

## Science Understanding

### Biological Sciences:-

*Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems.*

### Chemical Sciences:-

*Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer.*

### Physical Sciences:-

*Energy transfer through different mediums can be explained using wave and particle models.*

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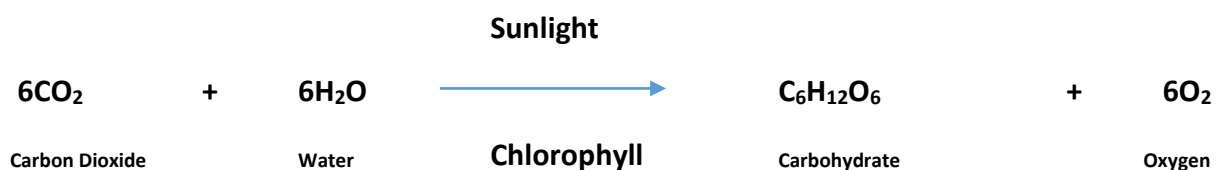
## Introduction to the Movement of Energy through Coastal Marine Ecosystems:-

**YouTube Video** <https://www.youtube.com/watch?v=3AZwhSIIY7k&t=18s>

Huge amounts of energy are introduced to our planet's ecosystems through the process of photosynthesis.

Photosynthesis is a chemical process that is used by organisms that contain a pigment called Chlorophyll. These organisms include representatives of two of the five Kingdoms. They are from both the Plant and Protist Kingdoms.

During photosynthesis the chlorophyll in the plants and protists captures light energy from the sun and converts it into a chemical energy that is stored in a molecule called Adenosine Tri-Phosphate (ATP). The ATP molecule can then be used by the organism to perform some type of work. The bonds in the ATP molecule can be broken apart and the energy released can be used to build useful biological molecules such as sugar or starch molecules.



**Fig.1.** Process of Photosynthesis

The vast majority of organisms on this planet use carbohydrates such as sugars and starches as a source of energy to live, thrive and survive in order that their species can reproduce and evolve. Mangrove ecosystems are no exception.

Mangrove ecosystems, as the name suggests, are dominated by mangrove trees. These trees are adapted to survive in the dynamic coastal marine environment.

The majority of the carbon dioxide that they use is obtained from the atmosphere surrounding the leaves whilst the water that they need is obtained from the ocean water that surrounds them. The

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nature of marine water is dynamic. The tide ebbs and flows through two high tides and two low tides in a twenty four hour period so the organisms that live there need to be able to survive whilst exposed to the atmosphere and whilst inundated with salt water.

The salty nature of ocean water can provide significant difficulties for those organisms that live in the marine environment unless they are well adapted to survive those conditions. If the environment that surrounds living organisms is more salty than the contents of their cells it will cause the cell to lose water and hence the organisms become dehydrated and could die.

The mangrove trees need to use the salt water that surrounds them in order to survive and produce their sugars for energy and complex carbohydrates such as starches for storing that energy.

Mangrove trees are well adapted to survive the difficult marine environment. According to the Australian Bureau of Agricultural and Resource Economics and Sciences there are approximately forty one species of mangrove from 19 plant species found here in Australia. That is more than half of the world's mangrove species that are found here in Australia.

The mangrove species found in Australia can survive in their marine environment through a variety of adaptations that can allow them to do some or all of the following; a) tolerate salt, b) exclude salt and c) excrete salt.

The mangrove forest itself is a very complex 3D structure that provides lots of hiding places for small animals such as fish, crabs, snails and worms which not only use the forest for shelter and protection but also find their food.

The mangrove ecosystem is considered a “nursery” ground. It is ideal for the younger, smaller members of animal species to find shelter and food whilst they grow. Some of these organisms will eat the plants and algae found in the mangrove whilst other animals will eat those animals that have eaten the plants and algae. The sugars and complex carbohydrates found in photosynthesising organisms can be consumed by animals. These animals then digest the carbohydrates thereby releasing the chemical bond energy. This energy is then further converted and used in functions such as mechanical work (e.g. movement) and production of new chemicals in the body (e.g. proteins).

The process of “consuming and converting” energy is not efficient. During the conversion process energy will always be lost. You could consider that chewing food during consumption is an example of this. During chewing energy is used to power the muscles. The muscle releases heat energy to the environment during the process and chemical bond energy is lost in the form of carbon dioxide, the by-product of cellular respiration. As long as the energy acquired is greater than the energy lost then the organism is likely to survive.

When these organisms mature and grow, many species will leave the security of the mangrove and head out into the big, wide ocean where they will complete their lifecycles by reproducing. Their planktonic offspring will then return to similar coastal ecosystems where they will obtain the resources that they need to survive, grow and complete the stages of their lifecycles... and so the cycle of life continues.

- Remember that the majority of the energy that moves through coastal marine ecosystems ultimately comes from the Sun.
- Remember that the light energy from the Sun is captured and transformed into chemical bond energy by plants and protists (algae and phytoplankton) that use the chlorophyll pigment for the process of photosynthesis.

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- Remember that the sugars and complex carbohydrates found in photosynthesising organisms can be consumed by animals. These animals then digest the carbohydrates thereby releasing the chemical bond energy. This energy is then further converted and used in functions that include but are not limited to mechanical work (e.g. movement) and production of new chemicals in the body (e.g. proteins).
  - Remember that the process of energy conversion in nature is not efficient and a certain amount of energy is lost to the environment during each conversion.
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**Student Quiz:-**

1. Which Australian Marine Park is this Mangrove forest found in?

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2. Where does the majority of energy in a coastal marine ecosystem come from?

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3. What is the name of the chemical that photosynthesising organisms produce and use for food?

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4. What are the two ingredients used by photosynthesising organisms to make their food?

a. \_\_\_\_\_

b. \_\_\_\_\_

5. What three processes can mangrove trees use to survive in salty ocean water?

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

6. Is the process of energy conversion by organisms efficient? Explain your answer.

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7. Give two examples of how animals use the energy obtained from food.

a. \_\_\_\_\_

b. \_\_\_\_\_