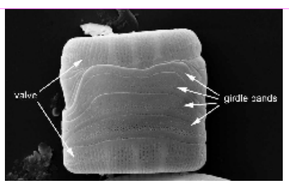
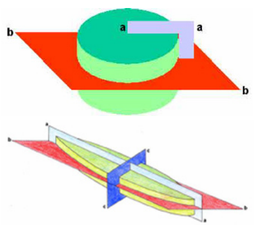
A basic guide to diatom morphology and biology from: Common Freshwater Diatoms of Britain and Ireland, http://craticula.ncl.ac.uk/EADiatomKey/html/index.html

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.

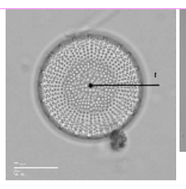


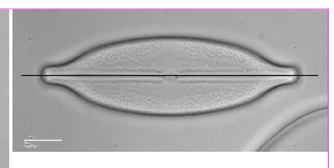


Morphology

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.

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 raphid diatoms. Raphid 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 sternum 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 brebisonii). 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 (strutted or labiate processes) associated with the production of chitin fibres or mucilage fultoportula. 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.

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 protoplast 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 raphid diatoms, the latter being opposite 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 (monoraphid diatoms), so the valves of a cell differ. This key is designed so that the raphid 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 protoplast 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 photosyntheseis). 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 Achnanthaceae where one valve has a raphe and the other does not, and the Cymatosiraceae 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 as Environmental Indicators

Living diatoms often have specific salinity, temperature and other environmental tolerences, 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 palaeonvironmental reconstructions. This type of work has been used extensively and very successfuly, 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 nutient that most likely to limit primary production in freshwaters. 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 ater quality classand gives a numerical value with these parameters.

Value	Description	Water quality class	O_2 saturation(%)	BOD(mg l^{-1} O_2)
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/polysaprobous	III-IV	10-25	13-22
5	Polysaprobous	IV	<10	>22

Sensitivity to acidification

The table below presents the common classification of diatom occurances 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- (mg l-1)	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 developmen

