

Let's get beezy with Bees!

Adithi Muralidhar

I was accompanying Manjappa, a man in his sixties through the dense forests of northern Karnataka. We were part of a wildlife survey team and he was the local expert.

"There is a honeybee colony nearby," he said suddenly. I stopped in my tracks. How did he know, I thought. "Listen," he said pointing upward.

After a couple of minutes, through the loud insect buzzes and chirpy bird calls, I heard a low and continuous sound. It was the low humming of a thousand bees. I could see from a distance the bee hive that hung precariously from a high branch. Through my binoculars I could see the hive, it was completely filled with bees with just a small patch visible to me where I could see the hexagonal units it was made of.

Mathematics

Have you ever looked at a bee hive closely? It contains units which are called honeycombs, which comprise of hexagonal sub-units. Careful observation tells us that these hexagonal units (at times even appearing circular) are equal sized and stacked perfectly against each other. There is a lot of scope to engage students in discussions around estimation and approximation using bees as a context. For example, you can give them a problem like this: Suppose you come across a big beehive hanging from a tree branch (image reference below). When viewed from one side, the shape comes across as a semicircle (the radius of which can be approximately half a meter).



Photo courtesy: CC0/Image: <https://www.maxpixel.net/Beekeeping-Bee-Bees-Honey-Hive-Honeycomb-Beehive-4845760>

Suppose a small piece of the hive falls down and you find that the side length of each hexagonal unit is 0.5cm, then can you calculate how many (approximately) hexagonal units can be seen on one side of the hive? Hint: We are not considering how "thick" the hive is.



Photo courtesy: <https://pixabay.com/photos/honeycomb-bees-hexagons-comb-330755/>

This particular hive which Manjappa pointed out was a bit too high. Had it been a bit lower, Manjappa would have “smoked” the area with fire and driven out the bees. He would then collect the pieces (honeycombs) and the copious amounts of honey it came with. On one occasion, he even got me a piece of the comb and asked me to eat it. It was a large piece that was dripping in honey with some dead bees visible over the viscous liquid.

“This is the purest form of honey you will ever get... have it, put the whole thing in your mouth,” he told me jollily. I did so only to miraculously find that the honey drenched piece of comb reduced to a mere speck of solid which I spit out.



Pieces of honeycomb (Photo: Adithi Muralidhar)

Science

Often a shade of golden brown, honey is a sweet and viscous liquid that is produced by bees. Bees visit hundreds of flowers during their lifetime and keep collecting nectar from flowers. These sugary secretions are refined in bees through enzymatic activity and also in the hive where they are exposed to dynamic environmental changes which concentrates the sugars present in the liquid. The end product is a thick golden-brown liquid which has become an integral part of our cuisine. Did you know honey may appear in different shades and have different tastes depending on the floral source from which the honey was derived? Most commercially available honey is a mix of 2-3 honeys that may vary in colour, flavour, floral source, and geographic origin.

Honey is such a fascinating liquid. One spoon of it in our desserts, breads or cereal enhances the taste of the dish and never fails to tingle our taste buds. We know that honey is thick and does not flow easily. And one can't help but think – what will happen when you mix honey with other liquids. So let's do a simple Predict, Observe, Explain (POE) exercise.

What you need: A glass or test-tube, Honey (yellow-brown colour), water + blue food colour, dish-washing liquid (green coloured), oil (could be transparent or coloured), and droppers or pipettes.

Predict: If we add equal volumes of each of the aforementioned liquids, what will be the order of stacking? Can you predict this?

Perform and observe: If you have predicted the order of liquids, start making your liquid column by adding the above liquids into the same glass or test tube as per your prediction. Add equal volumes of liquids using a dropper or a pipette and check if the final outcome matches your initial prediction. If the liquids did not stack in separate layers or got mixed, try and make a second prediction. Again, perform and observe! This experiment is a wonderful way to visually see how different liquids stack depending on what their density is. Essentially, liquids with lower density will tend to float while liquids with higher density like honey will sink.



