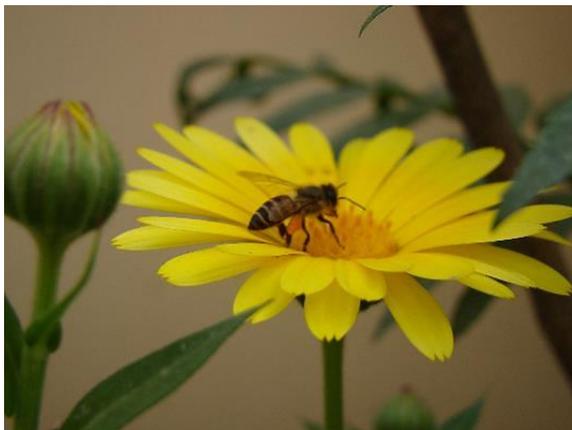


Exemplar: Bees and Pollination

How are bees a critical part of biodiversity?

We know that food on the shelves of supermarkets will be close to empty in a few years' time and food prices will soar if pollinators disappear from the face of the earth. It is because of pollination that plants bear fruits and seeds on which we heavily depend as part of our healthy diet. Fruits and seeds are also necessary for the existence of the plants since they grow into new plants. And honeybees are one of the major pollinators besides many other pollinators such as other insects, bats, birds, other animals, air, water, and even sometimes humans as we artificially try to pollinate flowers.



Linkage to SDGs

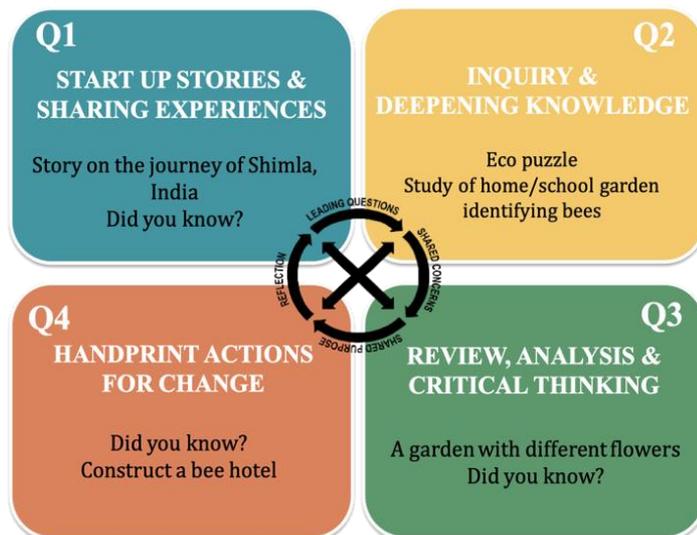
While none of the 17 SDGs are directly linked, the relationship between the SDGs and the importance of pollination and honey bees are evident. We just want to highlight the relationship among several SDGs as shown in the diagram. As we learn about the role of honey bees in pollination, we will be able to address some of the concerns of SDGs as mentioned above.

We shall see in this exemplar how honey bees and pollination are linked with the economic growth of farmers, sustainable production, climate change and dwindling bee population.



Handprint CARE Pedagogy

Teachers using the Handprint CARE pedagogy could facilitate learning among students by taking them through experience sharing to inquire about the issues to critically think about what can be done and then taking actions.



Quadrant 1

Start up Stories & Sharing Experiences

Story 1: The journey of apple to Shimla, India

It is said that Samuel Evan Stokes, 21, came to India with the intention of working at a home for lepers in the Shimla hills. He married a local *pahari* girl, played an active role in India's freedom struggle and was even jailed by the British. Somewhere along the way, he introduced apple crops in the hills around Shimla^[1]. Today, Himachal Pradesh is one of the major apple producers in India. India's share in the total world apple production is 2.05 per cent.



Polythene bags on apple trees!

Come apple flowering season, farmers start hanging polythene bags with water and twigs (branches) with flowers from other compatible flowers which are known as pollinizers which will provide pollen. It turns out that the apple tree varieties that are cultivated do not self-fertilize, that means, they need another compatible variety of apple tree for their flowers to be pollinated. With pollinizer twigs on the apple tree, there are higher chances for pollination. Therefore, apple farmers cultivate pollinizer varieties so as to increase the chances of apple fruit to set in or apple production. But even pollinizer varieties are difficult to find since farmers don't want to grow them.