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 paleoliminology

Acidobiontic	Occurring below pH 7 with optimum development below pH 5.5.
Acidophyte	Preferring an acid environment.
Aerobic	Any biological process occurring in the presence of molecular oxygen (CO2); also applicable to organisms requiring oxygen for survival.
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.
Algal bloom	A condition which occurs when excessive nutrient levels and other physical and chemical conditions facilitate rapid growth of algae.
Alkaliphilous	Occurring at about pH 7, with optimum development above pH 7.
Ampotixen	Intolerant to tidal movement.
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.
Anaerobic	Any process that can occur without molecular oxygen; also applicable to organisms that can survive without free oxygen.
Anoxia	The absence of oxygen or a pathological lack of oxygen.
Apical symmetry	Symmetrical about the apical (longitudinal) plane of pennate diatoms. May be isopolar (e.g. Navicula) or heteropolar (e.g. Gomphonema).
Apochlorotic	Algae that lack photosynthetic pigments (some dinoflagellates, euglenids and diatoms).
Astatic	Ephemeral; the term usually applies to pools and puddles.
Apiculate	Condition where end of valve is drawn out into a fine point. Cf rostrate, where the valve end is broader.
Axial area	Area between the two rows of striae. May be narrow (e.g. Synedra ulna) or broad (e.g. Pseudostaurosira brevistriata) and is a useful diagnostic feature in some taxa. cf sternum.
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.
Biopel	The organic component of lake mud regardless of its origin.
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.
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' (< two-thirds total width of valve) between the main body of the valve and the apex, cf sub-capitate, rostrate and inflated.
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.
Chlorophyl a	A green pigment, found in all plants that undergo photosynthesis, that is used as an indicator of algal growth in a water body.
Circumneutral	pH indifferent, around 7.
Clavate	'Club-shaped' or 'wedge-shaped'. Term relating to shape of valve. Examples include some Gomphonema species and Meridion circulare.
Convergent	Condition where striae are directed towards the ends of the valve). This feature is often pronounced in Pinnularia. cf. radiate.
Costae	(plural) Silica thickenings on the inside of the valve.
Cruciform	Shaped like a cross. Term relating to shape of valve. E.g. some species of Tetracyclus.
Cryopelagic	Term used to refer to a subset of the sympagic community; it is descriptive of the ice community composed of pelagic organisms over deeper water. Inhabiting mass of sea instead of bottom (plankton - floaters and nekton - swimmers).
Cuneate	wedge-shaped. Often used to describe shape (particularly girdle views) of heteropolar genera such as Gomphonema and Meridion.
Cyanobacteria	Photosynthetic bacteria; often referred to as blue-green algae.
Denitrification	Reduction of nitrate-yielding gaseous nitrogen.
Dinoflagellates	Unicellular biflagellate algae with thick cellulose plates. May secret toxins leading to occurrence or "red tides".
Dorsal side	The broader side of the valve in dorsiventral genera such as Cymbella.
Dystrophic	Water poor in nutrients but rich in oxygen and humus 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.
Eccentric	Literally 'out of centre'. Refers to position of raphe is nearly always slightly (e.g. N. dissipata) or totally displaced towards the edge of the valve.
Eirythermal	Tolerant to temperature changes.
Endopelon	General term to describe all diatom species growing within the sediment.
Epibiotic	Living on the surface of other plants, parasitically or otherwise. Synonym: epiphytic.
Epilimnion	Warm, oxygen-rich, upper layer of a stratified water body; usually a seasonal phenomenon.
Epilithon	General term to describe all diatom species growing attached to rock surface.
Epitheca	The upper valve and associated girdle bands that, together with the (slightly smaller) hypotheca, forms the diatom frustule.
Epipelagic	Relating to the oceanic zone into which enough light for photosynthesis penetrates.
Epipelic	Occurring on mud. Attached diatom species growing on mud; benthic, adhering to sediments. Benthic species living on silt grains, as a part of the interstitial micro flora.
Epiphyte	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.
Epiphyton	General term to describe all diatom species occurring, growing on plants.
Epiplankton	The portion of the plankton between the surface and 100 fathoms.
Epipsammic	Benthic species that are attached to sand grains, as part of the interstitial micro flora. The definition also applies to epipsammon. Growing attached to sand grains.
Epizooic	Growing attached to animals. Occurring on animals.
Epontic	Diatoms which spend a part, a portion of their life cycle frozen into the underside or the bottom layers of sea-ice. Algae frozen into sea-ice, or associated with ice. Epontic means "out of the sea", and the term describes the pennate diatom component of the sea-ice biota.
Euhalob	Preferring a very salty environment.
Euhalobien	Can tolerate salinity of 30,000 to 40,000 mg/l or ppm [= 30 to 40 o/oo or ppt].
Euhalobous	Marine forms, occurring in salt concentrations of 30,000 to 40,000 mg/l. Marine forms, 30 to 40 ppt salt content.
Euphotic zone	Surface layer of water to the depth of light penetration where photosynthetic activity equals respiration, or where 1% of incident light remains.
Euplanktonic	Normally suspended in the water, distribution is current dependent.
Euryecious	Occurring in a wide variety of habitats or environments. Synonym: eurytopic.
Euryhaline	Having a wide range of tolerance to salt concentration, often encompassing 2 or more large spectral designations.
Euryhalinous	Occurring over broad ranges of salt concentration, often encompassing 2 or more large spectral designations. Synonyms: euryhalobous, euryhaline.
Eurythermal	Tolerant to temperature changes. Occurring over a temperature range of 15 °C or greater.
Eurytopic	Growing in different environments. Tolerant to a wide range of environmental conditions. Having a wide range of tolerance to variation of one or more environmental factors. Occurring in a wide variety of habitats or environments. Synonym: euryecious. Antonym: stenotopic.
Euryök	Exhibiting a wide range of ecological tolerance.
Euthermal	Warm-water forms usually occurring at temperature greater than 30 °C.
Eutraphent	Preferring an environment rich in nutrients.
Eutraphentic	Diatoms that exist in eutrophic conditions.
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.
Eutrophication	A process by which a water body becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen, and changes in community composition.
Flocs	Mass of filamentous algae and associated mucilage, either loosely-attached to a substrate or free-floating.
Frustule	Silicieous cell wall of diatoms, composed of two valves plus associated girdle bands.
Fultoportula	Tube penetrating the silica framework of a valve and supported internally by two or more buttresses (also known as 'strutted process'). Confined to centric diatoms such as Cyclotella and Thalassiosira. See also rimoportulae.
Girdle band	Siliceous bands wrapped around the outside of a frustule. The number depends upon the species and can vary in number. They enclose and protect the cell whilst permitting an increase in volume during the cell cycle. Also known as copulae.
Girdle view	The side view of a diatom frustule, in which the mantle and girdle bands may be visible, but not the valve face.
Habitat spectrum	The general habitat spectrum is the type of water body or macrohabitat characteristic for the species. Includes benthic, lentic [lakes, ponds, bogs/swamps], lotic [crenophilous-general, crenophilous-thermal, rivers/streams], aerophilous/terrestrial, estuarine, littoral, neritic, oceanic/marine, and eurytopic/euryecious. The specific habitat spectrum can be subdivided into 3 categories: planktonic/pelagic [euplanktonic, tychoplanktonic], periphytic-attached [epipelic, epilithic, epiphytic, epizooic, epidentric], periphytic-unattached.
Halophilous	Forms generally living in freshwater, but even in slightly brackish water. Common in freshwater, but not uncommon in slightly brackish water. Stimulated by small amounts of salt. Halobian spectrum includes euhalobous, polyhalobous, mesohalobous [alpha (strong), beta (weak)], oligohalobous [halophilous, indifferent, halophobous], and euryhalobous/euryhaline.
Halophyte	Preferring salt.
Haplobiontic	Life cycle with only one free-living stage, as opposed to diplobiontic.
Haptobenthic	A diatom which is adnate to a solid surface.
Herpobenthic	Diatoms which live in or on the uppermost sediments.
Heterotroph	Organism that obtain energy by ingesting preformed organic matter.
Heteropolar	One end of the valve (or frustule) differing from the other. Typical heteropolar genera include Meridion and Gomphonema . cf. isopolar
Holoeuryhaline	Salinity 0 to 35 o/oo.
Holomictic	A lake that undergoes a complete mixing of its surface waters during periods of circulation or overturn.
Holoplankton	Planktonic organism that lack a benthic stage, hence that spend whole life as free-floating organisms. All oceanic species are holoplanktonic greater part of neritic species are meroplanktonic.
Hyaline	Literally 'glass-like'. Refers to areas of the valve free from any obvious ornamentation.
Hydrophytic	Forms growing submersed in water, in lakes, streams, rivers, sea.
Hypolimnion	Cool, oxygen-deficient, bottom layer of a stratified water body; usually a seasonal phenomenon.
Hypoxia	A condition of low dissolved oxygen in aquatic systems.
Infaunal	A general term that applies to all aquatic animals living in the bottom sediment of a body of water. More specifically, applies to benthic organisms that dig into the sea bed or construct tubes or burrows. They are most common in the subtidal and deeper zones
Internal chambers	Structures associated with the girdle in the genera Mastogloia and Diatomella. In Mastogloia, these chambers (technically 'partecta') have porous internal walls and are concerned with the production of mucilage strands. They open externally via apertures close to the valve margin.
Interstitial flora	Microflora living in interstitial water in shore sands and bottom muds and silts.
Isopolar	Both ends of the valve (or frustule) identical. Typical isopolar genera include Diatoma, Synedra and Navicula. (cf. Heteropolar).
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.
Lanceolate	Shaped like the head of a lance, and tapering towards each end. Term relating to shape of valve or central / axial areas.
Lentic	Still or standing water. Standing water can be subdivided into: lentic lakes, lentic ponds, and lentic bogs/swamps.
Lentic lake	Characteristic of large inland bodies of water.
Lentic pond	Characteristic of small bodies of standing water.
Lentic swamp	Characteristic of soft, wet, or marshy ground. Synonym: lentic bogs.
Limiting nutrient	The plant nutrient present in lowest concentration relative to need: limits growth such that addition of the limiting nutrient will stimulate additional growth. In north temperate lakes, phosphorus [P] is commonly the limiting nutrient for algal growth.
Limnobiontic	Forms restricted to standing water. Forms characteristic only of stagnant waters.
Limnophilous	Forms with their optimum development in stagnant waters, but which also may be found in running water.
Linear	Of uniform breadth for most of the length of the valve. Term relating to shape of valve or axial area.
Linear-lanceolate	Between linear and lanceolate in shape. Term relating to shape of valve.
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.
Lotic	Flowing, running water. Running water can be subdivided into: lotic crenophilous-general, lotic crenophilous-thermal, lotic rivers and lotic streams.
Lotic crenophilous	Occurring in spring water in general [general], or occurring in hot springs [thermal] .
Lotic streams	Occurring in larger and smaller bodies of running water that have more or less continuous geographical expression.
Macrophyte	A macroscopic vascular plant; a multicellular aquatic plant, either free-floating or attached to a surface.
Marginal lines	Features caused by breaks in the striae which give the impression of hyaline lines, usually close to the edge of the valve face. See diagrams of Cocconeis and Neidium for examples.
