Buzzy bees

Summary

Age category
6 - 8 years
Topic
Data & Statistics
Geometry
Measurement
Numbers & operations
Total duration
210 minutes

Children learn about the life and behaviour of bees. They experience the advantages of hexagonal structures, such as the honeycomb, and try to decode and read the language of bees.

Problem(s) to be tackled

- How do bees live?
- What is the relationship between bees and their environment (flowers)?
- Why and how do bees communicate with each other?
- How can we decode and read the language of bees?
- How can we collect as much nectar as possible by using the language of bees?
- Why do bees use hexagonal honeycombs?
- How do we go about building a honeycomb ourselves?

Real context

Real world motivation

Bees are having a hard time. For some reason, their numbers are decreasing. We want to help them. But in order to do that, we need to know how they live. We learn about their way of life and find out that these little animals are really intelligent creatures.

Goals

Skills

- Searching for answers based on research questions, collecting and analysing data and formulating findings
- Designing and constructing a technical system (honeycomb) by handling technical tools and materials
- Conducting research into how to construct a technical system (honeycomb) that matches criteria
- Logical and algorithmical thinking: reading an algorithm to solve a specific task
- Logical and algorithmical thinking: applying and controlling an algorithm to solve a specific task

Knowledge

- Knowing how bees live
- Knowing how bees communicate and why
- Knowing how to transform observations in representing data (graph)

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- Knowing about the characteristics of hexagonal structures

Methodology

Part	Description	Timing
1	**Bees are having a hard time: discussion** The teacher introduces the context of the activity: Bees are having a hard time. (different possibilities: e.g. picture book, newspaper article, etc.) Focus on the unique relationship between flowers and bees: • Why do bees need flowers? • Why do flowers need bees? • What is the problem for the bees? • What causes the problem? The children can be asked to research this topic (books, clips, wikis, etc.). (Key words: pollination, nectar, honey/pesticides, climate change, etc.)	30'

2	**Outdoor observations: group work - discussion**
	
	The teacher invites the children to go outside to observe bees and other little (invertebrate) animals.
	
	• First, the children discuss the questions:
	  ◦ Can we find bees in our environment? Where should we look?
	  ◦ Can we find other little creatures? Which ones? Where?
	• The children go outside. Each group searches for animals in a certain area for 10'. Based on the observations of the different groups, an observation graph is created showing the number of creatures the children have found (e.g. each sort of animal is represented in a column, each time a group observes an animal, add a post-it or mark a cross in the right column). E.g.:
	
	 
	
	An alternative approach: Before going outside, the children can make their own observation table so that they are able to tally (e.g. piece of paper with 2 columns, the children can draw the different animals they (want to) observe in the left column, in the right column they can tally each time they observe a certain creature). An observation graph can be created in class based on the scores of each group.
	
	• The children discuss the graph. They analyse the results:
	  ◦ Which column is the highest? What does that mean?
	  ◦ Of which animal did we find the most?
	  ◦ How much more … did we find compared to …?
	  ◦ How many bees have we counted?
	  ◦ Are there a lot of bees compared with other creatures?
	
	The children think about reasons as to why they didn't find (or maybe found) many bees. Let them think about the relationship between bees and flowers.
		50'

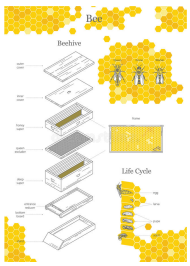
3	**The home of bees Part I - The honeycomb conjecture (see also tips & tricks): group work** The teacher introduces the problem of designing rooms in a beehive. Honey bees are social animals, they live together in big groups in a very compact 'house', the beehive. In this beehive, that is made out of wax, they store their food (honey) and breed their larvae. They need rooms (squares, cells) to store their honey (as we store our gym bags at school) or to breed the little bees. Which form would be the best for building these rooms? You must know… The home of the bees is made out of wax, which is very 'expensive' to make. Bees need a lot of honey to make just a little bit of wax, so the challenge is to use as little material as possible.	50'

Let children explore things made out of wax, like candles – or if you have the possibility of bringing a beehive (without bees of course), that would be nice! Check if there is a beekeeper in your neighbourhood.