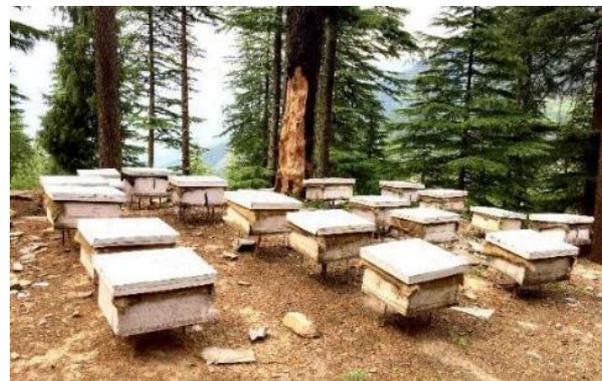


Kids may share their own stories or stories that they have heard of.



Did you know?

During this flowering season bees are also on high demand since there are not enough bees naturally occurring in and around apple orchards. So, growers place boxes of honey bees in orchards to speed up the process of pollination. However, bee keepers prefer to keep the bee hives in the lower elevation since more nectar is produced compared to when they are fed with apple flowers. In order to tackle the scarcity of bees in the apple orchards, the government provides some facilities where farmers can hire the bee hives at lower and affordable rate.



What else have changed?

For good production, appropriate climate is necessary. Flowering season has apparently shortened. Short winter period with reduction in snowfall, change in temperature caused decrease in chill accumulation, abrupt rainfall patterns and extreme weather phenomena i.e., hailstorms, droughts, torrential rains, floods, cloudbursts, etc., have been found to have impacted apple production. Apple flowering was previously reported to take place in the month of March-April, but now this has been observed to have shifted a month earlier i.e., February-March.

Apple production is more now in higher altitudes where it is colder than in lower altitudes. Sudden drop in temperature, cold and rain along with use of different kinds of fungicides and insecticides are impacting pollinator population such as honey bees, butterflies, insects, etc.

Coping with adversities

Apple growers have come up with different strategies to overcome the issues that have caused decrease in apple production.

For example, farmers adopt to hanging pollinizers with flowers on the main apple varieties. They then collect pollen grains from the pollinizers. After some treatment, the pollen grains are applied to the flowers of the main variety. The pollen grains are then



transferred by honeybees to other flowers of the apple tree.

To reduce impact of frost, farmers burn grasses in the orchards which raises the temperature by a few degrees. Some farmers also spray pure water at night to avoid frost the following morning. Farmers also spray chemicals to delay flowering by about one week. This will prevent flowering when the temperature is very low.

Farmers have also started selling their produce in the local market instead of transporting them to big cities like Delhi. This is more profitable to them.



Image Source: 1 & 2. [https://commons.wikimedia.org/wiki/File:NP_Himachal_Pradesh_64_\(6347513475\).jpg](https://commons.wikimedia.org/wiki/File:NP_Himachal_Pradesh_64_(6347513475).jpg)
<https://www.flickr.com/photos/sandeepachetan/15547711178>

Did You Know?

There are about 20, 000 different species of bees. On the basis of their colonization bees are broadly of two types—Solitary bees (that do not have “families”) and social bees (that have “families”). Bees can be with or without stinger (ovipositor). The stinger is present only in female bees and they are used to lay eggs or to sting. The stinger can be smooth or barbed.

Those bees with barbed stingers eventually because their stingers tear off after trying to get away after stinging ^[1]. All kinds of bees help in pollination

Honey bees — wild and domestic — perform about 80 percent of all pollination worldwide. A single bee colony can pollinate 300 million flowers each day. Grains are primarily pollinated by the wind, but fruits, nuts and vegetables are pollinated by bees. Seventy out of the top 100 human food crops — which supply about 90 percent of the world’s nutrition — are pollinated by bees ^[2]. For much of the past 10 years, beekeepers, primarily in the United States and Europe, have been reporting annual hive losses of 30 percent or higher ^[3]. Conversion of grasslands and forests into monoculture farms, excessive use of pesticides, etc., are majorly responsible for the decline in bee population.