Meioeuryhaline	Salinity between 1,7% and 3,5% (= 17 to 35 o/oo, or 17,000 to 35,000 mg/l).
Meromictic	A lake that undergoes incomplete mixing of its waters during periods of circulation. More specifically, a lake in which the bottom, non-circulating water mass (monimolimnion) is adiabatically isolated from the upper, circulating layer (mixolimnion).
Meroplankton	Planktonic organisms that produce benthic resting spores, hence generally restricted to near-shore or shallow water environments. Greater part of neritic species are meroplanktonic
Mesohaline	Waters characterized by autochtonous brackish-water diatoms.
Mesohalob	Moderately salt-loving.
Mesohalobous	Forms preferring brackish water of approximately 0,5 o/oo to about 30 o/oo salt content. Mesohalobous can be subdivided into 2 categories: mesohalobous Alpha (strong), and mesohalobous Beta (weak).
Mesoplankton	The portion of the plankton found only a part of the time at or near the surface.
Mesosaprob	Form living in moderately polluted water.
Mesosaprobic	Characteristic of zone where oxidation of organic load is proceeding. Occurring characteristically with decomposition and oxidation widely present, and with decomposition products of protein, ammonia salts, etc., and moderate dissolved organic nutrients. Mesosaprobic can be subdivided into: mesosaprobic Alpha (strong), and mesosaprobic Beta (weak).
Mesothermal	Temperature-water forms, usually occurring between 15 °C and 30 °C .
Mesotraphent	Preferring moderately nutrient-rich environment.
Mesotrophic	Characteristic of waters intermediate in dissolved inorganic or mineral nutrient materials. Characteristic of water with moderate nutrient concentration.
Metalimnion	Zone of rapid temperature change in a stratified water body; marks the transition zone between the epilimnion and the hypolimnion.
Metathermal	Occurring over a temperature range of from 5 °C to 15 °C.
Microplankton	Plankton between 20 and 60 microns in size.
Mixolimnion	The upper, low-density, freely circulating layer of water in a meromictic lake. Also see: monimolimnion, chemocline.
Monimolimnion	The deep, usually salty layer of a meromictic lake, of high density and perennially stagnant or non-circulating. Also see: mixolimnion, chemocline.
Nannoplankton	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.
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).
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.
Nitrogen fixation	The conversion of gaseous nitrogen to ammonia or nitrate.
Nutrient spectrum	Like the saprobien spectrum, the nutrient spectrum present a reflection of nutrients in bodies of water. It as 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.
Obligate anaerobes	Organisms that can survive only in anoxic environments.
Oligohaline	Waters characterized by many (mainly) freshwater diatoms. Tolerant of little salt.
Oligohalob	Not very salt loving.
Oligohalobien	Can tolerate a salinity of less than 0,5 o/oo (less than 500 mg/l).
Oligosaprobic	Characteristic of zones where oxidation of biodegradable compounds is complete. The concentration of inorganic nutrients is usually high. Characteristic of clean water, associated with termination, mineralisation and all aggressive processes of self purification (low dissolved organic nutrients).
Oligothermal	Cold-water forms, usually occurring between 0 °C and 15 °C.
Oligotraphent	Preferring environment poor in nutrient.
Oligotrophic	Characteristic of water of limited nutrient level, which may be highly oxygenated. Characteristic of water poor 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.
Panduriform	Elliptical or oval in outline, with a concavity in each side, like the body of a violin.
Pelagic	Inhabiting mass of sea instead of the bottom (pelagic plankton = floaters, and pelagic nektons = swimmers). Can be subdivided into 2 categories: euplanktonic and tychoplanktonic.
Periphytic	Microorganisms attaching to rocks, objects, plants, etc.. Can be subdivided into 7 categories: epipelic, epilithic, epiphytic, epizooic, epidendric, attached, and unattached.
Periphyton	Micro-organisms attaching to rocks, objects, plants, etc. The definition also applies to periphytic.
pH spectrum	Cyanophyta are all indifferent or restricted to the alkaline end of the spectrum. Perhaps of greater importance are the optimum pH values for individuals. Include: acidobiontic, acidophilous, indifferent/circumneutral, alkaliphilous, and alkalibiontic.
Phytoplankton	Free-floating microscopic aquatic organisms capable of photosynthesis.
Pleioeuryhaline	Salinity 0,3 to 35 o/oo (300 to 35,000 mg/l).
Polyhaline	Waters characterized by many (mainly) brackish and marine diatoms.
Polyhalobien	Can tolerate salinity greater than seawater. See also: euhalobien, euhalobous.
Polyhalobous	Marine forms, 30 to 40 o/oo salt content. Occurring in salt concentrations over 40, 000 mg/l.
Polysaprobic	Occurring characteristically in the predominance of reduction and cleavage processes, because of absence or low content of oxygen, and because of carbon dioxide and a relatively high content of nitrogenous and putrescible nutrient substances.
Polytrophic	Characteristic of extreme rare eutrophic conditions.
Profundal	The region occurring below the limnetic zone and extending to the bottom in lakes deep enough to develop temperature stratification.
Protracted	Outline of the valve apices is different (typically narrower) than the outline of the main part of the valve.
Pseudoampotiphil	Indifferent to tidal movement and occurring nearly exclusively on mud flats.
Pseudosepta	(plural) Internal plates (best seen in girdle view) projecting into the cell from the valve, as in Rhoicosphenia. cf. septum.
Psychrophilic	Associated with low temperatures.
Puncta	(plural) Fine perforations on valve surface, usually organised into rows termed striae.
Radiate	Condition where striae are directed towards the centre of the valve. Cf. convergent.
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.
Rheobiontic	Characteristic only of running water. Forms typical of running water only.
Rheophilous	Forms with their optimum development in running waters, but which may be found in standing waters also.
Rimoportulae	(plural) Tubes on the valve, connecting the diatom protoplast with the outside. Possibly used in secretion of mucilage. See also fultoportulae.
Ringleiste	A thickening on the inside of the valve of Aulacoseira (p. ##). Associated with the sulcus.
Rostrate	Condition where end of valve is drawn out slightly but not inflated. Cf. capitate, apiculate.
Salinity	The amount of dissolved salts in water, generally expressed in parts per thousand [ppt]. The average salinity of sea water is 35 parts per thousand. Salinity can range from 0 up to 37 ppt.
Saprobe	An organism that feeds on non-living organic matter.
Saprobic	Living on decaying organic matter.
Saprobien spectrum	Although the saprobien and nutrient spectra are similar in that they both present a reflection of nutrients in bodies of water, they are not the equivalents of each other The saprobien spectrum can be subdivided into 7 categories: polysaprobic-saprobiontic, mesosaprobic-alpha [strong], mesosaprobic-beta [weak], oligosaprobic, saprophilic, saproxenous, and katharobic.
Saprobiontic	Organisms occurring only in most heavily polluted waters.
Sapropel	Highly reduced, bituminous sediments.
Saprophil	Prefers to live on dead or decaying organic matter. Synonyms: saprophyte, saprophibic. Note: oligosaprobic = saproxen = polyoxybiont.
Saprophilous	Occurring generally in organically polluted waters, but also occurring in other communities.
Saprophobic	Organism which is not capable of thriving in polluted waters. Characteristic of waters that have not been exposed to pollution. Synonym: katharobic.
Saprophyte	Any organism living on dead or decaying organic matter.
Saproxen	Requires oxygen.
Saproxenous	Occurring in clean water habitats, but also in polluted ones. Occurring primarily in biotopes other than the organically polluted ones, but occurring also in the presence of pollution.
Septa	(pleural) Internal plates projecting from the girdle band into the frustule.
Seston	A general term for all suspended matter in water, both organic and inorganic.
Stauros	Technical term for a central area which is extended transversely to the valve margins. Best observed in Stauroneis.
Stellate	Literally 'star-shaped'. Refers to colonial forms of genera such as Asterionella and Tabellaria that are formed by several frustules united by mucus pads at one end to form a star-shaped colony.
Stenothermal	Occurring over a temperature range of no greater than 5 °C.
Sternum	The central rib along the longitudinal axis of pennate diatoms.
Striae	(pleural) Lines on the valve surface formed from rows of puncta or other fine perforations, which may or may not be resolvable.
Stromatolite	Laminated organo-sedimentary structure produced by algal mats that entrap detrital sediments, commonly by blue-green algae, but less frequently by bacteria.
Sub-littoral zone	Area which lies immediately offshore and extends up to extreme low water spring tides.
Subdominants	Species which though generally not numerous, are common in some horizons.
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.
sub-rostrate	Similar to rostrate, except that the valve apices have trapezoidal, rather than parallel sides.
Supra-littoral zone	Intertidal or littoral waters. Region about 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.
Sympagi	With ice. General descriptive term used to refer to both benthic and pelagic fauna of the inner shelf fast-ice community, as well as the offshore ice community populated more by zooplankton.
Sulcus	A furrow between the mantle and ringleiste.
Synecology	Ecology of communities, as opposed to ecology of individual species (autecology).
Synusia	A plant community of relatively uniform composition, living in a particular environment and forming part of a phytocoenosis.
Terminal fissure	Extension of the raphe itself. Often curved or hooked towards one side.
Temperature spectrum	This spectrum includes both optimum temperature in centrigrade degrees and ranges of temperature change tolerated by individuals. The temperature spectrum can be subdivided into 7 categories: euthermal, mesothermal, oligothermal, stenothermal, metathermal, and eurythermal.
Thanatocoenose	Totality or assemblage of dead organisms.
Thermocline	Zone of rapid temperature and density change in a stratified water body; marks the transition zone between the epilimnion and the hypolimnion. Also known as the metalimnion.
Total Kjeldahl nitrogen	An oxidative procedure that converts organic nitrogen forms to ammonia by digestion with an acid, catalyst, and heat. Abbreviation: TKN.
Total Kjeldahl phosphorus	An oxidative procedure that converts organic phosphorus forms to phosphate by digestion with an acid, catalyst, and heat. Abbreviation: TKP.
Transapical symmetry	Symmetrical about the transapical plane (i.e. perpendicular to the longitudinal axis) of pennate diatoms. e.g. Cymbella ehrenbergii.
Trophogenic	Originating from nutritional differences rather than resulting from genetic determinations, such as various casts of social insects.
Truncated condition	where end of valve is broadly capitate but extreme end is flattened. See Diatoma ehrenbergii.
Tychopelagic	Littoral species suspended in the plankton, torn from their means of support, and thrown up into the plankton where they are carried about for a time by current and wind.
Tychoplanktonic	Normally associated with periphytic or terrestrial habitats but often suspended in the water.
Ultramicroplankton	Plankton between nannoplankton and microplankton in size, thus between 2 and 20 um.
Upper brackish water	At the tide limit in estuaries; the river, which is poor in salts, moves over the tide water, which is rich in salts.
Valve	A structural component of the diatom frustule. Two valves fit together (like the two halves of a date box or petri dish) to form (along with associated girdle bands) a frustule.
Valve face	The surface of a valve, on which various sorts of ornamentation (striae,
Valve view	The view of a diatom obtained by looking down from above onto the surface of the valve.
Ventral side	The narrower side of the valve in dorsiventral genera such as Cymbella.
Wetlands	Areas that are inundated or saturated by surface or ground wate. Wetlands generally include swamps, marshes, bogs, and similar wet areas.
Zooplankton	Free-floating or weakly-swimming planktonic organisms not capable of photosynthesis.