A beehive, © Wikipedia

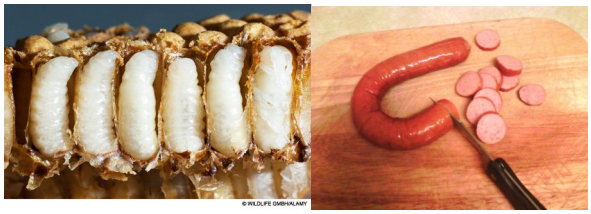
What else do you need to know? A larva lives in a room of the beehive.

(Don’t focus on the hexagonal structures at this stage, if you talk about this with the children.)



© Bartamarabara

Larvae have the shape of a sausage. If we cut a piece of a sausage, what form do we get?



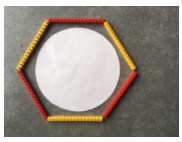
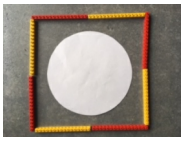
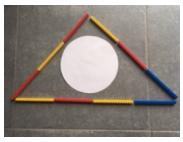
© Wildlife GMBH/ALAMY

A challenging task: 1. Make a room for a larva into which she fits.

- The children work in small groups with some materials, e.g.
- Lego sticks (Lego Technic), 16 nops.
- Circle (paper): diameter: 20 cm

Criteria:

- Use as few sticks as possible (in order to fit the larvae into it)

- The children discuss the results of the different groups:
  - Which shapes have been formed?
  - Who used the least amount of sticks?

Put the sticks of each group behind each other (form a line - longer = more sticks were used). E.g. rectangle (8x16 = 128 nops), hexagon (6x16 = 96 nops). The children will see that the hexagon gives the shortest line.

Of course, a circle is the geometric form with which you would need less material if you were to use real short sticks.

A child may ask to use shorter sticks, and then a circle will of course give the best option. But... bees don’t make cylindrical rooms for their larvae. Why not? Because if they do, they will need less wax... But there is also a second challenge:

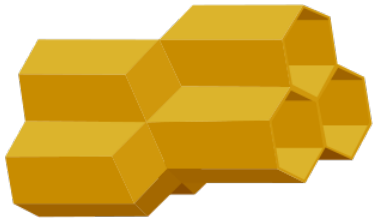
A challenging task: 2. Make a home for as many larvae as possible

- Divide the class into e.g. 5 groups. Each group gets the paper forms. They must put as many forms as possible on a large piece of paper (e.g. A3). E.g. The diameter of each form is 10 cm.

1. Group 1: triangles
2. Group 2: rectangles
3. Group 3: pentagons
4. Group 4: hexagons
5. Group 5: circles

Criteria:

- Make as many rooms as possible on a large piece of paper (e.g. A3)
- The rooms (cells) should fit as well as possible (no empty spaces in between - easily piled upon each other).



© Wikipedia

- The children discuss the results of the different groups:
  - Which group has the most forms? How many?
  - Which group has open spaces between the forms? Which group hasn't?

They will notice that pentagons and even circles leave a lot of open space and that hexagons fit snuggly to each other and leave no open spaces.

The combination of the different rooms is called a honeycomb.

