

Classroom VIDEO

Teacher's Notes

Butterflies Lifecycles and Survival Strategies



Years: 7-12

Duration: 20 mins

The study of butterflies offers an excellent avenue for studying the living world at the local level. In this video we present the lifecycle of the butterfly in its four stages, describing each fully and showing the relationship that exists between each stage and between the insects and their environment. The viewer of the video will find it very rewarding, as live footage and time lapse photography have been integrated to show detail that cannot be experienced in any other way.

Introduction

As symbols of beauty, with their striking colours ranging from iridescent to earthy, they are a constant source of inspiration to all. Their often amazing adaptations and interactions with their environments throughout their lifecycle, are also inspirational, and are valuable as triggers for further research, projects and study.

Butterflies are insects belonging to the order Lepidoptera with about 140,000 species. The Australian number is about 370.

Over weeks the insect dramatically changes form and behaviour. Colours and patterns adorning the adult are used in displays to communicate while finding a mate and reproducing. The eggs that are laid on an appropriate food source are camouflaged well from predators to develop and hatch. When the larva or caterpillar emerges from the egg it starts eating. When done with the eating and growing, the caterpillar pupates by encasing itself in a cocoon where metamorphosis of form takes place. Finally the adult butterfly emerges as the glorious creature we know so well.

The Egg

After mating the female must find the perfect place to lay her eggs. As many caterpillars are very specific in the food they eat, the eggs have to be laid on the appropriate food. Sensors in the legs, antennae, and abdomen signal information about the plant by detecting chemical compounds in the leaves. The shape, colour and the shape of the egg cluster is species specific. The number laid can range from tens to thousands. Thus we see that there are several properties of the egg that influence the number of tiny caterpillars that hatch.

The Caterpillar

Caterpillars are amazing feeding machines and incredible growers. If a human baby grew at the same rate it would be roughly the size of an elephant in just weeks! Their body is that of a typical insect. There are three parts: a head, a thorax and an abdomen. The thorax and abdomen are segmented, while the segments in the head are fused. Several pairs of appendages are modified as jaws or mandibles and are especially designed to slice through leaves. While the head of the adult has one pair of compound eyes most larva have six simple eyes on each side of the head. Three pairs of legs are attached to the thorax but it's hard to keep control of such an extended abdomen. So they also have "prolegs" which aren't true legs, but have a sucker-like base with tiny hooks. Other extensions of segments of the abdomen that help with control are the anal claspers. Growing rapidly from just mms in length, the caterpillar molts or sheds its tough skin several times during a number of growth phases. As slow movers they are vulnerable to attack and employ several strategies to avoid or deter predators. These include hairs, spikes, very bright colours and camouflage.

Pupation

After several months the larva encases itself in a cocoon and becomes a pupa. Within the pupa the larval tissue is broken down and rebuilt by cell division and the differentiation of cells that were dormant in the larvae. This process is termed metamorphosis. During metamorphosis the larva is immobile and escapes detection by blending into its surroundings. It is attached to a branch or leaf in one of two ways. It either hangs from one point, originally the anal claspers of the caterpillar, or it is connected to the twig in two places, first at the anal claspers, and also by a kind of belt wrapped around the upper half of its body called a silk girdle.

The caterpillar prepares for pupation by firstly spinning a silk pad around the twig. The video shows this process over eight hours in the life of a monarch caterpillar as it prepares to pupate. Underneath the skin the transformation is rapid as it enters the chrysalis stage. Over the next few hours, the chrysalis hardens to take on its final shape and colour in a variety of weird and wonderful forms. It remains stationary for many weeks. In some species the chrysalis changes colour and becomes transparent as the pupa reaches maturity. Often the shape of the adult butterfly can be made out through the thin outer cocoon at this time.

The Adult Butterfly

The change in form is dramatic. As the adult emerges, it is actually quite vulnerable. The struts in its wings are soft and bent and the proboscis or feeding tube is in two halves. Fluid is pumped into veins in the wings to quickly straightens them. As the fluid is then withdrawn, the veins harden to form the struts that support the wings to give them their shape. The wings are attached as extensions of the cuticle of the thorax and are not appendages like their legs. This is common to all flying insects and has allowed them to retain their three pairs of legs and still fly. Butterflies have two pairs of wings that overlap to form the flying

surface, the flapping coming from contracting flight muscles that distort the cuticle of the thorax. Flight gives the adult the ability to migrate, moving into new areas to search for food and partners. In fact some species migrate considerable distances at speed. The two active stages of the lifecycle thus occupy different niches, requiring different food and so do not compete. While the larva consumes large quantities of foliage as food for growth, food for the adult is confined to the glucose-rich nectar from flowers which only supplies the energy they need. Their high energy activities comes at a price. Without a supply of protein they are unable to repair damaged tissue and it doesn't take long for their wings to show signs of wear and tear.

