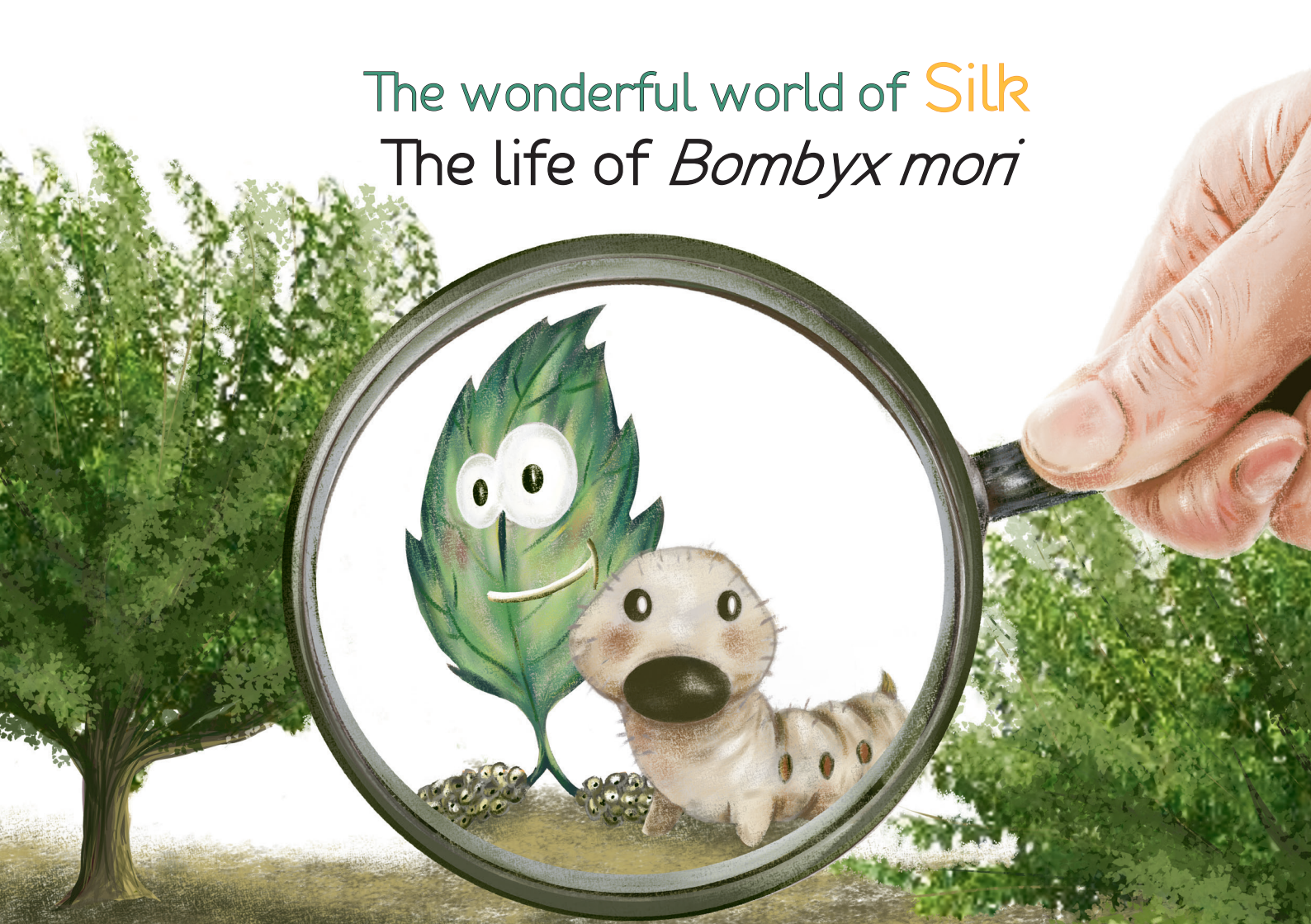
The wonderful world of Silk

The life of *Bombyx mori*



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The wonderful world of Silk.
The life of *Bombyx mori*.

Learning guide to explore the world of silk farming.