4	**The home of bees Part II - Design your own honeycomb: group work** The teacher introduces the problem of designing a honeycomb. • The children can watch a movie that shows the life of bees in a beehive. They can see the larvae in their rooms. They can see the vertical piling of the rooms. There are different 'youtube' videos available that shows the beehive structure. You can search on 'youtube' by using the keywords 'beehive' and 'structure' (www.youtube.com). • The children are given paper and glue (or a wide variety of materials). They must design their own 3D honeycomb in small groups. Criteria: • No empty spaces between the shapes • Needs to be strong (be able to stand up vertically) • Size of the honeycomb: at least 40 cm x 40 cm The honeycombs will be used in activity 4. Dancing like bees.	30'
5	**Dancing like bees: learning conversation – group work** 1. How do bees talk to each other? Honey bees are social animals. They talk to each other. • The children watch the movies and discuss the following questions: • Which movement can you see in the dance? Can you make a drawing of it? • What do you think bees need to say to each other? What is important for bees? What do they need?	30''

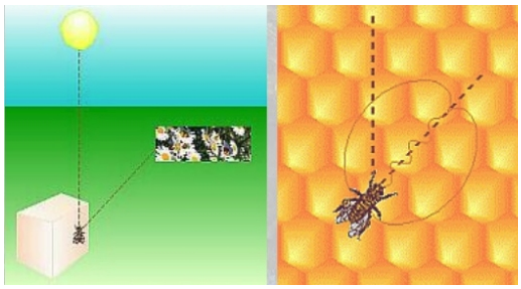
https://www.youtube.com/watch?v=YHXt_CVCCg4 (stop at sec 56)

https://www.youtube.com/watch?v=G0PiSBf6f28

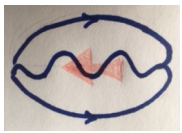
https://www.youtube.com/watch?v=13uP6qYHTWM

Bees are always looking for flowers. They tell each other where there are flowers, how far away these flowers are, in which direction, ...

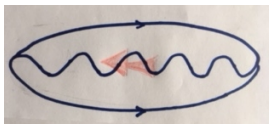
Top of the honeycomb:



But bees tell each other more than that. They talk about direction but also about distance.



The more the bee waggles its body (zigzag movement), the further the flowers are away



Based on some examples of bee dances, they can discuss:

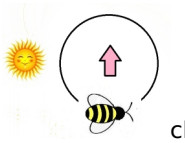
- In which direction do you think the flowers are now?
- What would the bee do if the flowers are in another direction? What will change?
- What is the difference with the former dance?

There is also another dance. What would this mean?

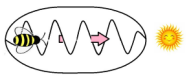
The flowers are very close now. This means less than 50 m away from the honeycomb. No direction is shown.

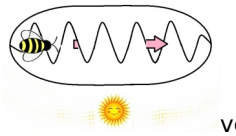
So in fact, we can have 4 kinds of dances: close/far/farther/very far

(4 symbols: the more the bee 'waggles' the further the flowers are)


close


far


farther


very far

2. Collecting nectar

This activity takes place on a large field such as a play garden or other open space.

In fact, this activity is a game in which children have to become 'bees' in a bee hive and have to collect as much nectar as possible from flowers in the field based upon the different bee dances.

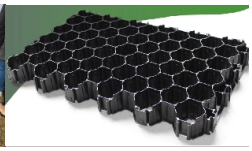
Divide the class into small groups (3-4 children per group).

What do you need?

A large open space: see map on p. 9 of the template for children. In the centre there is a bee hive, with

flowers in the different wind directions. In each wind direction there are 4 ‘flowers’ corresponding to the codes of the bee dances: close – far – farther – very far.

- The bee hives the children made before can be put in the centre of the open field. Make enough room here, so that everyone can be in the centre of the field. This will be the where the children will have to collect as much nectar as possible from the flowers.

- Now put flowers in the different wind directions.
  There are 4 kinds of dance and 4 wind directions, so 16 combinations are possible *(If you work with 8 wind directions, you can have even more combinations, 32: all possible codes can be found in the worksheets for children, see the template for children p. 10-13).*

Flowers with nectar: These can be toy blocks which are spread in the field.

The map of the playground (see the template for children)

Each group gets this map on a large piece of paper.