The adults are the reproductive stage of the lifecycle. With many species complex territorial displays and courtship rituals are an integral part of mating. On mating the sperm from the males are stored in a special second sac within the reproductive organs of the female and just before the eggs are laid they are fertilized.

As a lifecycle the butterfly's is a fascinating one to study, raising many questions that easily expand into further research and intrigue. Some of these questions and research topics are to be found in the following sections.

Key word list

Adaptation, iridescent colours, colour production, lifecycle, egg, egg pattern, caterpillar, (larvae), predators, growth, food, pupation, chrysalis, adult, insect anatomy, head, thorax, abdomen, legs, appendage, wings, mouthparts, mandibles, prolegs, anal claspers, shedding, compound eyes, antennae, molting, defense strategies, bright colours, camouflage, metamorphosis, pupae, attachment, proboscis, specialization, glucose, courtship ritual, mating, territorial display, fertilise.

Visit the following websites:

<http://www.usyd.edu.au/macleay/larvae/>

<http://www.usyd.edu.au/macleay/larvae/butter.htm>

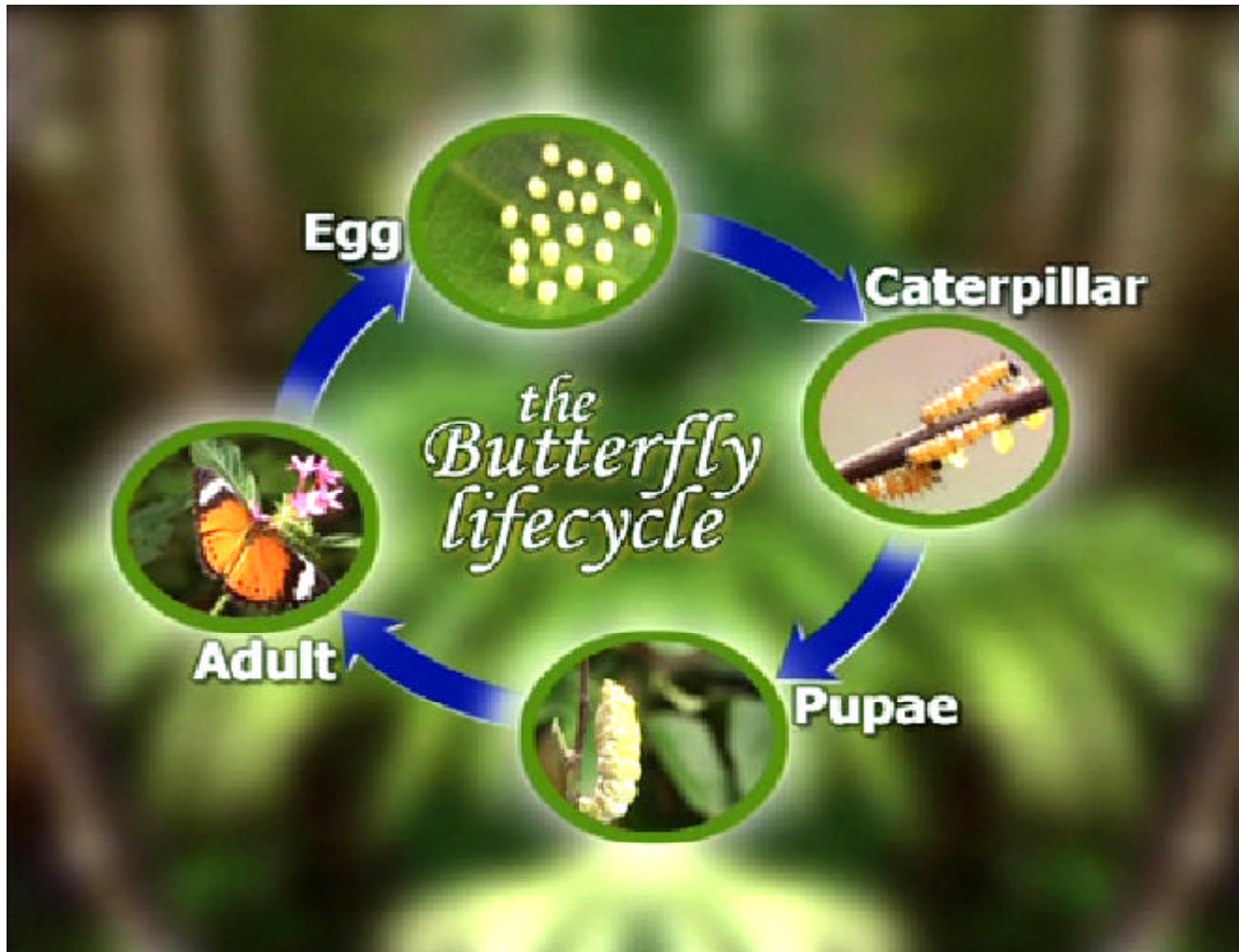
<http://www.usyd.edu.au/macleay/larvae/>