Diatom: Biology, Morphology and Ecology of Selected Genus : This chart has been developed to provide an "at a glance" process for keying out Genus of diatoms and providing some generalized ecological information. This is an introductory key. For more specific information and identification of species of diatoms, many web based diatom databases are accessible to students. This chart has been developed using the following resources. http://craticula.ncl.ac.uk/EADiatomKey/html/index.html, http://diatom.acnatsci.org/AlgaeImage/, http://westerndiatoms.colorado.edu/genera, http://gsc.nrcan.gc.ca/paleo/diatoms/index_e.php, These diatom resources are the basis of this chart and they serve as access to more detailed further analysis.

Class Bacillariophyceae Cells elongate and often symmetrical about at least two planes, one of which is the pervalvar plane; heterovalvar cells also occur. Stria pattern bilateral, orientated about a longitudinal sternum, raphe present (sometimes subtended internally by siliceous bridges), either within the longitudinal rib or to one side of it. Costae and septa may be present. Rimoportules absent. Usually one, two or four plastids per cell, occupying characteristic positions in relation to the raphes; rarely many small, discoid plastids. Chain-like, zig-zag or stellate colonies rarely formed, but epiphytic species often form stalks for attachment.

Genus, Image	**Gerus description**	**Ecological Information**
Achnanthes	Cells are heterovalvar and are flexed in girdle view. They are solitary attaching directly to a surface by one valve face, or by a mucliage pad or stalk at one valve apex. A single plate-like plastid, lies under the rapheless valve and extends under the girdle. Valves are linear to elliptical or bluntly lanceolate, with rounded or, in a few cases, protracted apices. The raphe valve is on the convex side of the shallow 'v' caused by the flexing of the girdle. The central area is variable, and is sometimes replaced by a thickened stauros. The rapheless valve is typically with coarser striation and differences in the size of the sternum. Both valves must be observed to ensure accurate identification.	"Common in hard-water streams throughout the UK and tends to be more common in the summer than in spring or autumn. It thrives in nutrient-rich water free from significant organic pollution. TI S:1,7 V:0 Mesotrophic, Saprobic S:1.5 V:1.5 Tolerant of slight organic pollution, pH Circumneutral (mainly occurring at pH values about 7), Salinity, Fresh
Achnanthidiun	Cells are linear, lanceolate or elliptical when seen in valve view, and are bent about the median transapical plane to form a shallow "v" when seen in girdle view. They are heterovalvar, with the central raphe thickening usually distinct on the concave valve. There is a single plastid, lying against the one side of the girdle and extending beneath the rapheless (convex) valve. The raphe valve has a narrow, linear axial area and fine, radiate striae. The rapheless valve is similar, except that there is no raphe and the central area is small or absent. Striae on the rapheless valve vary from slightly radiate to transverse and parallel.	widespread and abundant diatom, common in well-oxygenated, circumneutral or alkaline lakes and streams with low or moderate concentrations of nutrients and organic pollution. It can be abundant in streams affected by heavy metal pollution. Saprobic S:1,7 V:1.7 Tolerant of slight organic pollution, pH 3 Circumneutral (mainly occurring at pH values about 7) Salinity: Freshwater"
Amphipleura	Valves linear-lanceolate to slightly rhombic with acutely, rounded ends. Very distinctive due to short raphe-slits restricted to poles.	Epipelic and also found associated with aufwuchs around aquatic plants. Found occasionally in epilithic biofilms in rivers. TI S:2 V:2.0 Meso ? Eutrophic, Saprbotic S: 1.3 V:1.3 Pollution sensitive, pH 4 Alkaliphilous (mainly occurring at pH > 7) Salinity: Fresh
Amphora	Valves small lunate, cells bi-convex and usually seen in girdle view with dorsal margin much deeper than ventral margin. Raphe normally towards ventral margin can appear almost central and almost straight. Central margins with hyaline areas.	Very common in epilithon in streams and rivers, often the most numerically abundant diatom, in streams with some nutrient enrichment. TI S:2.0 V:2.8 Eu ? polytrophic, Saprobtic S:2.1 V:2.1 Tolerant of moderate organic pollution, pH, Alkaliphilous, Salinity Fresh brackish
Aneumastus	Cells broadly lanceolate in valve view with rostrate or subrostrate apices, narrowly rectangular in girdle view. Valves coarsely striate, striae sometimes becoming biseriate near the margins. Raphe slits central, undulate, continuing to valve apices. Several girdle bands with rows of pores.	TI S:4 V:1.0 Optimum occurs between 0.1 and 0.35 mg l-1 filtrable P Sapbrotic S:1.1 V:1.1 Very sensitive to pollution Salinity Freshwater
Anomoeoneis	Valves lanceolate to elliptical-lanceolate with broadly rounded to capitate ends. Striae distinctly punctate. Usually with hyaline areas on either side of the axial area. Distal raphe ends clearly deflected to one side.	An epipelic species, found in littoral zones of waterbodies with moderate to high electrolyte TI S:3.4 V:3.0 Sapbrotic S:2.7 V:2.7 Tolerant of heavy organic pollution pH: 5 Alkalibiontic, Salinity Freshwater brackish
Bacillaria	Most easily recognized when alive, because of the unique motile colonies it produces, in which the cells, though linked to each other via a ridge and groove arrangement of their raphe systems, are able to move over each other, so that the colony can alternate between a Fragilaria-like chain and an extended, fibre-like configuration, in which each cell is connected to its neighbour only by its tip. Frustules isopolar. Cells seen in valve or girdle view. Valves shallow, always lying in valve view, bilaterally symmetrical, linear or linear-lanceolate, with pointed, rounded, cuneate to slightly rostrate poles. Striae transverse, appearing as simple lines. Raphe system fibulate, central.	The species is recorded from marine, brackish and freshwater habitats. Epipelic, loosely associated with the benthos, or planktonic; in inland waters, often found in brackish or saline habitats. TI S:2 V:3.0 Tolerant to heavy pollution Sapbrotic S:2.3 V:2.3 Tolerant of moderate to heavy organic pollution pH: 5 Alkalibiontic Salinity Extends into brackish water
Brachysira	Valves linear to linear-lanceolate to rhombic with rounded to protracted ends. Striae finely punctate, and appearing to form longitudinal undulations. Raphe straight and axial area narrow.	Widespread in the epipelon of littoral zones of oligotrophic, typically upland, waters with low to moderate conductivity. TI S:1 V:5 Favoured by low nutrient concentrations Sapbrotic S:1 V: 1 Pollution sensitive pH:4 Alkaliphilous, Salinity Freshwater
Caloneis	Valves linear to broadly lanceolate sometimes centrally inflated or undulate. Ends cuneate, rounded, rostrate to sub-capitate. Axial area often broad and centrally inflated and slightly asymmetrical or "scruffy". Raphe +/- straight with ends hooked to one side. Striae visible and usually course, some species lacking striae in central area.	Widespread epipelic diatom in waters of moderate to high electrolyte content. Not common in rivers.TI S:3.9 V:2 Poly ? hypertrophic Sapbrotic S:2.3 V:2.3 Tolerant of moderate to heavy organic pollution pH:4 Alkaliphilous, Salinity Brackish fresh
Cavinula	Cells solitary, usually H-shaped in girdle view, comprising lobed plates under the valves, connected by a bridge containing the pyrenoid. Valves linear-lanceolate or rhombic-lanceolate, to more or less elliptical; girdle narrowly rectangular. Raphe slits central, stopping short of the apices, deflected in opposite directions at the apices. Striae uniseriate, fine, pores sometimes elongated along the striae. Girdle composed of narrow bands with transverse rows of pores.	TI S:1.2 V:2 Oligotrophic Sapbrotic S:1 V:1 Pollution sensitive pH: 3 Circumneutral , Salinity Freshwater
Cocconeis	Cells are solitary and heterovalvar with a concave raphe valve and a rapheless valve that is convex, often very strongly so. They live attached to substrates by mucilage produced by the raphe valve. There is a single C-shaped plastid, which is sometimes lobed and which contains one to several elongate pyreneoids. Valves vary from almost circular in outline to elliptical with rounded, or slightly pointed, ends. The raphe valve has fine, radiate striae with a narrow, linear axial area and a small central area. The rapheless valve has coarser striae, which are often obviously punctate, a linear or lanceolate axial area and no central area. The convex curvature of the rapheless valve is often apparent under the light microscope. There are a few narrow girdle bands, none of which possess pores.	Very common, and often quite abundant in lowland rivers. An epiphyte, but also occurs in large numbers in samples scraped from stones. It favours circumneutral to alkaline water with relatively high nutrient concentrations and it can tolerate moderate levels of organic pollution. TI S:2.6 V:2.6 Eutrophic Sapbrotic S:2 V: 2 Tolerant of moderate organic pollution pH: Alkaliphilous Salinity brackish water
Craticula	Cells usually lanceolate to linear lanceolate in valve view with subrostrate to rostrate apices, narrowly rectangular in girdle view. Valves with central raphe slits, continuing over the apices, slightly expanded at centre. Striae often more or less parallel, uniseriate with fine regular pores. Valves may appear as if transected also by longitudinal striae. Few girdle bands, each with a single row of pores.	TI S:3.9 V: 5 Poly ? hypertrophic Sapbrotic S:3.5 V:3.5 Tolerant of very heavy organic pollution pH:4 Alkaliphilous , Salinity Freshwater
Cymatopleura	Cells solitary. Frustules isopolar. Mantles and girdle shallow, so that cells are most often seen in valve view. Valves elliptical to elongate, sometimes constricted at the centre. Raphe system running around the whole of the valve perimeter, raised very slightly above the valve face. Highly characteristics is the prominently undulate valve face, which is homogeneously structured, containing very fine striae that bend in various directions according to their positions relative to the undulations. Short ribs may be present towards the periphery of the valve face: these are continuous with bar like fibulae subtending the raphe.	Generally epipelic, fresh water. TI S:2.9 V: 3 Eu ? polytrophic Sapbrotic S:1.4 V:1.4 Tolerant of slight organic pollution pH:4 Alkaliphilous , Salinity Freshwater
Cymbella	Valves asymmetrical around apical axis and symmetrical to the transapical axis. Cells showing slight to pronounced dorsiventrallity. Ends rounded to subcapitate. Raphe central or slightly ventral, +/- straight to sinuous. Stigmata lacking or on the ventral side of the central area. Terminal raphe ends straight or deflected dorsally.	Found on rocks and plants in circumneutral streams and lakes with low nutrient concentrations. TI S:1 V:3 Optimum occurs at or below 0.01 mg l-1 filtrable P Sapbrotic S:1.2 V:1.2 Pollution sensitive pH:4 Alkaliphilous , Salinity Freshwater