The silkworm *Bombyx mori*

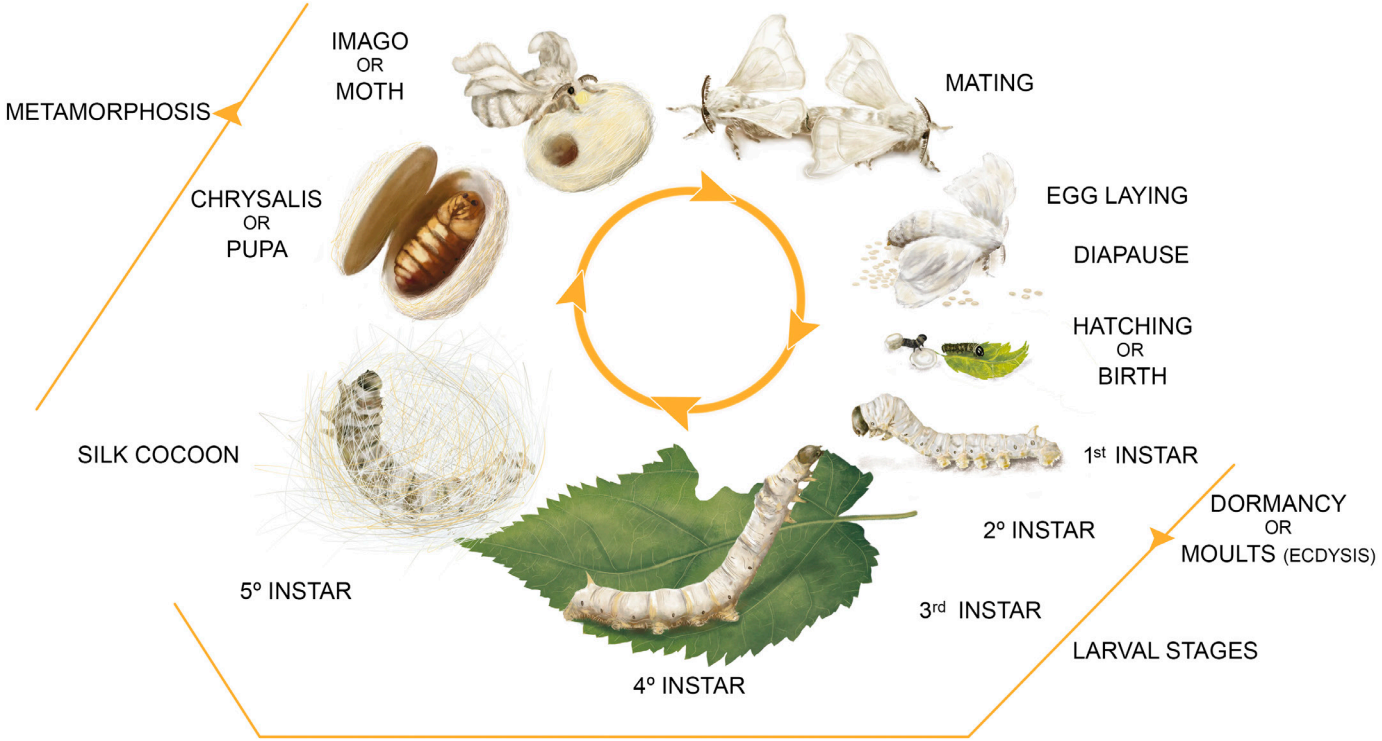
Hello! We are Bombyx and Mori, and we're here to tell you everything about silk

Since the Neolithic era, the fate of our species has been closely interwoven with that of humans by means of a delicate thread of silk.

The scientific name of the silkworm is *Bombyx mori*. It comes from Latin and Greek and means:

- *Bombyx:* silkworm
- *mori*: mulberry tree

Life Cycle



The complete life cycle of the silkworm lasts about 65 days

History of silk

Sericulture is a very ancient activity, practised in China as early as the late Neolithic period. It is an art that involves cultivating mulberry trees, raising the silkworms, and processing the silk. The first textile remains and tools related to this activity were found in the archaeological excavations of Jiahu and are 8,500 years old.

Silkworms were first raised for silk production in the palace of the "Yellow Emperor" Huang Di, around 2,700 B.C. This is where the legend of the discovery of silk began, an accidental discovery during tea time.

One day, Empress Leizu found a silk cocoon in her tea cup. When she tried to remove it, sticky threads got tangled and those threads turned out to be silk.

History of silk

This discovery was kept secret in China until 550 A.D. During that time, monks sent by the Roman Emperor Justinian brought silkworm eggs to Europe hidden inside bamboo canes.

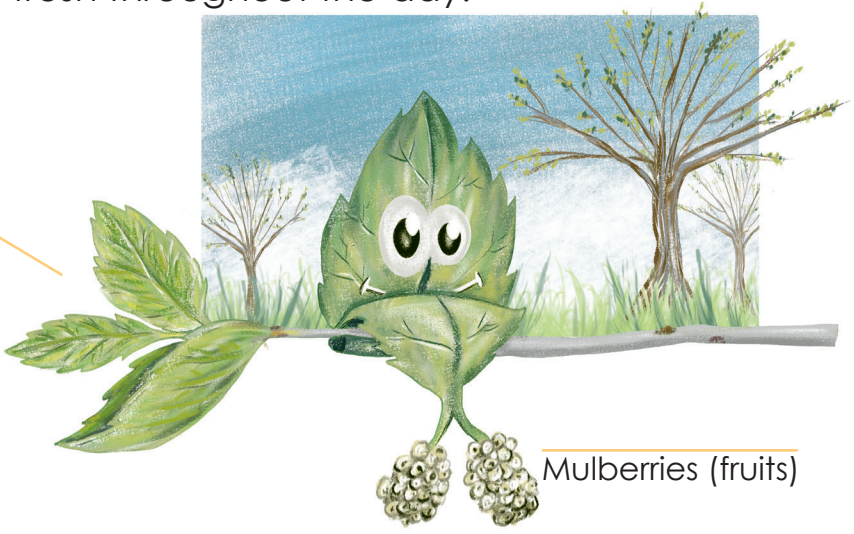
This special fibre gave its name to the famous Silk Road, which connected East Asia with Europe, India, and Africa. It opened the door for trade and cultural exchange between East and West.

