Understandings:

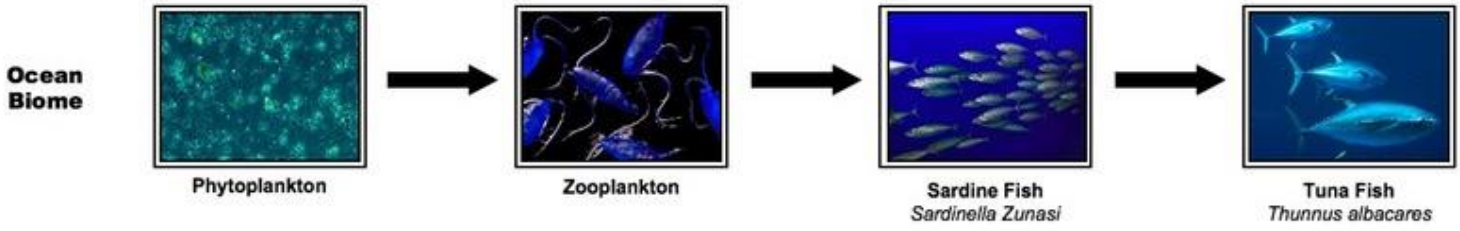
1. State that sun is the fundamental energy source for living organisms on Earth.
- For almost all communities, sun is the initial source of energy. The energy is converted by three main autotrophs: plants, eukaryotic algae, and cyanobacteria (bacteria that use photosynthesis). These are a.k.a. producers.

The energy then passes on to consumers and detritivores. Hence all organisms are somehow, either directly or indirectly, dependent on the sun.

2. State that conversion of light energy to carbon compound is via photosynthesis.
- Producers absorb the light using chlorophyll and convert light energy into chemical energy. This chemical energy then makes carbon compounds, such as carbs, lipids and protein.

Even though producers use some of these compounds and release in the form of heat, most of it remains as cellulose.

3. Explain food chain in terms of stored energy in carbon compounds.
- Food chain is a linear sequence of animals that feed on each other. Know at least 1 food chain by heart.



As we can see, there is an order of producer, primary consumer, secondary consumer, tertiary consumer and quaternary consumer.

The arrow indicates the direction of energy flow. In other words, it is the transport of carbon compounds.

4. State that most of the energy is released in form of heat by respiration.
- ATP is produced by cell respiration. That ATP is used in making DNA, RNA and proteins; active transporting; muscle contraction.

First of all, the process of ATP making is exothermic, hence heat is released.

Secondly, the usage of ATP also usually generates heat, especially muscle contraction.

These processes are happening all the time in our body, so image how much energy is lost as heat! Yes, most of it is lost. Indeed, around 80% is lost as heat.

5. State that living organisms cannot convert the heat energy into other forms of energy.
OR?
- For now, let's say that heat energy is non-transformable.

I have a dream that one day heat energy is transformable.

I have a dream that one day my school can collect heat energy from other places to warm up the cold classrooms during winter. Like seriously, it is bloody cold.

6. State that heat energy is lost from ecosystems.
- Heat is ultimately lost from the ecosystem, since heat moves from hotter areas to colder areas.

7. Explain the reason for restrictions of trophic levels in terms of energy and biomass.
- Biomass is the total mass of a group of organisms. The interesting thing is, when ecologists measure in a certain area all the bio mass of producers, primary secondary etc. consumers, they noticed that biomass is less for each successive trophic level. Why?

Well, in essence, not all energy is transferred to the next level, meaning that there is not enough energy sufficient enough to support equal mass of organisms from the previous level.

1. As mentioned before, much of the energy is used and hence lost as heat. Only leftovers are the energy not used in cell respiration.

2. Not everything gets eaten. Primary consumers do not eat the roots of plants and secondary consumers may not eat the bones or the hair of primary consumers etc. All the leftover parts contain cellulose and other carbon compounds that might be useful.

3. Not all is digested. Some come out as faeces undigested and yes they contain energy as well. Everything with mass contains energy actually ($E=mc^2$).

Around only 10% is transferred.

Extra notes
- Cellulose is a main component in cell wall in plants.

Applications and skills:

1. Be able to draw energy flow by using pyramids of energy and biomass.

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The units are really important and it should be in $\frac{kJ}{m^2 yr}$

Also make sure that the pyramid is stepped, not triangular.

You should label the trophic levels, and if possible, draw the width of the box proportionally.