Colour column with liquids by Adithi Muralidhar (Refer to: Chougule M., & Muralidhar, A. (2021, August). Colour Columns. *Teacher Plus*, 19(7), 6-8.



Be it the forests of Karnataka where I was walking with Manjappa or any other forests of south India, I secretly hope to stumble upon a honey buzzard feeding on a beehive. The Oriental Honey Buzzard, a common raptor in India feeds on bees, wasps, and hornets and their larvae, pupae as well as the combs of bees. They seem immune to the bee attacks and can vehemently pursue the beehive to access the larvae and honey.

Oriental Honey Buzzard with a piece of honey comb.
Photo: Sivaramakrishnan Sivasubramanian

Honeybee colonies typically comprise three types of individuals, namely the queen bee (reproducing female), the worker bees (the non-reproducing females), and the drones (males whose main duty is to mate with the queen bee). The lifecycle of a honeybee is dependent on the species as well as the type of bee it is. This means, the number of days it may take for an egg to develop into an adult may vary depending on whether the bee is a queen, worker, or drone.

Ecology and Craft/Modelling

The lifecycle of the bees is a great way to engage children in some hands-on modelling, which not only requires children to understand the morphology of bees but also to emulate the same using materials like clay. To begin with, expose children to a wide range of resources that are available on bees (several listed in references section). Ask students to refer to books and internet sources to understand the lifecycle of a bee. Once having understood it, use clay dough (yellow, white, black, brown colours) to replicate the lifecycle of the bee on a paper plate. Evaluate students on how well they have been able to replicate the bee morphology (for e.g.- if they are able to replicate the hairy appendages, patterns on the honeybee egg and pupa, etc). Many science laboratories also maintain bee specimens for observation. Students could also refer to those while making their clay lifecycle model.



Image: Jayashree Kulkarni/Adithi Muralidhar

Source of activity: <https://www.steamsational.com/life-cycle-of-a-bee-activity/>

I was back home in my city, which unfortunately harbors concrete forests. However, it is not very uncommon to see beehives on high rises or trees near buildings. We worry when we see them close to our houses! Oh, will they enter our homes and sting us!

What we don't realize is that honeybees not only play a major role ecologically but also economically. Did you know, according to the Food and Agriculture Organization of the United Nations, three out of four crops producing fruits or seeds for human consumption depend entirely or at least in part, on pollinators! Nearly 80 per cent of all flowering plant species depend on pollination by birds and animals, and they directly or indirectly affect 35 per cent of the world's crop production! Bees, therefore, are absolutely critical for our ecosystem and our survival depends on them. On the one hand, nearly one-third of all the food we eat are possible because of bees! But on the other, we are now losing more bees than ever from our environment which is detrimental to their and our survival! Reasons for decline of bee population include excessive use of pesticides, intensive farming practices, pathogens and diseases prevalent among populations, habitat loss, mono-cropping, etc.

Design and make activity

Have you ever wondered how bees pollinate plants?

When bees visit a flower to feed on nectar, the pollen grains stick to the bodies of the bees. And when this same bee visits another flower of the same species, the pollen gets deposited in the other flower. This ensures that the plant is fertilized and this will help in creating seeds for the next generation of that plant.

Make a paper flower with a hole in the centre, where a test-tube can be fixed. In this test-tube, add a small amount of wheat/atta to emulate the pollen.

Now, use the following materials (craft sticks/twigs, cotton, pipe cleaners, velcro, cloth of different materials – silk, cotton, nylon – glue, tape, rubber bands) to create different types of artificial pollinators for the given

flower. Note that the length of the pollinator will directly depend on how deep you need to reach in the test-tube to access the “pollen”. Once you make the pollinators, test which of your designs is able to capture the maximum pollen.

Test the pollinator by accessing the “pollen” via the test-tube and “dust” the captured “pollen” on a black paper to see how much pollen you got. Tabulate your data and infer which of your designs were better.