The Silk Road

Spring: beginning of the life cycle

When spring arrives, the temperature rises, and the hours of sunlight increase. New leaves begin to sprout on the mulberry trees, and we, the silkworms, are born.
We develop at the same pace as the trees, eating tender leaves when we are small and tougher leaves as we grow.
It's best to collect the leaves in the morning and store them in a place where they will stay fresh throughout the day.

Tender shoots at the tips of branches are light green in colour.



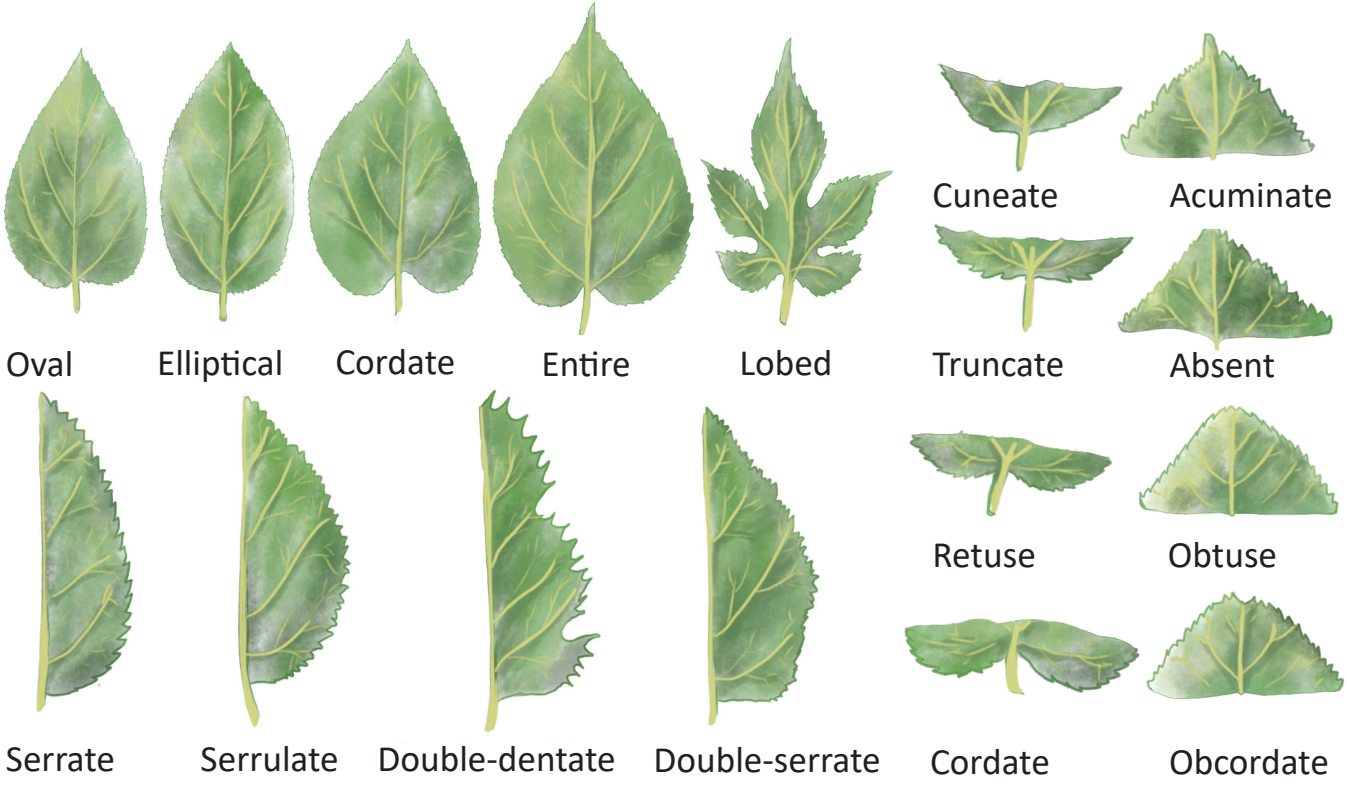
Mulberries (fruits)

Morus: mulberry tree

Mature leaves, dark green in colour, have a rougher texture.

