DIATOMS:

Diatoms are pigmented unicellular algae whose cell walls are silicified to form a shell or frustule that consists of two valves. Typically, one valve overlaps the other like the lid of a pillbox or an agar dish. Frustules are either pennate (elliptical) or centric (circular) in outline. Both benthonic and planktonic types are known. Drawings of both types are illustrated in Figure 1, and a scanning electron micrograph of centric forms is reproduced in Figure 2.

Figure 1.—Pennate (left) and centric (below) diatoms. The glassy frustules can be relatively smooth or elaborately ornamented.

The diatom frustule is composed of opaline silica, which is a very unstable form of silica that readily dissolves or becomes altered to a more stable mineral such as chert (microcrystalline quartz). Under certain conditions, however, great concentrations of diatom frustules can accumulate and be preserved. Rock that is largely composed of diatom frustules is called diatomite. Diatomite is used commercially in high quality chemical filters,
sugar refining, toothpaste, fireproof insulation, abrasive polish and paint. Because diatomite is very porous and light, it has been used as “stunt rock” in Hollywood films.

Paleoenvironmental Range:
Diatoms live in marine and fresh water, even in moist soil. They are most abundant and best preserved in cool-water settings where the solubility of silica is low, the solubility of calcium carbonate is high, and there is little terrigenous influx: e.g., sub-Artic and sub-Antarctic seafloors, cool and/or alkaline lakes, and the abyssal depths of tropical oceans.

Stratigraphic Range:
Diatoms are abundant today and they are known as far back as the Cretaceous. There are equivocal reports of Jurassic ones. Because of their mineralogical instability, though, well preserved diatoms become rarer with increasing age of the host strata.

Diatom Examples:
1. “Diatomaceous earth.” Examples these samples of the sedimentary rock diatomite, which is composed almost entirely of diatoms. Note how soft and light (low density) the rock is.
2. Freshwater diatoms (oriented specimens). Are these specimens centric or pennate, or both? Make sure you can distinguish diatoms from radiolarians.
3. Marine diatoms (oriented specimens). Again, are these specimens centric, pennate, or both? Make sure you can distinguish diatoms from radiolarians.
4. Strew slide of freshwater diatoms from a bog (courtesy of Dr. Brant). Scan this slide to see the diversity of types present.
5. Examine the microfossil chart and look at the diatom photos under the heading "siliceous microfossils."

**RADIOLARIANS:**

Radiolarians are animal-like protists who, like diatoms, secrete siliceous skeletons. Unlike diatoms, though, radiolarians are exclusively marine and planktonic, and their shells tend to be better preserved. Radiolarian morphologies span a considerable range from simple spine-like structures to elaborate latticed cones and spheres. Typical examples are illustrated in Figures 3 and 4.

![Figure 3. Examples of radiolarians.](image)

Figure 3. — Examples of radiolarians.
Paleoenvironmental Range:
As mentioned, radiolarians are exclusively marine and planktonic. Their shells are most common in deeper marine waters, well away from the continental shelves. Like diatoms, preservation of their siliceous skeletons is favored by cool temperatures, high Ph, and absence of "diluting" sediments.

Stratigraphic Range:
Radiolarians originated in Cambrian time and they are extant today. They are biostratigraphically useful in Paleozoic strata, even more so in Mesozoic and Cenozoic strata in which they are better preserved.

Radiolarian Examples:
1. Fossil radiolarians (oriented specimens). Make sure you can distinguish radiolarians from diatoms.
2. Recent radiolarians (oriented specimens). Make sure you can distinguish radiolarians from diatoms.
3. Strew slides (two) of Recent and Tertiary radiolarians. Note the exquisite preservation.
4. Strew slides (two) of Cretaceous and Jurassic radiolarians. Note that the preservation of these geologically older specimens is not as good as in the Recent and Tertiary material at station 3.
5. Examine photos of radiolarians on the microfossil chart (front table).
PLANKTONIC FORAMINIFERA:

Planktonic forams are perhaps the most intensively studied and geologically useful group of microfossils. Forams are animal-like protists that secrete shells of calcium carbonate. Benthonic forms evolved in the Cambrian Period, became extremely abundant in the Late Paleozoic (remember the fusulinids?), and have remained abundant up to the present time. In contrast, planktonic forams originated rather late, probably in the Jurassic Period.

Molecular phylogeny studies suggest only a distant relationship between benthonic and planktonic forams. These studies also suggest that rates of evolution within the planktonic ones may be up to 100 times faster than within the benthonic ones, thus accounting for the extraordinary usefulness of the planktonic forams in marine biostratigraphy. Planktonic forams also are used as "paleothermometers," because the $\delta^{18}O$ of their shells varies in a predictable way with ambient water temperature.

Planktonic forams are unicellular organisms whose shells are generally inflated or keeled to maintain buoyancy in water. Under high magnification, the shells appear highly perforated. Pores in the shell wall allowed the inhabitant to extrude pseudopodia ("arm-like" strands of cytoplasm) for capturing tiny prey and other nutrients. A living planktonic foram, with pseudopodia extended, is shown in Figure 5. Fossil examples are illustrated in Figure 6.

Figure 6.—Living planktonic foram with pseudopodia extended. This individual’s shell is made up of many bulbous chambers, of which four can be seen in this view.
Paleoenvironmental Range:
Planktonic forams are exclusively marine and they occur most abundantly in warm, tropical oceans. The shells of dead organisms may accumulate along with calcareous nannoplankton on the seabed to form calcareous ooze. When lithified, this calcareous ooze is the common form of limestone known as "chalk."

Stratigraphic Range:
Jurassic to Recent.
**Planktonic Foram Examples:**

1. Free specimens of planktonic forams. Are the chambers globular or keeled?
2. Free specimens of planktonic forams (two slides). Are the chambers globular or keeled?
3. Free specimens of planktonic forams. Are the chambers globular or keeled?
4. Free specimens of planktonic forams. Are the chambers globular or keeled?
5. Thin sections of Recent forams. Only one of these specimens is planktonic, whereas all of the others are benthonic. Can you identify the planktonic one?
6. Examine the wall chart (front table). Can you tell the difference between benthonic and planktonic forams?