Other requirements: Black paper, test-tube, sketch pens, coloured papers, wheat atta

Source: <https://loopinwithmsfitz.files.wordpress.com/2014/09/design-a-hand-pollinator.pdf>

I am personally not a fan of dancing because I think I have two left feet. Dances are a great way to convey emotions, messages and can be a way to self-express. But then I got to know that apart from that complex societal structure, bees have an even more complex communication system which involves dancing! Scientists have discovered that bees communicate important information with each other through their “dances”. Typically, their dances comprise a move called “waggle”; via which they may communicate information like location and distance of a potential food source, and at times even the quality of the food source.

Critical thinking with coding and decoding

In this activity, students have to hide a sweet box somewhere in the school campus/classroom. After this, they will develop a road map leading to the sweet box but it will be encoded into a dance format. So students will first come up with 8-10 simple dance moves. Then assign each dance move with a specific instruction. For example, clapping your stretched hands in the air once means taking one step forward. Clapping your hand in front of your chest three times means move three steps to the right. Rotating your hips means taking a left turn, while jumping up and down may mean take a u-turn and so on. Once the group has created their secret dance code, they present their dance to the other groups and hand them the decoding key. The other groups will then decode the dance and try to find the sweet box.

Inspired from: <https://rainydaymum.co.uk/bee-dance-communication-code-activity/>

Bees are just so cool! They are so tiny and yet they play such a vital role in our ecosystem. Bees can be great topic to engage students in various subjects like science, mathematics, design, social studies, art and craft whilst also having an opportunity to develop skills related to communication, collaboration, problem-solving, making and evaluating, observation and investigation, etc.

Additional resources

- <https://tohonochul.org/pollination/>
- <https://blog.growingwithscience.com/2010/05/honey-bees-science-activities-for-kids/>
- <http://andygiger.com/science/beye/beyehome.html>
- <https://www.teacherspayteachers.com/Browse/Search:bees%20pollen/Type-of-Resource/Activities>
- <https://www.education.com/science-fair/article/what-makes-honey-crystallize/>
- <https://www.sciencelearn.org.nz/resources/1713-antibacterial-effects-of-honey-experiment>
- <https://sciencetrek.org/sciencetrek/topics/bees/teachers.cfm>
- <http://www.thevirtualvine.com/bees.html>
- <https://www.education.wa.edu.au/dl/epl2p43>
- <https://www.nytimes.com/2023/01/07/science/honeybee-vaccine.html>

Acknowledgments: I would like to thank Arnab Bhattacharya, Disha Dbritto, Shweta Naik; discussions with them were very helpful. Thanks to Jayashree Kulkarni who collaborated on developing the lovely poster for this piece. I acknowledge the support of the Government of India, Department of Atomic Energy, under Project Identification No. RTI4001.

The author is a Scientific Officer with the Homi Bhabha Centre for Science Education, TIFR, Mumbai. She can be reached at <adithi@hbcse.tifr.res.in> or <adithi.hbcse@gmail.com>.



Nearly 80 percent of all flowering plant species depend on pollination by birds and animals, and they directly or indirectly affect 35% of the world's crop production!

Which other subjects?

Architecture,
Marketing..?

Ecology
& craft

Life cycle of the
bee using clay

Did you know
has deve

Science

Density & viscous
nature of honey

Pro
fro
F

Design

Making effective
pollinators

No!

Individual bees will not be
vaccinated with syringes!

The vaccin
queen bees
would the
her eggs, E
immunity l

Maths

Estimation & approximation

Critical thinking

Coding & decoding

that a US based company developed a vaccine for bees?

protects the bee from certain pathogens

will be delivered to via royal jelly, which get passed on to hereby extending the to her progeny

Bees waggle,
They communicate through dance

Bees are just so cool!!

Honey is such a fascinating liquid

Honey bee colonies

Queen - Reproducing female

Worker bees - Non producing females

Drones - Males who mate with queen bee