Cymbellonitzschia	Cells solitary or forming short chains linked via their valve faces. Frustules isopolar. Cells seen in valve or girdle view. Valves bilaterally asymmetrical, with a straight ventral margin and a curved dorsal margin. Transverse striae visible, regularly spaced. A fibulate raphe system runs along the ventral or dorsal side of the flat valve face, detected by the presence of fibulae, small square or rectangular structures.	An adnate freshwater form, occurring in epilithon or epipsammon. pH: 5 Alkalibiontic, Salinity Fresh brackish
Denticula	Cells solitary or occasionally forming very short chains linked via their valve faces. Frustules isopolar. Cells seen in valve or girdle view. Valves bilaterally symmetrical, linear, lanceolate or elliptical, with bluntly rounded to slightly protracted poles. Valve traversed by prominent partitions, appearing as bars. These partitions are extensions of the fibulae beneath the raphe. Between the partitions are striae, which can sometimes be resolved as single or double lines of pores. A fibulate raphe system is present, either subcentrally or near the margin of the valve face. Between the fibulae/partitions, faint but distinct elliptical apertures can be detected.	Usually associated with solid substrata or occurring associated with submerged plants or mosses (periphytic), but occasionally epipelic. TI S:1.3 V:4 avoured by moderate nutrient concentrations Oligo ? mesotrophic Sapbrotic S:1.3 V:1.3 Tolerant of moderate to heavy organic pollution pH: 4 Alkaliphilous, Salinity Fresh
Diadesmis	Cells small, more or less linear, solitary or forming band-like colonies. Live cells with a simple or slightly lobed chloroplast extending from the girdle under one valve, occasionally under both valves. Valves linear or linear lanceolate with bluntly rounded apices, valve faces sharply differentiated from mantles, sometimes with a row of peripheral spines at the junction. Girdle almost as deep as valves wide. Raphe central , often terminating before valve apices, in a broad sternum, sometimes filled in. Striae uniseriate, pores sometimes elongated along stria. Girdle comprising few to many bands with one or two rows of round pores. Spines may interdigitate and link adjacent valves.	A diatom with a largely tropical distribution. Early records note that it is common in power plant discharges in Europe. They suggest that it may spread further if global warming persists. TI S: 5 V:1 Optimum occurs between 0.35 and 1 mg l-1 filtrable P Sapbrotic S: 3 α-mesosaprobous pH:3 Circumneutral (mainly occurring at pH values about 7) Salinity Freshwater
Diatomella	Cells forming chains or zig-zag colonies. Valves linear to elliptical, with bluntly rounded apices. Girdle much deeper than valve is wide. Striae biseriate and alveolate, raphe central in a broad hyaline area, with quite widely separated central endings, polar endings extending over valve apices. Girdle bands without pores, but valvocopulae with septa that meet at two points in the cell lumen creating three circular openings.	TI S:5 V:1 Very sensitive to pollution Sapbrotic S:1 V:1 Pollution sensitive pH: Salinity Freshwater
Didymosphenia	Valves heteropolar, large and robust, symmetrical to apical axis and broadly capitate at both apices. Cells wedge-shaped in girdle view. Striae strongly punctate. Short terminal spines can sometimes be seen at the head pole. No pseudosepta. 2-5 stigmata occur on one side of the central area	Found on rocks in upland streams. Colonies start to grow in the spring, spreading to cover the entire substratum by summer. TI S: 2 V: 3 Optimum occurs between 0.01 and 0.035 mg l-1 filtrable P Sapbrotic: Very sensitive to pollution Freshwater
Diploneis	Valves elliptical to panduriform with broadly rounded apices. Thickened canals are present on either side of the raphe slit and usually have a pattern of ornamentation that differs from the marginal striae (often seen as longitudinal lines either side of the axial area). Cells often robust in appearance.	Widespread in littoral sediments of oligotrophic standing waters, particularly those with moderate conductivity. TI S:1.7 V: 7 Mesotrophic Saprobic S:1.1 V:1.1 Pollution sensitive pH:Alkaliphilous Salinity: Fresh brackish
Encyonema	Valves dorsiventral and symmetrical to the transapical axis. Dorsal margin normally highly arched, ventral margin more-or-less straight or slightly convex. Valve apices bluntly rounded to subcapitate. Stigmata absent or, if present, only on the dorsal side of the central area. Raphe more-or-less straight with central endings deflected dorsally and apical ends deflected ventrally.	Often common in circumneutral waters with low nutrient concentrations. TI S: V: Saprobic S: 2 V: 1 Meso ? eutrophic ph: circumneutral Salinity: Freshwater
Epithemia	Cells solitary or occasionally forming very short chains linked via their valve faces. Frustules isopolar. Cells when alive are more often seen in girdle view, but isolated valves lie in valve view. Valves and cells dorsiventral, with a straight or concave ventral margin and an arched dorsal margin; shape linear, linear-elliptical to lanceolate. Valve poles either bluntly rounded or broadly rostrate to capitate. Stria pores almost always easily visible in the light microscope; The valve is traversed by prominent partitions, which appear in valve view as dark bars. Raphe system fibulate, biarcuate. Each branch of the raphe is marginal near the poles, but curves inwards to become subcentral, or even marginal on the opposite side of the valve, at the centre.	Attached to macrophytes and other solid substrata, in epiphyton or epilithon, or more loosely associated with surfaces in the periphyton; generally found in neutral to high pH environments. Apparently capable of N fixation, via 'endosymbiotic blue-green algae
Eucocconeis	Cells are elliptical to lanceolate in outline with rounded or rostrate poles and a relatively deep mantle. They are heterovalvar, and are bent about the median transapical plane and also twisted about the apical axis. There is a single lobed chloroplast. The raphe valve is concave, with fine, radiate striae. The raphe is sigmoid and contained within a narrow axial area. The central area is rounded or elliptical.	A species that is found in low to moderate numbers in low nutrient circumneutral waters. TI S: 1 V:1 Pollution sensitive Saprobic S:1 Oligosaprobous pH: Circumneutral Salinity: Freshwater
Eunotia	Valves dorsiventral and symmetrical to the transapical axis. Dorsal margin convex, smooth or undulate, ventral margin straight or concave. Valve apices bluntly rounded to capitate. Striae extend across entire valve face. Raphe mainly on valve mantle and restricted to the poles. Raphe curved slightly or strongly onto the valve face at the apices. Terminal nodules usually conspicuous. Frustules box-like or rectangular in girdle view. Raphe often only visible in girdle view.	Extremely common in oligotrophic, poorly-buffered sites acidic habitats. can thrive at pH levels down to 2.2 , one of the few species to survive in acidic mine drainage where accompanied by high concentrations of nutrients and heavy metals. pH Acidobiontic, Salinity: Fresh
Fallacia	Cells solitary. Valves linear, lanceolate to elliptical, with bluntly rounded apices, girdle view narrowly rectangular. Striae uniseriate, but interrupted by lateral hyaline areas that connect with the central area. Raphe central in a narrow axial area, terminal fissures extending over valve apex, central fissures straight and expanded. Girdle bands without pores.	TI S:3.7 V:5 Poly ? hypertrophic, Saprobic S:2.6 V: 2.6 Tolerant of heavy organic pollution pH Alkalibiontic, Salinity: Brackish fresh
Frustulia	Valves rhomboidal to linear-lanceolate. Apices bluntly rounded to subcapitate. Raphe central and contained in a median rib extending most of the length of the valve. At the apices the raphe rib has the appearance of a pencil tip. Striae fine and arranged so as to produce a pattern of apical and transapical rows.	Widespread in well-aerated waters, including eutrophic conditions. TI S: 2 V: 2 Meso ? eutrophic Saprobic Tolerant of moderate organic pollution pH Alkaliphilous Salinity Freshwater
Gomphonema	Valves asymmetrical to transapical axis and symmetrical to apical axis. Cells usually wedge-shaped in girdle view with pseudosepta visible. Apices rounded to capitate. Raphe often slightly sinuous. A single stigma usually present on one side of the central area. Striae often coarse.	Often abundant in epilithon of upland, low nutrient streams, particularly in areas with calcareous geology. TI S: V: Saprobic: Oligosaprobous pH Circumneutral Salinity Fresh
Gyrosigma	Cells sigmoid in valve view, narrowly rectangular in girdle view, solitary. Live cells with two plate-like chloroplasts lying along each side of the girdle, sometimes lobed under the valve faces, with several rod shaped pyrenoids along their length. Valves sigmoid, raphe sigmoid, more or less central, apical fissures extending to the apices, central fissures usually deflected in opposite directions. Striae transverse and longitudinal. Girdle bands plain, without any pores.	TI S:3 V:3.7 Poly ? hypertrophic Saprobic : S:2 β-mesosaprobous pH Alkalibiontic, Salinity: Fresh brackish
Hantzschia	Cells solitary Frustules isopolar but dorsiventral. Cells seen in valve or girdle view. Isolated valves almost always in valve view. Valves bilaterally asymmetrical with a slightly concave, straight or slightly convex ventral margin and a convex dorsal margin. Poles simply rounded, rostrate or capitate. Transverse striae visible, regularly spaced, uniseriate or biseriate; stria pores within them sometimes visible in the light microscope.	Usually subaerial or terrestrial but some populations also occurring in freshwater. TI S: 3.6 V:3 Poly ? hypertrophic Saprobic: 3 α-mesosaprobous pH: Circumneutral Salinity: Fresh brackish
Karayevia	Elliptic to lanceolate valves sometimes with drawn-out apices. Striation patterns differs between raphe and rapheless valves, with raphe valve having fine radial striae whilst rapheless valve has coarser, parallel striae. Axial area is narrow on both valves and the raphe is straight with polar endings turned to one side.	rarely forming more than about 4% of the epilithic, pH and TP optima which suggest a preference for eutrophic hardwater conditions. TI : Meso ? eutrophic pH Alkaliphilous, Salinity Fresh
Kolbesia	Elliptic to elliptic-lanceolate valves with bluntly-rounded, rostrate ends. The striae are slightly radial on both valves and are each composed of a few elongate areolae. The axial area is ellipticdal or lanceolate on both valves, extending to about one third of the total breadth. The raphe is straight with a hooked external polar ending and expanded central ending.	found in calcareous rivers, common constituent of the sand flora, TI S: 3.9 V: 2 Poly ? hypertrophic Salinity Freshwater
Luticola	Cells solitary. Live cells with a single lobed chloroplast, lying with its centre against one side of the girdle and the lobes extending under each valve. Valves linear, lanceolate or elliptical with bluntly rounded, sometimes subcapitate to capitate apices. Raphe slit central, ending before the poles, with laterally deflected polar fissures. Central fissures also deflected to same side. Uniseriate striae comprised of distinct pores, often with a hyaline interruption around the valve margin. Girdle narrowly rectangular, girdle bands with one or two rows of pores.	TI: S:3.6 V:5 Poly ? hypertrophic Saprobic S:3.3 V:3.3 Tolerant of heavy to very heavy organic pollution pH: Alkaliphilous Salinity: Fresh brackish