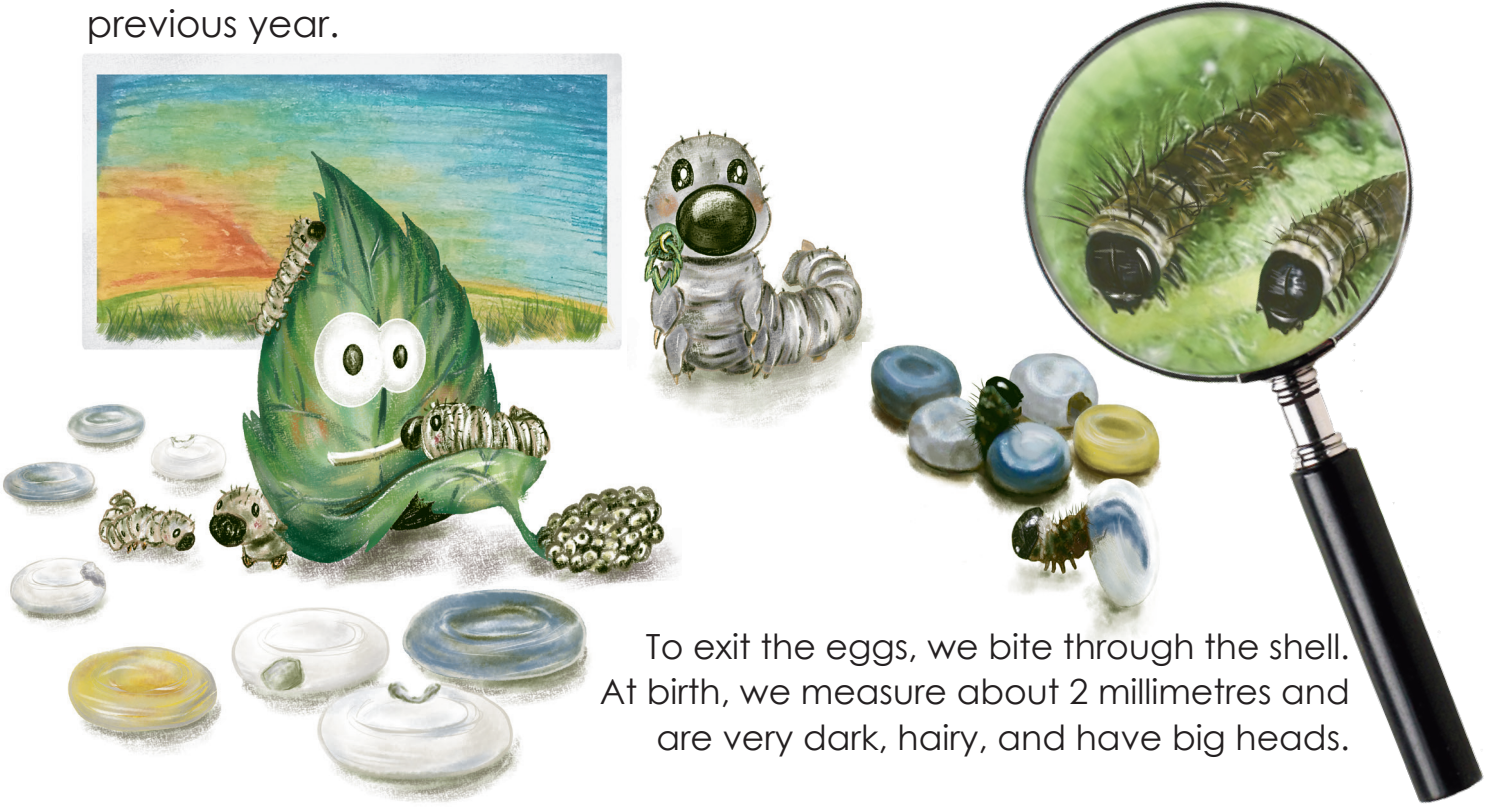
Classification of mulberry leaves by shape

The *Morus* genus has many species, the most well-known being:
Morus alba (white mulberry), *Morus nigra* (black mulberry) and *Morus rubra* (red mulberry).



Birth of the silkworms

Silkworms always hatch at dawn from tiny eggs laid by the moth the previous year.



To exit the eggs, we bite through the shell. At birth, we measure about 2 millimetres and are very dark, hairy, and have big heads.

Incubation

You can help us hatch by incubating the eggs.
This involves placing them at a constant temperature between 18 and 20°C and a relative humidity of 75 to 80%.

However, when you raise us at home, it's not necessary. Just keep an eye on the eggs as spring approaches, and check them daily. At some point, they will change colour, which means they will hatch in a couple of days.

That's when you should feed us lots of tender leaves!

INCUBATOR:
An ancient device used to maintain constant temperature and humidity, facilitating the simultaneous hatching of silkworm eggs.