Source ^[1] <https://www.pestworldforkids.org/pest-guide/bees/>; ^[2] <https://www.greenpeace.org/usa/sustainable-agriculture/save-the-bees/>;

^[3] https://e360.yale.edu/features/declining_bee_populations_pose_a_threat_to_global_agriculture

Story 2: The story of a ‘Stingless bee’ (Mexico)

Melipona beecheii, the Royal Lady bee, is a stingless bee which was part of the Mayan civilization in the tropical forests of Mexico’s Yucatan peninsula. The Mayan civilization disappeared with time but the art and culture of beekeeping of *Melipona* continued to be passed on from generation to generation since millennia. *Melipona beecheii* live in tree hollows and their honey is perhaps the best-tasting in the world. Their hive or nest have only one small hole which is the only entrance to their nest and is defended vigilantly by guard bee. The foragers bring colorful pollen and stomachs full of nectar from rainforest flowers. While they are the most important pollinators of the rainforest trees, it’s what they do with pollen and nectar that is most remarkable.

Inside a *Melipona* nest, a magnificent wax architecture is revealed. There, you find the bee society—Queen, workers, young bees and larvae—among the cells of the brood comb. Nearby are larger storage pots containing pollen or honey, the pantry of the bees. They only produce one or two liters of honey each year making it precious to the bees and people. Mayans called their beehives *Hobon*. They’re brought to thatched roof shelters. *Melipona* is tended and today harvested for honey. The bees are frenzied by the scent of spilled honey. Robber Africanized honey bees can’t resist and swarm in to steal the honey. As recently as 50 years ago beekeeping traditions were healthy with

grand ceremonies honouring the bees. Today it is difficult to find a village with a beekeeper still managing stingless bees.

After surviving more than two millennia Mayan culture is now threatened in our time as aging beekeepers die without passing along their skills. Young adults leave to work in tourist cities along the coast. Parasitic flies attack colonies. While beekeeping skills are rapidly lost, flowering plants are less abundant and Africanized honeybees are managed commercially by the thousands leaving few resources for the native stingless bees. Despite their deep history, the survival of one of the last remnants of ancient Mayan culture has fallen to this generation here. And now in a few places, young and old come together speaking about bees in their native language—the role of *Melipona* honey as food and their medicinal value is remembered as treasured knowledge. A few classes and workshops are teaching Mayan traditions and the ancient Bee craft. New meliponinis (stingless bees) are appearing in a few remote villages. The beekeeping message seems to be spreading. But it is to be seen how far this is successful in saving the rich culture and tradition of not only beekeeping of *Melipona* but also saving these valuable stingless bees^[1].