Mastogloia	Cells solitary or growing within mucilaginous masses. Valves linear-lanceolate to elliptical, with slightly protracted, bluntly rounded apices. Raphe fissure central, undulate, extending to apices. Striae uniseriate or occasionally biseriate, transverse, comprised of coarse pores. Valvocopulae loculate, girdle bands perforated by one or two rows of pores.	TI S: 5 V: 2 Very sensitive to pollution, pH Alkaliphilous, Salinity Brackish
Navicula	Cells solitary, usually seen in valve view and often actively motile when live. Valves variable in outline, usually linear-lanceolate to lanceolate, with variously shaped apices. Raphe central, fissures usually hooked over valve apices, slightly expanded at centre. Stria path variable, striae usually cross-lineate, i.e. containing linear pores at right angles to the direction of the stria. Girdle usually narrow, comprised of a few plain bands.	Oligotrophic habitats, including slightly humic waters. TI S:3.5 V: 4 Poly ? hypertrophic Saprobic S:3 α-mesosaprobous, pH: Circumneutral, Salinity: Freshwater
Neidium	Cells solitary. Valves often linear in their central region, with bluntly rounded, sometimes subrostrate or rostrate apices, girdle view rectangular, narrower than the valve width. Raphe slit central, in a narrow axial area, the central fissures usually deflected in opposite directions, the polar fissures forked. Striae uniseriate, comprised of fine rounded or elongate pores, more or less transverse, interrupted by longitudinal lines near the valve margins. Girdle bands plain, without pores.	TI S: 2.3 V: 2 Eutrophic, Saprobic S:1.3 Pollution sensitive, β-mesosaprobous pH: Circumneutral, Salinity: Freshwater
Nitzschia	Cells solitary or, more rarely, forming stellate or chain-like colonies, or living in mucilage tubes. Frustules isopolar. Cells and valves seen in valve or girdle view, depending on species Valves structurally asymmetrical, because the raphe system is almost always placed off-centre. They are usually highly elongate, may or may not be constricted or nicked centrally, and have rounded, rostrate or capitate poles. Transverse striae sometimes visible but often delicate. The fibulae are usually small and discrete, but in a few species, they are extended across part or all of the valve.	Benthic in neutral to basic waters, including subaerial habitats. TI, S:3.8 V: 5 Poly ? hypertrophic Saprobic, S:2 Tolerant to heavy pollution pH: Alkaliphilous, Salinity: Freshwater
Peronia	Cells cuneate in both valve view and girdle view. Broader pole rounded to subcapitate, narrow pole rounded. Valves differ in raphe structure. One valve with developed raphe extending from each pole to approximately one quarter valve length, other valve with only rudimentary raphe at poles. Both valves with very narrow central sternum. Short marginal spines can sometimes been seen.	Found in acid, oligotrophic habitats. TI S: 1 V: 5 Favoured by low nutrient concentrations Saprobic, S: 1 Oligosaprobous , pH: Acidophilous , Salinity: Freshwater
Pinnularia	Cells solitary. Live cells usually with two plate-like chloroplasts lying along the sides of the girdle without obvious pyrenoids. Valves usually linear with bluntly rounded, sometimes slightly subrostrate to subcapitate apices. Raphe central, complex, often in a broad hyaline area; polar fissures hooked, central fissures expanded. Striae alveolate, often coarse, sometimes interrupted at the centre to form a broad hyaline fascia. Girdle bands few, the valvocopula with a row of elongate pores.	Frequent on soils. TI S:1.9 V: 1 Meso ? eutrophic , Saprobic, S:1.4 Tolerant of slight organic pollution , pH: Circumneutral, Salinity: Freshwater
Placoneis	Cells solitary. A pyrenoid lies in the central bridge. Valves linear to linear lanceolate with bluntly rounded, sometimes protracted apices, subrostrate to subcapitate. Striae uniseriate or biseriate, comprised of small rounded pores. Raphe slit central, slightly expanded at the centre, deflected to the same or opposite sides over the poles. Girdle narrow, comprised of bands with a single row of pores.	TI S: 2 V: 2.5 Eutrophic , Saprobic, S:1.7 Tolerant of slight organic pollution , pH: Alkaliphilous , Salinity: Freshwater
Planothidium	Cells are solitary, elliptic, elliptic-lanceolate or lanceolate in outline, with a shallow mantle. In girdle view they are slightly curved often with a prominent thickening around the raphe endings on the lower valve. The raphe valve has a narrow linear axial area and a rectangular or "butterfly"-shaped central area. Striae are radial throughout. The rapheless valve has a similar density of striae to that on the raphe valve. There is often has a prominent horseshoe-shaped thickening on one side of the rapheless valve.	Common in epilithic biofilms and in epiphytic and episammic habitats across a wide range of conditions. Saprobic, S: 3 α-mesosaprobous , pH: Alkaliphilous , Salinity: Freshwater
Psammothidium	Cells are solitary, elliptical, elliptical-lanceolate or linear-elliptical in outline with rounded apices. They are flexed in girdle view, with a conves rapheless valve and a concave raphe valve. The raphe valve has fine radiate striae throughout with a narrow, linear or lanceolate axial area and a distinct rectangular or butterfly-shaped central area.	Found in rivers, particularly those with elevated nutrient concentrations. TI S:1.8 V: 3 Mesotrophic , Saprobic, S:1.9 Tolerant of moderate organic pollution, pH: Circumneutral , Salinity: Freshwater
Reimeria	Valves symmetrical to transapical axis, asymmetrical to the apical axis, with bluntly rounded to slightly subcapitate ends. Dorsal margin convex, ventral margin straight to undulate with central inflation. Raphe more-or-less straight and slightly ventrally located. Single stigma located almost centrally between the proximal raphe ends. Striae coarse and absent from the ventral central area.	Widespread and abundant in epilithon in streams subject to mild nutrient enrichment. TI S:2.1 V:1 Meso ? eutrophic, Saprobic, S:2 β-mesosaprobous, pH: Circumneutral, Salinity: Freshwater
Rhoicosphenia	Asymmetrical to the transapical axis and symmetrical to apical axis in valve view. Cuneate and flexed in girdle view. Wider pole broadly rounded, narrow pole rounded. Septa often clearly visible in both valve and girdle views. Cells heterovalvate with the concave valve having a fully extended raphe and the convex valve with only very short raphe slits. Raphe more-or-less straight on both valves, with inflated proximal ends.	A very common epiphyte of filamentous algae particularly in eutrophic rivers. TI S:2.9 V: 2 Eu ? polytrophic, Saprobic, S:2 β-mesosaprobous , pH: Alkaliphilous , Salinity: Fresh brackish
Rhopalodia	Cells solitary. Frustules isopolar. Valves dorsiventral, with a straight or concave ventral margin and an arched dorsal margin; shape hemi- lanceolate, linear-lanceolate or rhombic. Valve sometimes nicked at the centre, marking the position of the central raphe endings. Valve poles usually cuneate or pointed, but sometimes rounded. Striae visible but individual stria pores sometimes difficult to detect. The valve is traversed by prominent partitions.	A periphytic species, usually in high pH fresh- or brackish waters. TI S:2.7 V: 2 Eu ? polytrophic, Saprobic, S:2 β-mesosaprobous, pH: Alkalibiontic, Salinity: Freshwater
Sellaphora	Cells solitary, very occasionally forming chains of a few cells, but without linking structures. Frustules isopolar. Mantles and girdle shallow or fairly deep, so that cells can be seen often in valve view or girdle view. Valves bipolar, bilaterally symmetrical, usually quite simple in shape: elliptical, lanceolate to linear, with rounded, broadly subcapitate or capitate poles. Central area round to rectangular, sometimes extended across to form a clear band across the whole of the valve. Special rib-like thickenings are present at each pole in a few of the larger species. Raphe system present, central.	Epipelic in freshwater TI 5 S: V:2 Very sensitive to pollution, Saprobic, S: 2 β-mesosaprobous, pH: Alkaliphilous, Salinity: Freshwater
Simonsenia	Cells solitary, small. Frustules isopolar, bilaterally symmetrical. Cells lie in valve or girdle view and isolated valves always in valve view. Valves bilaterally symmetrical, narrowly lanceolate or linear-lanceolate, with pointed or shortly rostrate poles. Striae clearly visible. The fibulae are hollow structures, containing an extracellular tube that passes beneath the raphe, creating a narrow passage through from valve face to mantle.	Benthic in fresh and brackish waters TI S: 2.9 V: 2 Eu ? polytrophic, Saprobic, S:3 α-mesosaprobous, pH: , Salinity: Brackish fresh
Stauroneis	Cells symmetrical to the apical and transapical axes. Valves elliptical to lanceolate, some species undulate in outline. Apices rounded to capitate. Raphe straight. Striae often fine but visible and punctate. Central area with "bow tie" shaped stauros comprising of the non-striated, thickened central nodule and usually extending to the valve margin.	Widespread and common in all types of water (though rarely found in great numbers in epilithon). TI S: 1.8 V: 0 Mesotrophic , Saprobic, S: 2 β-mesosaprobous , pH: Circumneutral, Salinity: Freshwater
Stenopterobia	Solitary. Frustules isopolar. Cells seen in valve view or girdle view, straight or sigmoid. Isolated valves almost always lying in valve view. Valves elongate, isopolar, straight or sigmoid; linear or linear-lanceolate. Runnng around the whole perimeter of the valve is a raphe system that opens inwardly into a tubular canal, which is raised on a ridge or keel. The canal is separated from the remainder of the cell interior by fused infoldings of the valve face and mantle, which sometimes create small extracellular 'windows' beneath the raphe.	Epipelic in freshwater. Saprobic, S: 5 Very sensitive to pollution, Salinity: Freshwater
Surirella	Solitary. Frustules isopolar or heteropolar. Cells seen in valve view or girdle view, isolated valves usually lying in valve view. Occasionally cells are spiralled. Valves bipolar in structure, with a definite longitudinal axis, but may be elliptical or even circular in shape; more often, however, valves are linear, lanceolate or rhombic. Running around the whole perimeter of the valve is a raphe system that opens inwardly into a tubular canal raised on a ridge or keel.	Epipelic in fresh and brackish waters TI S:3.6 V: 5 Poly ? hypertrophic , Saprobic, S:3.5 Tolerant of moderate to heavy organic pollution, pH: Alkaliphilous, Salinity:
Tryblionella	Cells solitary. Frustules isopolar. Cells and valves seen in valve or girdle view, depending on species, but more often in valve view. Valves structurally asymmetrical, because the raphe system is always marginal. Valve outline ± symmetrical, linear to lanceolate or elliptical. There is sometimes a central 'nick' on one side, marking the position of the central raphe endings. Poles simply rounded, cuneate, to subrostrate; rarely subcapitate. Transverse striae usually resolvable, but often difficult to see.	Epipelic in fresh and brackish waters. TI S:3 V:3.9 Poly ? hypertrophic, Saprobic, S:3 α-mesosaprobous, pH: Alkaliphilous, Salinity: Brackish fresh