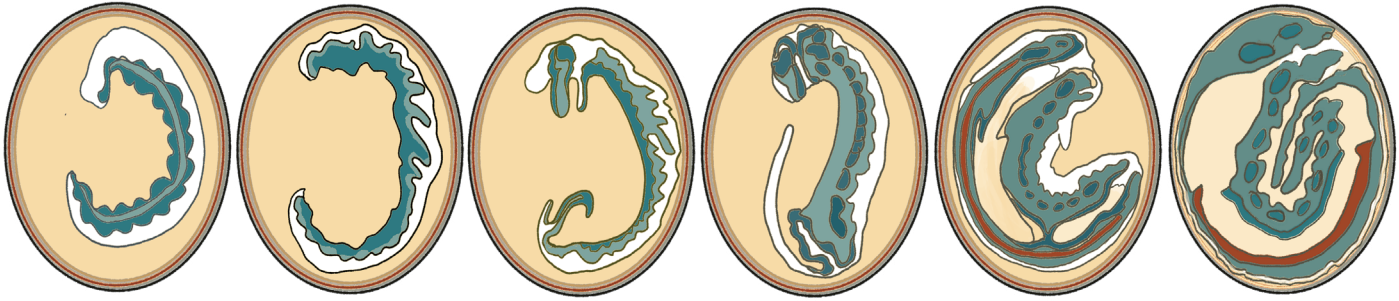
Development of the silkworm inside the egg

EMBRYO

This stage lasts 36 hours.

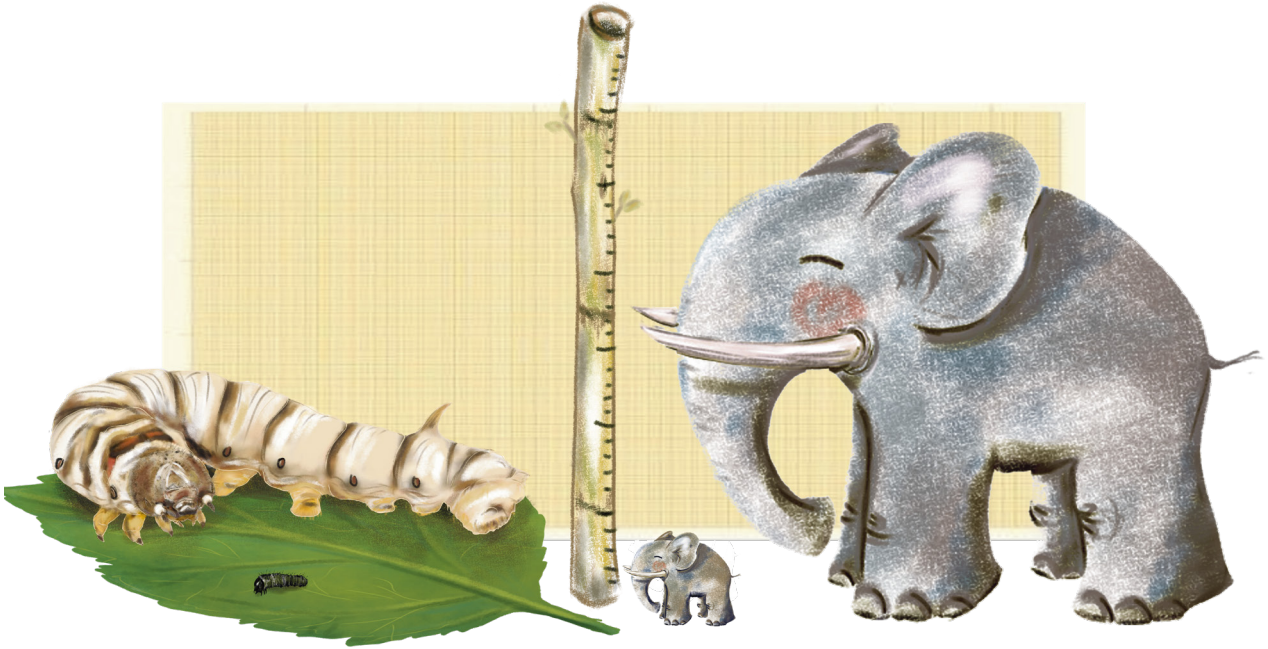
INCUBATION

This phase lasts from 16 to 20 days.



Growth of *Bombyx mori*

We silkworms grow so much that we multiply our weight by 12,000 just by eating non-stop!
We start out measuring only 2 millimetres and weighing 0.001 grams, but we grow to about 8 centimetres long and weigh around 7 grams.



Growth of *Bombyx mori*

Because we grow so quickly, we need to shed our skin and head capsule four times during our development. This process is called moulting.

To do this, we hold ourselves in place with silk threads and lift our thorax and head. We stay very still and don't eat for about two days.
Then, we shed our old skin, leaving it behind in the moulting spot.
Finally, we shed the skin from our head.

Don't touch us during moulting!

Moulting

Head cuticle

Larval stages

During our growth, we go through different stages called instars.

- 1st instar: lasts 5 days, eating very tender leaves.
- 2nd instar: lasts 6 days, eating leaves that are between tender and mature.
- 3rd instar: lasts 6 days, with a moult that takes a day and a half.
- 4th instar: lasts 7 days, with one and a half days spent moulting.
- 5th instar: the full development stage, where we devour mature leaves. After 8 days, we start to build our cocoon instead of moulting.

