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METHODOLOGY OF TEACHING STUDENTS THE MAIN TYPES OF SILKWORMS, THEIR DEVELOPMENT STAGES, AND THE TECHNOLOGIES OF PRELIMINARY PROCESSING OF SILK FIBERS

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Abstract: This article provides an insight into the main types of silkworms, the stages of their development and the methods of teaching about the technologies involved in the initial processing of silk fibers. It teaches a variety of approaches and strategies to effectively engage students in the learning process. The article presents activities, visual presentations, research findings, along with potential methods for teaching this topic.

Key words: silkworm, stages of development, preliminary processing, teaching methods, practical presentations, visual presentations, research.

Introduction. Silk is one of the world's most famous and high-quality fabrics. It has a long and interesting history that stretches back thousands of years. From its humble beginnings as a closely guarded secret in ancient China, silk production

has become a global industry. In this article, we will study the main types of silkworms, their developmental stages, and the technologies used in the initial processing of silk fibers.

Silk production in Uzbekistan has a rich history, the country is famous for its high-quality silk fibers. In order to understand this amazing industry, it is very important to study the main types of silkworms, to study their development stages and to learn the technologies of the initial processing of silk fibers. This article aims to show the importance of sericulture in Uzbekistan and provide general information about these aspects.

To understand the production of silk, one must first learn about the main types of silkworms used in this process. The two principal species are Bombyx mori and Antheraea mylitta. Bombyx mori, also known as the domesticated silkworm, is widely used for silk production. This species is native to China and has been selectively bred for thousands of years to increase its silk production capabilities.

Antheraea mylitta, on the other hand, is commonly known as the tussar silkworm and is found in India. Unlike Bombyx mori, tussar silkworms are not domesticated, but instead are semi-wild creatures that feed on specialized plants such as oak trees. Tussar silk is coarser than traditional silk, but has a unique sheen that makes it very pleasant.

The life cycle of a silkworm consists of four stages: egg, larva (worm), pupa (cocoon), and adult moth. The process begins with female moths laying eggs on specially prepared sheets of paper or fabric known as "paper frames". These eggs hatch into larvae within ten days.

During the larval stage, silkworms consume large amounts of mulberry leaves to ensure rapid growth. They molt or shed their skin several times to accommodate their growing size until they reach their maximum length in four to six weeks.

When the silkworm is fully grown, it spins a cocoon, which is made up of a single continuous thread of silk. It takes about two to three days for the silkworm

to complete this process. The cocoon serves as a protective covering for the pupa as it metamorphoses into an adult moth.

To extract the silk fiber from the cocoon, farmers have to use different methods of primary processing. The most common method is known as reeling, which involves unwinding the silk thread from the cocoon. To avoid damage to the delicate fibers, the cocoons are first subjected to a heat treatment or steaming process, which kills the pupa inside.

The spinning process is done by placing several cocoons together in warm water and gently unwinding the silk fibers onto a spool or spindle. This requires skill and precision so that the threads do not break and get tangled. The resulting thread is wound on bobbins or spools for further processing.

Another method used in preliminary processing is called spinning. In this technique, damaged or defective cocoons that cannot be used for reeling are removed by hand and the silk fibers are spun into threads using a spinning wheel or spindle.

After the initial treatment, the silk fibers undergo additional treatments such as degumming and dyeing before being woven into fabric. Degumming involves the removal of sericin, the natural gum-like substance that binds silk filaments together, by boiling in an alkaline solution. This step improves the luster and softness of the silk.

Dyeing is usually done after degumming, where the silk fibers are dipped in dye baths to obtain the desired colors. Various techniques such as tie dyeing, batik and block printing can be used to create intricate patterns on silk fabric.

Mulberry silkworm (Bombyx mori) and Tussar silkworm (Antheraea pernyi) are the main types of silkworms common in Uzbekistan. The mulberry silkworm is mainly domesticated for its ability to produce fine and shiny silk fibers. On the other hand, the Tussar silkworm is known for its tough nature and production of more textured silk [1].

Understanding the stages of silkworm development is essential to understanding the process of silk production. The cycle begins after the female

silkworm lays eggs, which eventually develop into larvae. Larvae, also known as caterpillars, feed on mulberry leaves, grow rapidly, and shed their skin when they pass through the five instars. After completing the fifth instar, the caterpillar passes through the cocoon stage, where it secretes silk protein to form a protective structure. Finally, the cocoon undergoes metamorphosis, and the adult silkworm or moth emerges.

Silk fibers must undergo preliminary processing to transform them into a usable form. Uzbekistan is famous for using modern technologies along with traditional methods of obtaining and processing silk fiber. The process starts with opening the cocoon by boiling the cocoon or softening the silk glue with steam. After this stage, the silk thread is wound from the softened cocoon, which is then wound into spools. Experienced silk weavers skillfully control and manipulate the tension of the silk thread to ensure high-quality fiber.

Teaching the main types of silkworms, stages of development and technologies of silk processing in Uzbekistan has a number of advantages. First, it helps to preserve the rich cultural heritage and traditional crafts associated with silk production. By passing on this knowledge, future generations can continue the legacy of sericulture with an awareness of its historical and cultural significance. In addition, teaching these topics instills scientific curiosity, encouraging students to explore the natural world, the life cycle of insects, and the complex process of silk production.