Class: Fragilariophyceae Cells elongate and usually symmetrical about at least two planes, one of which is the pervalvar plane. Stria pattern bilateral, orientated about a longitudinal rib, as in a feather, raphe always absent. Costae and septa may be present. Rimoportules usually present. Many genera have many small, discoid plastids lying under the valve face, but some have one, two or a few plastids. Many genera have rows of small spines at the junction of the valve face and mantle which allow sibling cells to form filamentous colonies. Taxa also form zig-zag or stellate colonies, where cells are joined at the base by mucus secreted from apical pore fields, or clusters radiating from a common pad or stalk

Genus, Image	**Gerus description**	**Ecological Information**
Asterionella	Elongate cells, which are joined at the base to form stellate colonies. The poles are swollen, with the basal pole typically wider than the apical pole. Numerous small, plate-like plastids. Valves elongate, more-or-less linear with swollen or capitate poles, the basal pole wider than the apical pole. Striae parallel and perpendicular to apical axis. Narrow, linear axial area. Apical pore fields present at both ends. Several girdle bands, each with one or two rows of pores.	Water quality indicators: TI S: 1.8 V 2 Mesotropic Saprobic S: 1.5 V: 1.5 Tolerant of slight organic pollution pH: S: 4 Alkaliphilous (mainly occurring at pH > 7) Salinity V 2 Fresh brackish
Diatoma	Cells joined either at the valve face to form ribbon-like colonies, or at one corner to form zig-zag or stellate colonies. Quadrate to oblong in girdle view. Many small discoid or slightly elongate plastids. Valves are elliptical to elongate in valve view. Poles are variable, from rounded to swollen. Striae are fine, transverse at centre, becoming radiate towards poles. Narrow axial area with no central area. Transapical costae present, along with a single rimoportula. Girdle bands have two rows of pores.	Often abundant in eutrophic rivers, where it is often found entangled within epilithic and epiphytic assemblages. Found as tychoplankton in lakes and rivers. TI S: 2 V:0 Meso eutrophic, Saprobic S: 2.1 V:2.1 Tolerant of moderate organic pollution, ph: Alkalibiontic (occurring at pH > 7), Salinity, S: 2 Fresh
Fragilaria	Cells joined at valve face to form ribbon-like colonies. Those taxa that are swollen at the centre are linked only there; otherwise linkage occurs across the entire length of the cell. Two plate-like plastids. Valves linear to linear-lanceolate with rounded, rostrate or capitate ends. Sometimes a slight swelling at centre of valve. Almost parallel striae separated by a narrow linear sternum. Valve face bordered by row of short spines. Central area variable, but often reaches to edge of valve on one or both sides.	Prefers water with low to moderate nutrient levels. Several tolerant to heavy metals, under such conditions often grow with a characteristic "twisted" growth form. TI S; 1.2 V: 2 Mesotrophic, Saprobic S: 2 β-mesosaprobous, pH circumneutral mainly occurring at pH values about 7 Salinity S Fresh
Fragilariform	Rectangular frustles, which form linear or zig-zag colonies. Numerous small, discoid plastids. Elliptical, lanceolate or linear valves with tapering, rostrate to capitate apices. Fine striae separated by a very narrow axial area. Short spines at margin of valve face and mantle. 4-6 open copulae, each with a single row of areolae.	"TI S: 1.1 V: 1 Oligotrophic, IPS S: 5 V: 1.1 Very sensitive to pollution, Saprobic S: 1.6 V: 1.6 Tolerant of slight organic pollution, pH Circumneutra, Salinity, Freshwater
Hannaea	Cells are approximately rectangular in girdle view and lunate in valve view. They are found either free-living or in clusters or short colonies. Two, lobed plastids adpressed to the valve face and extending onto the dorsal side. Valves are lunate in outline, narrowing gradually towards rostrate or slightly capitate poles. Striae are parallel and there is a narrow axial area. The central area is one-sided, extending to the ventral margin, where there is a slight swelling.	Found on rocks in streams, typically in upland areas and particularly in Spring. It is intolerant of organic pollution, and favours relatively low nutrient concentrations and circumneutral or alkaline conditions. TI Ultraoligotrophic, Saprobotic S: 1.5 V:1.5 Ultraoligotrophic, pH, s: 4 Alkaliphilous, Salinity Fresh
Meridion	Cells rectangular or wedge-shaped in girdle view, joined by the valve face to form straight or fan-shaped colonies. Many discoid chloroplasts. In valve view, the outline is either wedge-shaped or linear with rounded, sub-capitate or capitate poles. Thickened costae cross the valve at intervals. Small spines occur along the margin of the valve face. Striae are fine with a very narrow, linear axial area and no central area. There is a single rimoportula towards the head pole and a poorly-defined pore field towards the foot pole.	More-or-less confined to cool running waters where it is found attached to stones and plants. Not tolerant of low pH or organic pollution. Most abundant in early spring. TI S:2.5 V: 2 Eutrophic Saprobic: S:1,9 Tolerant of moderate organic pollution pH: Alkaliphilous Salinity: Freshwater
Pseudostaurosira	Cells are approximately rectangular in girdle view and are joined tightly to form filaments. Valve outline is linear to elliptical. The poles are rounded or sub-rostrate. Some species have undulate margins, or are cruciform, with poles that can be rostrate or capitate. The sternum is wide and the striae are, correspondingly, short, with only a few areolae near the valve face. A single spine occurs between each pair of striae.	Part of the sand flora of rivers. TI S: 3 V: 1 polytrophic, Saprobotic S: 1.3 V1.3 pH S: 4 mainly occurring at pH > 7 Salinity Freshwater
Staurosira	Cells are approximately rectangular in girdle view and are joined tightly to form straight or zig-zag filaments. Each cell contains two plastids, lying along the girdle. Valve outline is oval, elliptical, cruciform or, occasionally, triangular, with rounded ends. The sternum is variable, but never very broad. One or two spines are found between the striae at the junction of the valve face and mantle. There is a small apical pore field at each pole. There are several open copulae, all lacking pores, per valve.	TI: S: 2.3 V: 3 Saprobitic S: 1.4 V: 1.4 Tolerant of slight organic pollution, pH Alkaliphilous, Salinity Fresh
Staurosirella	Small cells, rectangular in girdle view and often linked, via marginal spines, to form linear (occasionally zig-zag) filaments. Two parietal plastids, adjacent to the girdle. Valves are linear, elliptical or cruciform in outline, with a wide sternum. Broad, uniseriate striae extend down the valve mantle. Spines are found at the margin of the valve face and mantle between the striae. Apical pore fields are present at both poles, and there is no rimoportula. Eight to ten open copulae.	Often occurring attached to sand grains. TI S: 2.2 V: 1 Meso eutrophic, Saprobotic S:1.4 V: 1.4 Tolerant of mild pollution, pH S:4 Alkaliphilous (mainly occurring at pH > 7) Salinity, Fresh
Synedra	Cells approximately rectangular in girdle view, typically long and thin, attached by mucilage pads at the base to form radiate colonies. There are two long plastids lying against the girdles and overlapping slightly onto the valve face. In unhealthy material, these plastids may split up, giving the appearance of many small discoid plastids. Valve outline is usually linear or linear lanceolate with rounded, rostrate, capitate or swollen ends. The striae are perpendicular to the narrow axial area. The central area, if present, is variable in shape and often contains ghost striae. A rimoportula is found close to each apex, along with a well-developed apical pore field. The copulae are few in number and have a single row of areolae.	"Typically epiphytic. TI S: 3 V: 1 Optimum occurs between 0.035 and 0.1 mg l-1 filtrable P, Saprobitic S: 3 α-mesosaprobous, pH S: Alkaliphilous, Salinity Fresh
Tabellaria	Cells square or rectangular in girdle view and joined to form zig-zag or partly linear colonies. Cells typically lie in girdle view, with septa clearly visible on the copulae. Short strip-like plastids lie between the septa. Valves are elongate, approximately linear in outline but with swollen poles and central regions. The valve face is flat with irregularly spaced striae that are either parallel or slightly radiate. Small spines occur along the valve margin. An apical pore field is present at both poles, and there is a single rimoportula, found near the centre of the valve. Copulae are either complete, in which case a septum is present at one pole, or are open, in which case no septum is present.	Typically found in zig-zag filaments attached to littoral rocks and vegetation by a mucilage pad at one corner. These filaments are easily detached from the substrate and are often found tangled amongst vegetation. TI S:1.4 V:3 Oligo ? Mesotrophic Saprobic S: 2 β-mesosaprobous Very sensitive to pollution, pH S: 3 Circumneutral Salinity Fresh
Tetracyclus	Cells are square to oblong in girdle view and form zig-zag chains held together by mucilage pads at the corners. Several discoid chloroplasts Valves are elongate to elliptical in outline, often centrally expanded to give a cruciform outline. Fine, parallel striae are separated by a narrow axial area and there is no central area. Transapical costae are present. 0, 1 or 2 rimoportulae may be present. If rimoportulae are present, these lie to one side of the sternum close to the valve centre. Several open copulae are associated with each valve. These have septa across the closed ends and a single row of pore.	Occurs on freshwater sediments and associated with bryophytes on rock faces. Prefers acid environments. Infrequent. Salinity Fresh