On this poster there is a drawing of the sun as an orientation point: the sun is in the top centre of the worksheet. *You can make it more difficult e.g. by putting the sun to the side*).

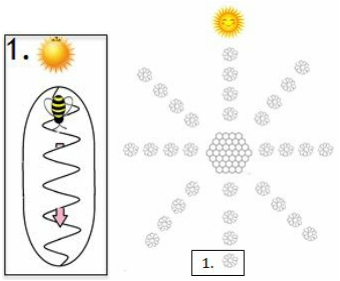
The orientation of the map is based on the sun: the sun on the map needs to be in the real direction of the sun!

Worksheets with the codes. There are 4 kinds of dance and 4 wind directions, so 16 combinations are possible (but if you work with 8 wind directions, you can have even more combinations, 32: all possible codes can be found in the worksheets for children, see the template for children).

Each group gets 5 to 10 codes (*see p. 10-13 of the template for children*), and a map of the playground (*see the template for children*).

The children need to search for the nectar based on the codes.

Give each code a number. If a child gets the code, he/she has to put this number in the right place on the

	map. In this way, it is can be checked afterwards. e.g.  For each code, a child can take one piece of nectar and put it in the honeycomb. Keep in mind! • The orientation of the map! The sun has to be in the right direction! • the sign '*' (☼) on the cards with codes, is the top of the honeycomb, which represents the sun. There is a limited amount of time... This is no game to win or lose. Each group has to collect as much nectar as possible in order to make as much honey as possible with the whole group. An extra activity can be carried out in the class only with the map and the codes: E.g. Every 30 seconds, a card with a code is passed through, and children have to draw the route for each code on the map.	
6	**Reflection** After the activity, there is the opportunity for **reflection**: - How much nectar was collected in each group? - What went well? What could be better? - In what way can bees work faster? - What is difficult about the bee code?	20''

Organization

Materials

Bees are having a hard time:

- Computer or other device in order to search on the internet
- Books about bees
- Template for children (worksheets)

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Investigation in nature: outdoor observations:

- Pen, pencil
- Paper
- Template for children (worksheets)

The home of the bees – the honeycomb conjecture:

- Large piece of paper (A3) for each group
- Circle (paper): diameter 20 cm (for each group)
- Sticks in order to build the cells (can be Lego sticks of 16 nops, but you can also use small wooden sticks such as brochette sticks and then measure the length)
- Paper, scissors
- Template for children (worksheets)

Design your own honeycomb:

- Paper, glue, scissors
- Template for children (worksheets)

Decoding the language of bees:

- Possibility of showing 'YouTube' clips
- Template for children (worksheets)

Collecting nectar:

- Template for children (worksheets)
- Plan of the playground (see p. 9 of worksheets for children)
- Worksheets with the different bee dance codes (you can decide yourself how many codes each group has to tackle)
- Beehive (which children made during the activity 'design your own honeycomb')
- Something that can represent 'nectar' on the playground (e.g. toy blocks)

Grouping

Groups consist of three to max. four children.

You can use mixed groups but be sure that the groups are mixed in a way that allows children to work together and use their problem solving skills, creativity, motor skills together.

Coaching

Useful questions

Bees are having a hard time:

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- Why do bees need flowers?
- Why do flowers need bees?
- Why are bees in danger?

Investigation in nature – outdoor observations:

- How many bees have we counted?
- Are there a lot of bees compared with other creepy creatures?

The honeycomb conjecture

- With which form did you use the least amount of sticks?
- Which form is the most useful one? Why is that? How does that come about?

Strange behaviour – decoding the language of bees

- How do bees talk to each other?
- Why should they talk to each other?
- Which movement can you see in the dance? Can you make a drawing of it?
- What do you think bees need to say to each other?
- In which direction do you think the flowers are now?
- What would the bee do if the flowers are in another direction? What will change?
- What is the difference with the former dance? What does that mean?