Source: ^[1]https://www.youtube.com/watch?v=d_pjoDxwYS8

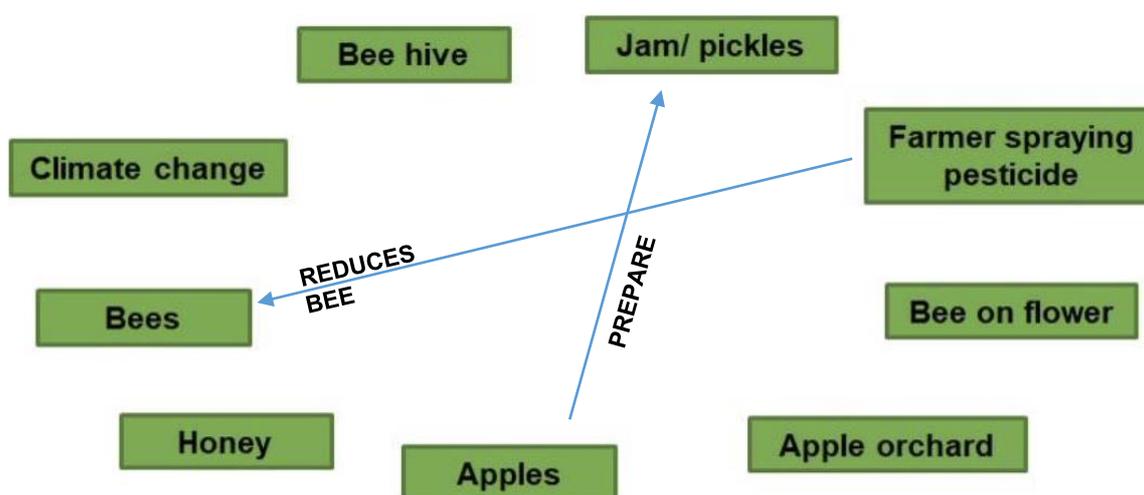
Quadrant 2

Inquiry & Deepening Knowledge

Eco Puzzle Activity 1: Exploring Patterns of Care

Teachers, after story sharing, can initiate discussion among students. Then the interconnectedness puzzle provided here as sample could be used to help students deepen their knowledge about this. Students may be asked to use arrows to indicate the interconnectedness among different components related to bees and pollination. Also ask students may also be asked to write how they are interconnected. A couple of examples are provided.

Use arrows to indicate their interconnectedness. Also write how they are interconnected. A couple of examples are provided.



Teachers can add more components to this activity as required or adopt to any other example.

Eco Puzzle Activity 2: A survey of school/ home garden

Students may be asked to do the following activity. They can study their school garden or the garden in their home. They may take up the following tasks:

- How many varieties of flowers do they find there? They may note down the local name if they know or take the help of the teacher's or elders.
- How many bees or butterflies do they find there?
- Do they see the bees and butterflies fly from one flower to the other?

Students may draw a sketch of their school/ home garden.



Eco Puzzle Activity 3: Exploring the importance of pollinators and pollination

To help understand the importance of pollinators and pollination in their locality/ area, students may be asked to do the following tasks:

- Find out which flowers, fruits or crops majorly depend on pollination by bees in your locality/area?
- Find out if the number of bees has declined over the years. If so, what is the impact of such a decline in bee population?
- Also find out other pollinators in your locality/area.
- After completing the above task, write a short essay on the role of bees and other pollinators on flower, fruit or crop production.

Note: In order to find out the above, students may speak to gardeners, farmers, researchers, scientists or anybody who has good knowledge about flower, fruit or crop production.

Did You Know?

Bee larvae are highly nutritious and are delicacies in many parts of the world.



News Update

World of Bees

A world without bees, or a world without honey? Which is worse? If you ask the bees, the choice is clear. Recent studies by researchers worldwide show 25% fewer bee species than before 1990.

Decline in pollinating bees is because the conventional food industry relies on non-specific pesticides to kill animal pests in agriculture and forestry. In addition to this, human's desire for honey has increased. Like any other factory-farmed animals, honey- bees are exposed to unnatural living conditions, stressful transportation and genetic manipulation.

Source:

What would happen if bees extinct? BBC. Would a World Without Bees Be a World Without Us? May 18, 2015.
NRDC: <https://www.nrdc.org/onearth/would-world-without-bees-be-world-without-us>

Eco Puzzle Activity 4: Unpuzzling Pollinator Mysteries

What are some of the concerns related to bees as pollinators?

- Pesticides and bees don't mix and bees are not doing well in some areas.
- Getting healthy pollinators to a farm is not easy.
- New ways of farming and looking after bees need to be developed.

The 'Mystery Method' presents stories that are complex and difficult to connect. This activity challenges students to connect to the four stories given here that are not easy to resolve.

Methodology:

1. Ask students to read the four-story cards in groups.
2. Put each of the story cards in a corner on a large chart paper or sheet of blank paper.
3. Ask students to construct a mind map looking at various ways through which these four stories are connected.
4. Once a mind map is done, you may ask students to brainstorm to find a solution solve the challenges and problems in the 4 story cards as possible.

Mystery Method

To understand the complex structure of multi-interdependent processes and the specific dynamics of any concept related processes, using the mystery method is valuable. This is a learning method, which involves learners to look at 2 to 4 different beginnings of story lines. These stories need to be prepared to make them mysterious and also, they need to be completely unconnected. To solve this mystery learners are then asked to reconstruct the complex narration with the help of information cards, which describe or explain single steps of the whole story. The result of this activity is similar to a concept map. The single cards might not only be arranged in a complex logic, but might also be interconnected with the help of pointing arrows. Doing this, it allows participants to learn to think not only in a linear, but more and more in a systematic way and hence develop and strengthen their individual systems thinking competence.