Coscinodiscophyceae Cells circular, triangular or quadrate, or elongate, usually symmetrical about at least two planes, one of which is the pervalvar plane. Stria pattern radial, orientated about a small boss or ring. Raphe always absent and costae and septa very rare. Rimoportules usually present. Mostly with many small discoid plastids. Sometimes connected into filamentous or zig-zag colonies by spines, pads of mucus or chitin threads.

Genus, Image	**Gerus description**	**Ecological Information**
Actinocyclus	Frustules or valves are usually seen in valve view. Valves are centric, flat or domed, with central and marginal areas composed of the same pattern. The valve mantle is shallow and appears striate. A pseudonodulus is visible at the valve margin. There are no spines and no central strutted processes. Valve face areolae are large, equally spaced and distinctly hexagonal in shape. They occur in straight radial rows of variable length. The framework of silica is foam-like or bubbly	Actinocyclus normanii and its variety subsalsus are planktonic, freshwater taxa and bloom typically in late summer and autumn.
Aulacoseira	Frustules are cylindrical due to deep mantle of the valve commonly seen in girdle view. Frustules usually form long chains but often appear as single valves or pairs of valves as the chains break during sample preparation. Areolae on the mantle are arranged in straight or curved rows. Areolae are simple, round to rectangular. Spines may be present around the junction of the valve face and mantle, particularly in end cells. The valve view is circular and the valve face is either plain or bearing puncta which are usually arranged randomly.	Many species of Aulacoseira are found in fresh waters. Aulacoseira subarctica common in the spring plankton when silica concentrations are relatively high.
Cyclostephanos	Cells are short, barrel to cylindrical in shape and occur either individually or in short chains. The valve view is most commonly seen. Valves are circular and concentrically undulating. The valve face has radiating rows of areolae. These are usually comprised of one row at the centre of the valve face and a number of rows grouped into bundles at the valve edge, separated by slightly arched, raised thickened ridges. The fascicles of areolae continue down the valve mantle. There is no clear distinction between the valve face and mantle. Ribs are present between the areolae rows on the inner side of the valve	They are typically found in the plankton during late summer-autumn.
Cyclotella	Cells are short and drum-shaped and are rarely found in chains. Valves are usually circular with a tangential or concentric undulation of the valve face. The central area of the valve face is clearly differentiated from the marginal zone. The central area is either structureless and unmarked or punctate and is surrounded by the marginal zone with radial striae, radial ribs and interstriae. Valve face fultoportulae are often visible.	Common in the spring-summer plankton of fresh waters.
Ellerbeckia	Cells are large, shortly cylindrical and occur in chains. The valves are circular and robust and are essentially flat. Valves have a distinctly delineated central area with a different structure to the marginal zone. The valve face does not bear distinct areolae but has visible rows of connecting ribs. The valve mantle is very thick. Tubular processes are present on the mantle and are easily discernable. The genus exhibits heterovalvy with one valve bearing ridges and the other a system of complimentary grooves.	Subaerial in habit, occurring on wet rocks, sometimes forming masses that are visible to the naked eye, forming 'crisp mat-like masses on dripping sandstone' but the authors have also seen it growing in calcareous ponds
Melosira	Cells are cylindrical to subspherical, with high mantles, well developed girdles and usually form long chains. The valve face is flat or domed and is covered with small spines or granules. The valve mantle is not usually differentiated from the valve face in most species.	Common in freshwater habitats, especially eutrophic waters. In rivers, it often forms fine brown filaments in marginal areas.
Skeletonema	Cells with high mantles and well developed girdles which form filaments. The cells are joined by long marginal processes to give the appearance of beads joined by fine threads. The cells are very weakly silicified and can become deformed during sample preparation. The valves are circular with convex to flat valve face. A single ring of processes occurs around the top of the mantle, associated closely with a ring of fultoportulae.	Most Skeletonema species live in the coastal marine plankton.
Stephanodiscus	Cells are disc, drum or barrel-shaped, occurring individually or in chains. Typically seen in valve view as mantles are shallow. Valves are circular and range from flat to strongly concentrically undulating. A single ring of spines is present at the junction of the valve face and mantle. Fultoportulae are present beneath the marginal ring of spines. The valve centre is not clearly distinguished it has either irregular or single straight, radial rows of areolae. The presence of valve face fultoportulae is species specific.	Many species are associated with productive waters and are good indicators of eutrophication.
Thalassiosira	Frustules are often very small and thin. Valves are circular and flat. Very few features are visible; often only the marginal spines and central and marginal processes can be seen. The valve face has radial striae which can be straight or sinous but these may be indistinct or invisible. It has a smooth valve surface and appears almost structureless. The only visible features are the marginal processes.	The most common species of Thalassiosira is planktonic and occurs typically in spring-early summer.