Larval stages and details

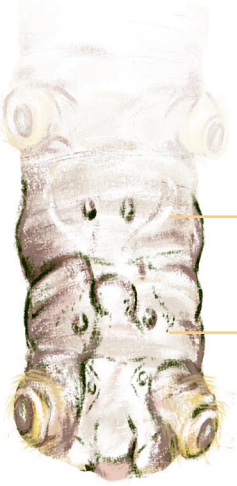
1st instar | 2nd instar | 3rd and 4th instar | 5th instar

Morphology of *Bombyx mori*

MALES

FEMALES

h



ai

Pi

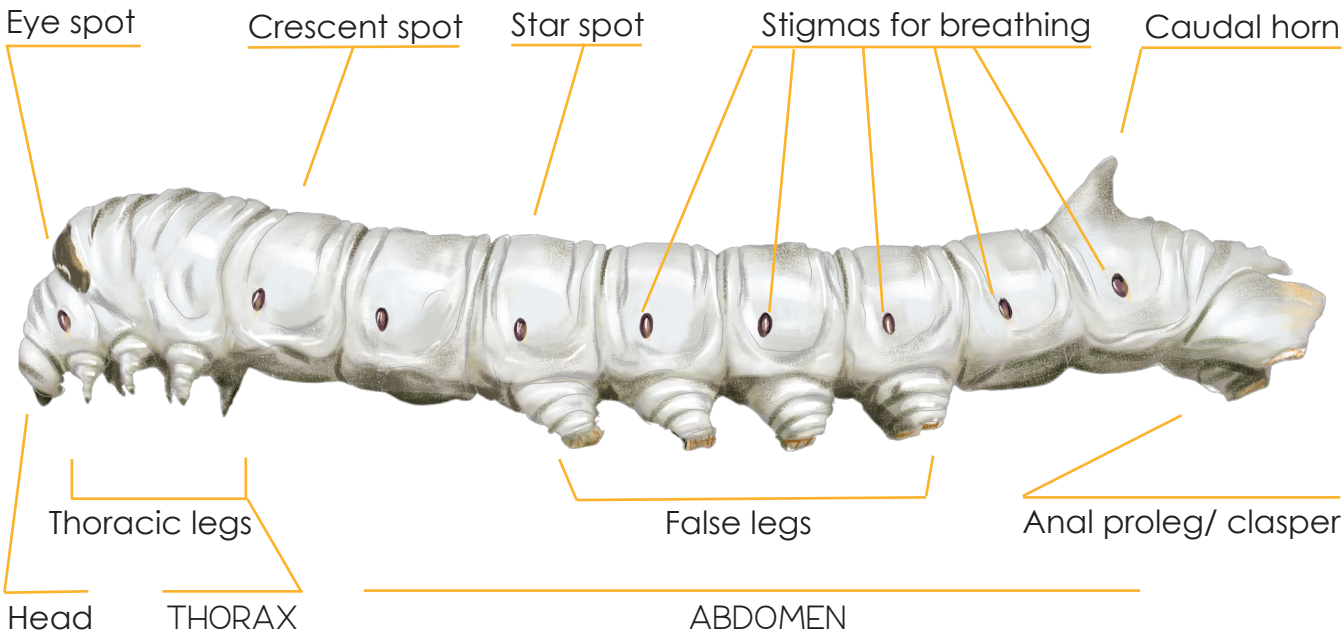
♂

♀

h: Herold's Gland

ai: Ishiwata's fore gland
Pi: Ishiwata's hind gland

Gender of *Bombyx mori*



Building the silk cocoon

Floss

We refer to floss or ‘blaze’ as the filaments that hold the cocoon in place.

The creation of floss signals that we have reached maturity and stopped eating. We are now searching for a safe place to undergo metamorphosis.

“Embojado”

We silkworms build our cocoons by attaching silk to whatever is around us. To assist in this process, dry branches of artemisia, albaida broom, or esparto grass are often placed nearby.
These montage frameworks are called “embojado”.

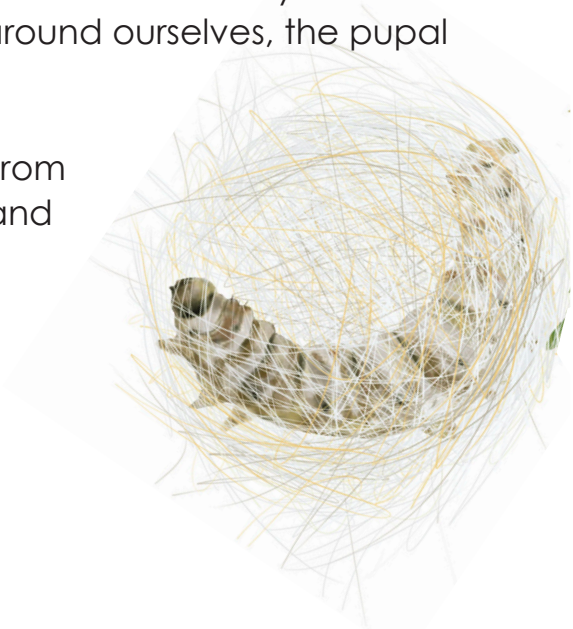
Building the silk cocoon

Building the silk cocoon

To make the silk, we compress our rings and expel silky slime through our silk-producing tube. When stretched, the slime hardens.