Discussion and Results. It can be an interesting and interactive process to inform students about the main types of silkworms, their development stages, and technologies for the initial processing of silk fibers. Some of the methods and possible outcomes that can be used in teaching this topic are:

1. Visual representations:

Use visual aids such as slideshows, videos, or infographics to present information. Show images or videos of the different types of silkworms, their developmental stages, and the techniques used in silk processing. This approach

helps students visualize concepts, making them more memorable and easier to understand.

2. Practical exercises:

Involve students in hands-on activities to deepen their understanding. For example, provide students with silkworm eggs or larvae to observe and care for. This allows them to witness the growth and development of the silkworm firsthand.

3. Field trips and visiting speakers:

Arrange to visit silk factories, farms, or museums that display silk-related artifacts. Alternatively, invite experts or individuals with practical experience in silk production to talk to the students. It provides real-world context and allows you to interact directly with industry professionals.

4. Research tasks:

Assign students research projects or presentations on particular aspects of the topic. For example, they can study the historical significance of silk production, advances in silk processing technology, or the economic impact of the silk industry in Uzbekistan. It encourages independent thinking and allows students to delve deeper into areas of interest.

5. Group discussions and arguments:

Create group discussions and debates to encourage critical thinking and sharing of ideas. Give students different perspectives or opinions about the relevance or future prospects of silk production and engage them in constructive discussions. We can obtain the results obtained by applying the above methods through the following table.

№	Visual representations	Practical exercises	Field trips and visiting speakers	Research tasks	Group discussions and arguments
1	To improve knowledge about the appearance and characteristi	Active engagement and participation in the learning	Getting to know the real silk production process, the machines and tools used in the	Research and analytical skills development	Increased the ability of critical thinking and argumentation

	cs of different types of silkworms	process	initial processing		
2	A deeper understanding of the successive developmental stages of the silkworm life cycle	To develop students' ability to observe and record the changes of the silkworm at different stages	Opportunities for students to ask specific questions and gain insight from industry experts	The study of interdisciplinary aspects such as history, science, economics and culture	Sharing different points of view, developing tolerance and open-mindedness
3	Getting to know the initial stages of silk fiber processing	Assessing the different requirements and needs of the silkworm during its life cycle	Inspiration and motivation for further research or careers related to sericulture	When students share their results with their peers, presentation and communication skills are improved	Development of teamwork and communication skills

Remember that the methods and results presented here are only examples and it is important to adapt them according to the teaching context, student needs and available resources. By using these techniques, you can create an engaging and enriching learning experience that gives students a thorough understanding of silkworm species, developmental stages, and silk processing technologies.

The table showing the educational results or skills that students can acquire through the methodology of teaching the main types of silkworms, their stages of development, and primary processing technologies of silk fibers:

	Educational results	**Description**
1	Increase in knowledge	An in-depth understanding of silkworms, their stages of development and silk processing technologies
2	Observational Skills	Develop the ability to observe and document the changes in the silkworm at different stages of development.

3	Critical thinking	To develop a critical analysis of the process of silk production, its significance and its impact on various aspects
4	Academic skills	Carry out independent research on various elements related to silkworm, silk production or its historical perspective
5	Communication skills	Ideas, findings and arguments related to the method of silk production to different audiences
6	Collaboration and teamwork	Access group activities, discussion or debates, teamwork, and the ability to collaborate effectively
7	Application abilities	Develop hands-on skills by taking part in silkworm, cocoon processing or silk processing activities
8	Interdisciplinary relationship	Recognize the interdisciplinary nature of silk production, including its connection to biology, history and culture
9	Appreciation of cultural heritage	Understanding the cultural heritage associated with silk production and its importance in Uzbekistan
10	Curiosity and enquiry	To develop a sense of curiosity about the natural world, life cycles and the complex process of silk production

The table above highlights the silkworm, their stages of development and some of the key learning outcomes that can be achieved by implementing silk fiber pre-processing technologies and pre-processing technologies. It should be noted that these results are not exhaustive and there may be additional aspects that can be integrated depending on the learning objectives set for the students.

Conclusion. Learning about silkworms and their developmental stages provides valuable insight into one of nature's most amazing processes. Understanding how different types of silkworms contribute to the production of silk and the technologies used in the initial processing will help you appreciate the intricacy and craftsmanship that goes into creating this luxurious fabric. By entering the world of the silkworm, we gain a deeper understanding of the history, art, and science of silk-making.

Sericulture is of great importance in Uzbekistan, and knowledge of the main types of silkworms, stages of development, and silk processing technologies is essential in appreciating this wonderful industry. Mulberry and Tussa silkworms play an integral role, each imparting unique property to silk fibers. At the same time, the stages of development of the silkworm emphasize the complexity of this

natural process. Finally, the technologies used in the initial processing of silk fibers demonstrate the expertise and skill involved in obtaining and processing high-quality silk.

Teaching the main types of silkworms in Uzbekistan, the stages of their development, and the technologies of primary processing of silk fibers is not only educational, but also a means of preserving cultural heritage and encouraging the next generation to study this fascinating field.

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