Source: Schools for Sustainability, A Resource Toolkit for Teacher Training, A Paper by Thomas Hoffman on "Is there a Specific ESD Methodology?"

STORY A

John's Dad keeps bees in the Dargle. It has not been a good season and there have been many dead bees in and around the hives.

They have been wondering if the problem is parasites or a virus that has been killing off the bees or could it be the use of insecticides in the surrounding farms.

The local farmers will need the bee hives on their farms to pollinate the avocado trees and other crops in the next season. They will have to meet export and safety standards if they are going to export their crops to Europe.

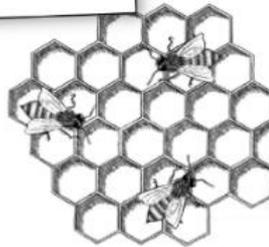


STORY B

Nosipo's Grandfather came to Howick from Zimbabwe to marry her Grandmother. At home in Zimbabwe he used to keep bees after starting as a honey hunter. He remembers his Grandfather from Mozambique used to call up the Honey Guide to point the way (*Umkhomba ndlela*) to wild hives of bees.

People no longer have the language to call birds and there are few wild bee hives left.

Nosipo knows how to handle bees and works in a honey business but things are not going well and the bees are not strong and energetic workers.



STORY C

Jody's Mom has a few bee hives at home and loves to sell her fresh honey to friends. She is worried because her hives are not strong in the low season before the honey flow starts when the trees come into flower again.

A bee keeper told her that she should take less honey off and then feed her bees sugar water so that the swarm stays strong and healthy during the low season.

She wonders is this a good thing especially after the recent scandal where sugar syrup was being sold as raw honey.

STORY D

Hilda's Dad has just converted his farm to organic vegetable production. Firstly, because he got sick from all of the chemicals he had had to spray on his vegetables over 20 years of farming.

Secondly, because more and more people in Howick are becoming conscious of insecticide residues in their food, and they now want organically grown vegetables. Fertilisers have to be replaced by compost and poisons by companion crops that repel insects. There are a lot of new things to learn - old solutions to problems have to be replaced by new ways of doing things.





Quadrant 4 Handprint Actions for Change

What Would You Do?

Grow plants/flowers

Students can grow different plants/flowers in their homes or school to invite pollinators. They can find out the increase in the number of pollinators before and after these plants/ flowers were grown.

Construct bee hotel

Students may construct a bee hotel where bees can come and live.

Spread awareness

Students may organize campaign to create awareness about the importance of bees and other pollinators. They can prepare a poster which will make people aware about the importance of bees and pollinators in food production. They can also suggest ways to increase the population of bees and other pollinators.

Contribute in policy making

Students may suggest what policies they think the government should up with to increase the population of bees and other pollinators.

News Update

Are we getting 'Honey'?

Food researchers at Centre for Science and Environment (CSE) has reported that 10 out of 13 top honey brands in India adulterated honey with sugar syrup. The samples from all top brands were first tested at the Centre for Analysis and Learning in Livestock and Food (CALF) at the National Dairy Development Board (NDDB) in Gujarat.

Almost all top brands passed the purity tests while some smaller brands failed the tests due to detection of C4 sugar or basic adulteration using cane sugar. However, when the same brands were tested using NMR, which is currently being used globally to check modified sugar syrups, all big and small brands failed the tests. Only 3 out of 13 passed the NMR test conducted in Germany at a specialized laboratory. What has become increasingly concerning than adulteration itself is the fact that the business of adulteration has evolved so that it can pass local tests.

Source: Dabur, Patanjali among 13 brands adulterating honey with sugar syrup: CSE study. Published December 3, 2020. India Today.

Video Resource

Honey bee story from Himachal Pradesh (Down To Earth, Centre for Science and environment (CSE) in English <https://www.youtube.com/watch?v=wR8vVhuAPg0> (7 mts)