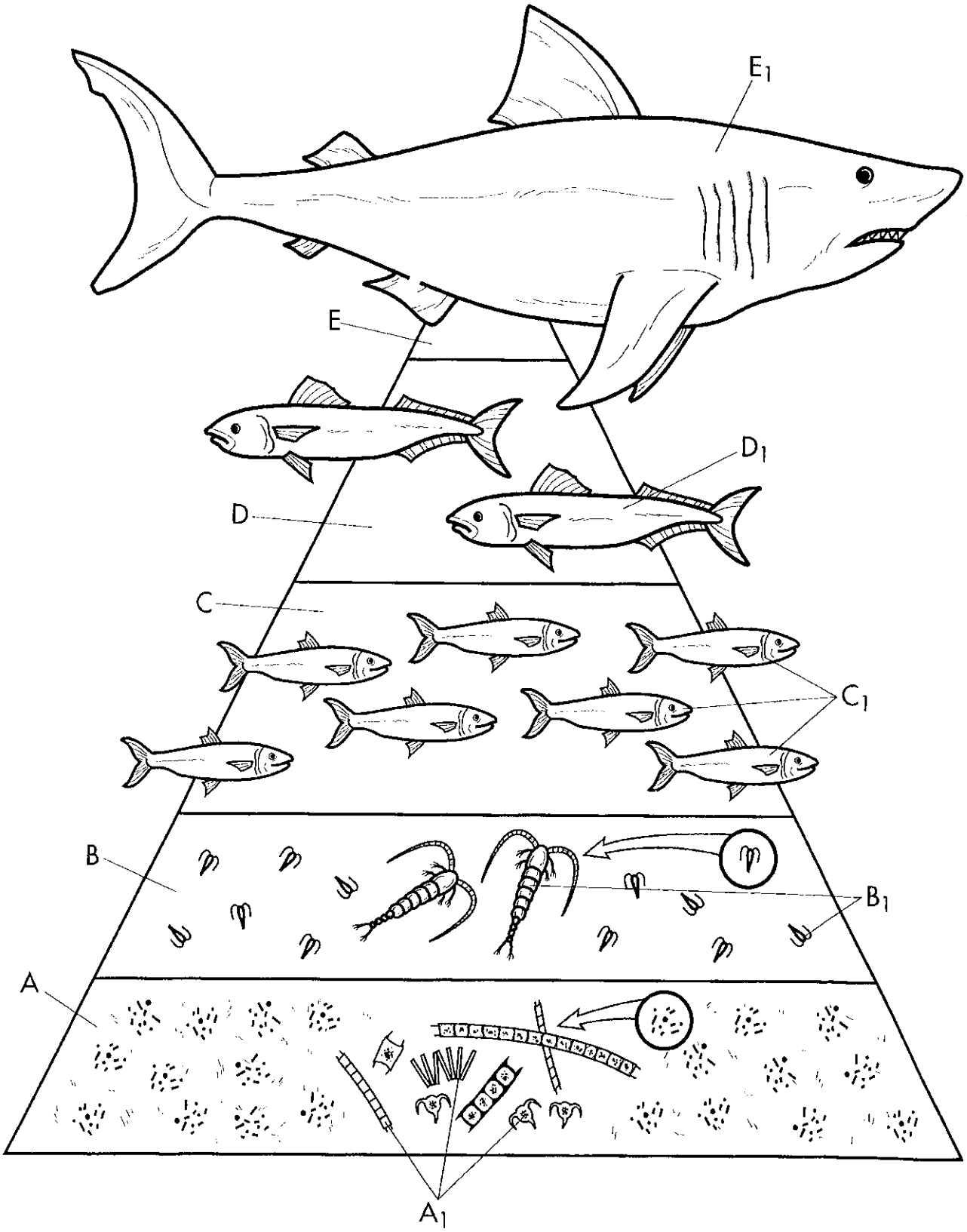
E1
E
D1
D
C
C1
B
B1
A
A1

Chapter 11-6: The Energy Pyramid

Although communities vary considerably in structure, certain basic processes are common to them all. Among these processes are the cycling of nitrogen, carbon, water, and phosphorous, which are discussed in future plates. Another basic process is the flow of energy through the community, which is the subject of this plate. All organisms take in energy to stay alive, and energy flows unidirectionally through the community. Feeding relationships within a community form a pyramid, and in this plate we will see how this pyramid is created in an oceanic community.