Collecting nectar

- How do we have to orientate the map? (based on the sun)
- What does the bee dance code mean?
- What is the best procedure in every group in order to collect as much nectar as possible?
- How much nectar was collected in each group?
- What went well? What could be better?
- In which way can bees work faster?

What is difficult about the bee code?

Adaptations

This is rather an activity for children of 7-9 years of age. Children can also be older, when you can make the activities more challenging.

Not all activities are entirely necessary. It is your choice as the teacher whether to do all activities or select just some of them.

Within each activity, there are possibilities to differentiate.

E.g. you can put the sun in a different place on the map. This makes it more difficult to orientate.

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E.g. you can add more codes within the group to make it more challenging.

E.g. You can use 4 wind directions, but you can also expand to 8 wind directions.

Assessment

Teacher's assessment:

Assessing will take place in a formative way, especially regarding:

- Problem solving *(e.g. in order to find the right solution for the shape of the cells of the beehive)*
- Planning (*e.g. planning in the group how to get as much nectar as possible from the flowers)*
- Reflecting (*e.g. reflecting on the process of the game: how did the children work together in order to collect as much nectar as possible?)*
- Collecting, analysing and interpreting data (*e.g. during outdoor observation: collecting results and representing in a graph and interpreting the graph//e.g. interpreting the bee dance codes)*
- Algorithms and procedures *(e.g. how could children use procedures efficiently in order to come to a solution: The children had to do it all the time during the game: finding a procedure in their group in order to collect as much nectar as possible.*

Students' assessment:

- Cooperate and add value to group work
- Schedule tasks, time and resources
- Individual contribution to the work
- Reflect on the process and results of the different stages of this activity
- Transforming observations in representing data
- Analysing and interpreting data from a table
- Information skills (gathering data from the internet and/or books)
- Logical and algorithmical thinking (reading, applying and controlling an algorithm, e.g. bee dance)
- Designing and producing a real 'model' (the bee hive) from a design they made on paper
- Orientation on a plan

Tips & Tricks

The honeycomb conjecture

This is one of the oldest research questions in maths, called the 'the honeycomb conjecture'.

Which form is the most efficient in order to divide a surface into regions of equal area with the least total perimeter. This was proven in 1999, by mathematician Thomas C. Hales. (https://en.wikipedia.org/wiki/Honeycomb_conjecture)

https://www.youtube.com/watch?v=kxDEcODUEP0

Where do you see it in everyday life?

-Hexagonal pales

-Pens and pencils: (they are stronger, less wasted material)

-Football:

-Compound eyes of insects (as many elements as possible on a small surface)

-Nuts and pins (strong, easy to handle, less material in order to make them)

-Beer mats (less cutting from carbon)

-Everything in nature is built by molecule-chains of 5 or 6 angles

- Solar panels on satellites (modular and surface)

- ...

Some remarks about the challenging task: 1. Make a room for a larva into which it fits: If one uses very short sticks, a circle will be the best solution for this challenge. The perimeter of a circle is smaller than this for a hexagon, when you want to fit in a circle of the same diameter. Why don't bees make cylinder to breed their larvae in? To find an answer. you also need to do challenge 2. Hexagons piled together will leave no empty spaces in between.

Where's the STEM in the activity?

1. Introduction - bees are having a hard time

Science: learning about the life of the bees (relationship between flowers and bees)

2. Outdoor observations: making an outdoor observation graph

Maths: counting, analysing data by making a graph

Science: observing, sorting and comparing organisms

3. The home of bees: investigating hexagonal shapes and designing a honeycomb

Technology - engineering: designing and constructing a honeycomb based on criteria and optimising.

Maths: learning about hexagonal shapes and how to build them

4. Dancing like bees: decoding and reading the language of bees

Maths: orientation, analysing data, algorithms and procedures

Science: observing, learning about the living conditions and behaviour of bees.

Technology: designing a program to...

Engineering: combining ideas to evolve into one optimised design

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