concentration of a substance in each progressive link of the food chain.  | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Biopel          | The organic component of lake mud regardless of its origin.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Biotope         | A clearly distinguished unit of the environment showing uniformity of principal habitat conditions. Any segment of the biosphere with convenient arbitrary upper and lower boundaries, which is horizontally homogeneously diverse relative to the large motile organisms present within it.                      | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Capitate        | Condition where end of valve is drawn out and slightly inflated, but not to such an extent that it is markedly broader than the main body of the valve. There is a distinct 'neck' (c. two-thirds total width of valve) between the main body of the valve and the apex, cf. sub-capitate, rostrate and inflated. | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Chemocline      | The boundary between the circulating and the non-circulating water masses or layers of lake. the boundary separating the mixolimnion and the monimolimnion in a meromictic lake, a zone of rapid change, with depth, in the chemical constituents of a lake.  | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Chlorophyll a   | A green pigment, found in all plants that undergo photosynthesis, that is used as an indicator of algal growth in a water body.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Circumneutral   | pH indifferent, around 7.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Clavate         | 'Club-shaped' or 'wedge-shaped'. Term relating to shape of valve. Examples include some <i>Gomphonema</i> species and <i>Meridion</i> circulare.  | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Convergent      | Condition where striae are directed towards the ends of the valve). This feature is often pronounced in <i>Pinnularia</i> , cf. <i>radiata</i> .  | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming them. A plant that grows on another plant and depends on that plant for mechanical support but not for nutrients.         | Littoral zone     | Intertidal or littoral waters. Area which lies between the extreme low water and the extreme high water spring tides. The littoral zone varies considerably according to the nature of the coastline.   | Oligotrophic      | Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water in dissolved inorganic or mineral nutrient materials. Low content of dissolved nutrients. (for example: rocky lakes). Deficient in plant nutrients and usually having abundant oxygen with no marked stratification.                       | Oligotrap-hent     | Preferring environment poor in nutrient.   | Ringleiste        | A thickening on the inside of the valve of <i>Aulacoseira</i> (p. #ff). Associated with the sulcus.  | Trochoplane                  | where end of valve is broadly capitate but extreme end is flattened. See <i>Diatoma ehrenbergii</i> .  |
| Costae          | (plural) Silica thickenings on the inside of the valve.   | Epiphytic       | Algal flora on the macrophytic benthic plants. Attached diatom species growing on plants without harming   |                   |   |                   |   |                    |  |                   |  |                              |  |