<http://abacus.gene.ucl.ac.uk/jim/helicinf.htm>

<http://abacus.gene.ucl.ac.uk/jim/>

<http://alpha.furman.edu/~snyder/snyder/lep/intern.htm>

The Butterfly Lifecycle



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Questions to answer while viewing the video.

1. What is meant by 'lifecycle'?
2. List the four stages in the butterfly's lifecycle.
3. Why must the female adult lay her eggs on special plant species?
4. Suggest what would happen if the eggs were broadcast about.
5. How does the female butterfly choose the right plant?
6. Are the eggs of different butterflies the same? Describe the eggs that are shown. How big are they? What are their colours? Are they always laid in the same places?
7. Think of why predator ants might favour these eggs as food.
8. Is there a strategy in the numbers of eggs deposited? What might happen if all the eggs survive to grow into caterpillars?
9. Identify the different body parts of the caterpillar. Why do they need to shed their tough skin?
10. Describe some of the colours and appendages of a caterpillar. How do they help in their survival? Are there any other forms of defense?
11. What would happen if they had no predators?
12. Make a list of the steps used in forming a pupa. * Note the two different ways of attachment of the pupae to the leaf or branch.
13. Are all pupae the same for different species? List how they are the same and how they are different.
14. Although there does not appear to be any changes occurring in the chrysalis stage, describe the changes that actually occur inside.
15. Research the process of metamorphosis. * Note the changes that still have to occur to the adult as it emerges from the chrysalis.
16. Contrast the eyes of a caterpillar with those of the adult butterfly.
17. The two stages of the cycle, larva and adult, are quite different in several ways. Contrast the two stages using properties such as food and movement.
18. What would happen if the food used in each stage was reversed?
19. Why is the sugar-rich nectar of flowers such a beneficial food for the life of an adult butterfly? Has such a single form of nourishment any disadvantages?
20. How does the butterfly use its wings in courtship displays?
21. Research the flight of a butterfly.
22. Note the differences between courtship, mating, and fertilization.

Activities to try.

- * Survey your local area. Note where flowers abound that may be used as food. Plan an activity called 'stroll and spot' in your area and local nature reserves to record the variety and number of butterflies spotted during the different seasons.
- * Safety and the care of your environment is always important.
- * Many other investigations can be planned as part of this activity including: spot leaves that have been eaten; record the variety of plants used as food by caterpillars; examine the amount of foliage eaten; determine if the caterpillars have become pests; try to locate the eggs and the larva responsible; how many species are observed; how many of each species can be counted; determine if they are present during the whole year or only at special times; determine if they are found only in special locations.
- * Research the different roles played by the active stages of the lifecycle.
- * Research the role of mimicry in different species of butterflies. How does mimicry assist species to survive?
- * Carefully maintain some captured caterpillars in a prepared container for closer observation. You may have to consider how to supply fresh foliage and whether they need access to water.
- * Use the internet and libraries to find out more information about the distribution, range and other special characteristics of the species seen.
- * Prepare a key to help identify different species. Photograph examples of the different stages in their lifecycle and prepare a display.
- * Find the nearest butterfly farm to your district.
- * The final question:

Some of the caterpillars you find may well be the larva of moths. Contrast and compare butterflies and moths as they belong to the same family of insects, the Lepidoptera.