By moving our heads in figure-eight patterns for 4 or 5 days, we create a uniform structure around us until we run out of the silk we carry inside. At the core, we spin a soft, smooth inner layer around ourselves, the pupal chamber.

The length of the thread in a cocoon varies from 600 to 1,600 metres, depending on the diet and breed.



Building the silk cocoon

Metamorphosis

Metamorphosis refers to the transformation from larva to moth, passing through the intermediate pupa stage. This change occurs inside the silk cocoon. In the illustration at next page, you can observe the process as if you had X-ray vision to see through the cocoon´s fibres.

We become smaller after using all our silk to build the cocoon. When we finish, we rest for about two days before starting the metamorphosis from larva to moth.

The lines separating our rings disappear, and we complete our fifth skin shedding, although this time we look different.

This process takes between 14 and 20 days, depending on the temperature.

Moth or Imago (adult insect)

Once the transformation is complete, we reach our adult form, the final stage of our life cycle.

Inside the cocoon, we twist and break the chrysalis, secreting a liquid that softens the silk and creates a hole.
We use this hole to push our way out with our legs and head.

At first, our wings are wrinkled and damp. Then they dry and slowly expand.

Liquid

The hole from which we emerge

We use our feathery antennae to smell.
We have compound eyes with thousands of facets.
We only use our mouths to expel the liquid that dissolves the silk; we don't eat anything.
Females are larger than males because they have an abdomen full of eggs.

MALE

FEMALE

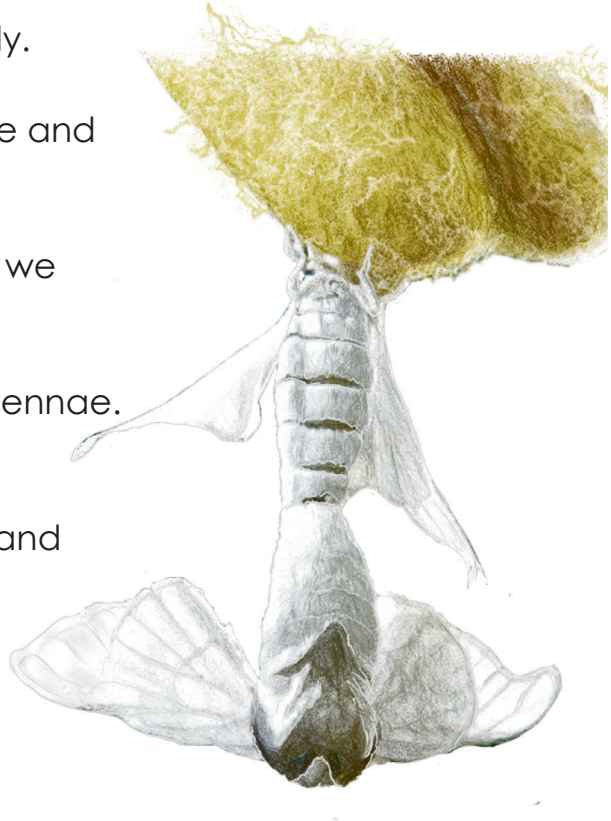
Reproduction and egg laying

The moths emerge ready to mate immediately.

Our lifespan varies depending on temperature and humidity, ranging from 3 to 15 days.

Although we moths have lost the ability to fly, we flap our wings as if trying to do so.
This is how we spread the scent that attracts potential mates, which detect it with their antennae.

The male holds the female by the end of her abdomen with two movable chitinous hooks and fertilizes the eggs inside her.



Reproduction

Egg laying

Females, whether fertilized or not, begin laying eggs side by side at dusk and during the night.

Each female will lay between 300 and 500 eggs. These eggs are lentil-shaped and 1 millimetre in diameter.
If the eggs are fertilized, their colour will change within 3 or 4 days. When first laid, they are yellow but, as the embryo develops, they turn dark brown or grey.

Egg Preservation:
To keep the eggs safe, they need to be stored in a dark place at a cool temperature between 5 and 10°C until the mulberry trees grow new leaves in spring.

Do not use sprays or insecticides near us!