> As you look over the plate, you will see that it contains a large pyramid with five levels that are designated by letters. As the energy pyramid extends upward, its levels contain a decreasing number of organisms.

All organisms must obtain nutrients and energy from their environment in order to remain alive and reproduce. Biologists categorize organisms as producers or consumers according to their means for acquiring energy. These terms are defined in the plate on ecological communities.

We begin our study of the energy flow in an oceanic community by focusing on the feeding habits of members in the community. Each step of the pyramid is called a trophic level, at the bottom is the **first trophic level (A)**. A light color should be used to shade this broad area.

The organisms in this first trophic level are the **phytoplankton (A_1)** and the entire collection of phytoplankton is known as biomass. The box shows several of these, and they may be colored in a medium color that's similar to the one used for the trophic level. Phytoplankton are primary producers, that is, they generate nutrients that are used by all other organisms in the community. By performing photosynthesis, they trap sunlight and convert it to the chemical energy contained in carbohydrates. The pyramid is widest at its bottom because the biomass of phytoplankton is greater than the biomass at any other level.

Look at the **second trophic level (B)** next. It consists of primary consumers in the form of **small crustaceans (B_1)**. These microscopic arthropods feed on the phytoplankton, obtaining energy from them. But some energy is lost in the transfer, and this leakage of energy continues throughout the pyramid. For this reason, less energy is present in the second trophic level than in the first, and the biomass of crustaceans is less than the biomass of phytoplankton.

> We have examined the first two trophic levels of the energy pyramid and have seen how energy enters the ecosystem and is subsequently concentrated. Passing to the next level, even more energy is lost and the biomass is further reduced.

We now pass to the **third trophic level (C)**, which should be shaded with a pale color. Within this trophic level are a number of **herring (C_1)**, which feed on the crustaceans in the second trophic level. As energy is transferred from the second level to the third, some of it is lost because it has been used up in metabolic processes of the crustaceans. The herring are secondary consumers, and their total biomass is less than the crustaceans, so the area of the third trophic level is less than that of the second.

We now proceed to the **fourth trophic level (D)**, and the energy flow encounters a new consumer. Here we see the **mackerel (D_1)**, which feed on the herring. Notice that there are many fewer mackerel in this trophic level. The mackerel are tertiary consumers, and again, this trophic level has significantly less energy than the previous one since energy was used by the herring for their metabolism. As you can see, the biomass of mackerel is less than that of herring.

At the uppermost portion of the pyramid is the **fifth trophic level (E)**. Here we find a **shark (E_1)**, which consumes mackerel. About ninety percent of the total energy of the mackerel trophic level is lost as we move to this final level. So little energy is left at the top that relatively few sharks can be nutritionally supported in ocean communities. The amount of food at the fourth trophic level acts as a limiting factor for the number of organisms at the fifth level. Very rarely does an energy pyramid have more than five levels.

The Energy Pyramid

- ○ First Trophic Level....A
- ○ Phytoplankton .....A_1
- ○ Second Trophic Level ..B
- ○ Small Crustaceans ....B_1
- ○ Third Trophic Level ..C
- ○ Herring .....C_1
- ○ Fourth Trophic Level ..D
- ○ Mackerel .....D_1
- ○ Fifth Trophic Level....E
- ○ Shark .....E_1

11.6 The Energy Pyramid

1. All organisms take in energy to stay alive, and energy flows _____ through the community.

2. Define the word you fill in #1 (use dictionary!)_____

3. As the energy pyramid extends upwards, it levels contain a _____ number of organisms.

4. Each step of the pyramid is called a _____ _____

5. Define biomass (use a dictionary!)_____

6. What does it mean to say that phytoplankton are primary producers? _____

_____

7. What process do producers use to trap sunlight and convert it to chemical energy? _____

8. How does *the amount of energy & biomass* in **higher** trophic levels of a pyramid **compare to lower** levels?

_____