SERVICIO DE SERICICULTURA
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Referencia
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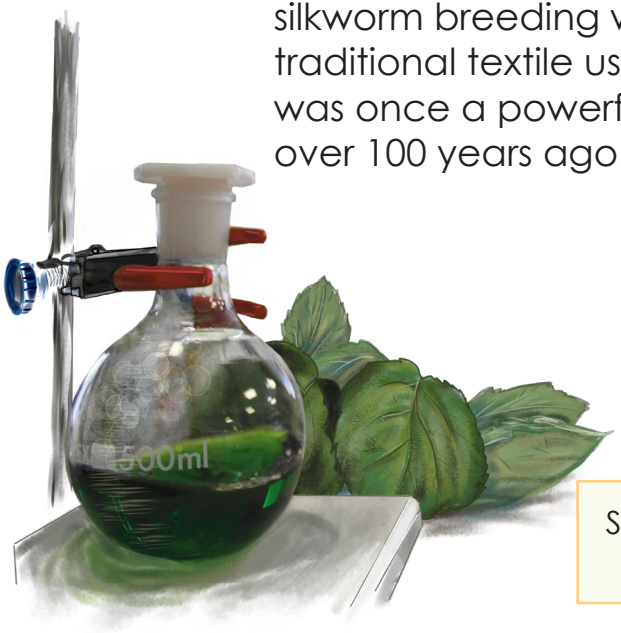
IMIDA

Murcia Institute of Agricultural and Environmental Research and Development

The Biotechnology Team at IMIDA is researching new applications for silk, particularly in regenerative medicine and tissue engineering.

In this way, the former Sericultural Station has resumed silkworm breeding with new applications beyond traditional textile uses and is revitalizing an activity that was once a powerful economic engine in Murcia region over 100 years ago.



Study of mulberry leaves and fruits, and their potential uses in food and health industries.

IMIDA

Murcia Institute of Agricultural and Environmental Research and Development

Currently, the team has nearly 20 years of research experience with silk, the silkworm, and the mulberry tree in the field of biomedicine.

Research and innovation with silk

Silk fibroin, extracted from silk cocoons in the laboratory, is used as a biomaterial.

Silk cocoon

The silk thread

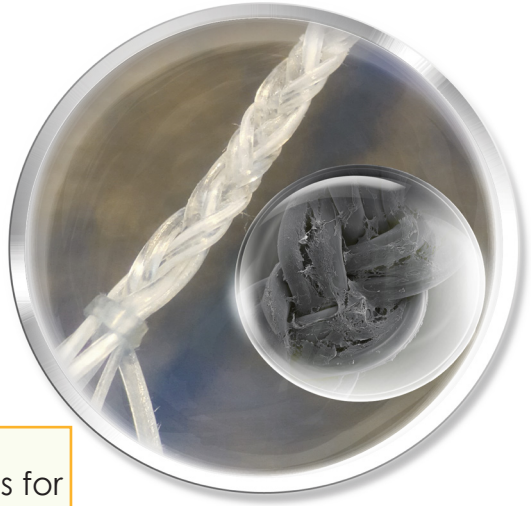
Sericin (the sticky coating)

Fibroin (the silk thread)

Under a microscope, you can see the structure of the silk thread: sericin coats the fibroin to form the silk.

Research and innovation with silk

Silk fibres are made up of two proteins: fibroin and sericin.
Fibroin is the main component; it gives structure to silk and has characteristics ideal for use as a biomaterial. It is biocompatible, biodegradable, and has exceptional mechanical properties found in nature.



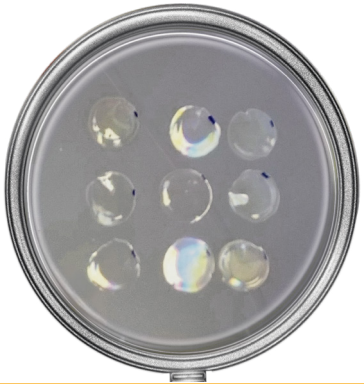
High-mechanical-strength silkworm gut fibre braids for tendon and ligament regeneration.

Research and innovation with silk

IMIDA develops a variety of silk fibroin biomaterials which, when combined with cells and biologically active molecules, can create functional tissues and stimulate the body's ability to heal and regenerate damaged tissue. These materials include transparent films for ocular tissue regeneration, electrospun silk meshes, porous silk "sponges" for bone tissue regeneration, and high-strength fibres obtained from braided gut fibres.

Bone

Porous "sponge"



Porous "sponges" of silk for bone tissue regeneration.

The transparency of fibroin films and their flat formation makes them ideal for ocular tissue engineering.

Research and innovation with silk

Silk mesh with fibroblasts for skin tissue engineering.




















Sericulture learning guide

Join our friends Bombyx and Mori on a historical, biological, and scientific journey through their life cycle and the art of sericulture.

The HORIZON ARACNE project is a European initiative aimed at recovering, preserving, and promoting the silk heritage as a mark of cultural identity and a valuable legacy.
It connects culture, art, tradition, and innovations in production and scientific research at both the international and European levels.

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aracne
ADVOCATING THE ROLE OF SILK ART AND CULTURAL HERITAGE AT NATIONAL AND EUROPEAN SCALE

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