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Case study F

Basic data

Title of Research Teaching Unit	**A Cell in a Honeycomb**
Unit created by	**Da Vinci School, Prague (CZ)**
Based on Concept	**Contrasting natures economy to overconsumption**
Concept created by	**Panepistimio Thessalis (GR)**
Date of teaching	**29/11/2023**
Number of students in class	**8**
Number of migrant students	**2**

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1. Unit Description of Research Teaching Unit

Title	What shape should a cell in a honeycomb be?
Teaching unit concept	Mathematical modelling
Age of students/grade	14 - 16
Length of the unit	90 minutes
Mathematical topic	Geometric shapes, area
Prerequisite knowledge	● Basic geometric shapes – triangle, rectangle, circle, hexagon ● Area and perimeter of these shapes ● Pythagorean theorem
Materials needed	● Worksheet ● Photos of a honeycomb (can be found on the Internet)
Objectives	● Revision of geometric shapes, their perimeter and area ● Use of geometric formulas ● Link between geometry and nature
Notes on work with migrant students	● Special vocabulary linked with bees has to be explained separately

Lesson plan

1. Introduction – some basic facts about a cell in a honeycomb
2. Work in groups using the worksheet below
3. Whole class discussion and comparison of results
4. A short movie - https://www.youtube.com/watch?v=QEzlsjAqADA&ab_channel=TED-Ed

What shape should a cell in a honeycomb be?

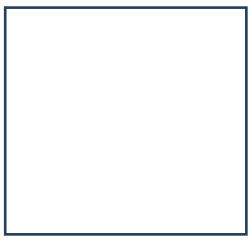
The cell in the honeycomb must be shaped in such a way in order to

- allow the queen to stick her bottom into it and lay the egg on the bottom,
- allow a bee to hatch,
- fit as many of them as possible in the smallest possible area to maintain the 35°C temperature required for larval development
- store honey and pollen
- allow the cleaner bee to get into it and clean it up

An adult bee needs a space of approximately 5.3 mm in diameter. For the shape of the bee cell, we can therefore consider formations that can accommodate a circle with a diameter of 5.3 mm. We will select some of these and compare their suitability for the honeycomb arrangement.

A. Shape of cell: a circle

1. Draw in the box what a honeycomb with circular cells would look like.



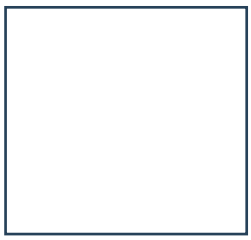
2. Calculate the area of one cell.

3. How many such cells would fit in a square of 1 dm^2?

4. What are the advantages/disadvantages of this arrangement with circular cells?

B. Shape of cell: an equilateral triangle

1. Draw in the box what the honeycomb would look like with cells of the shape of an equilateral triangle.



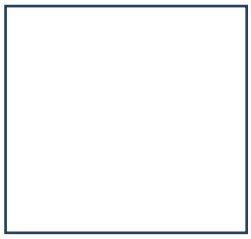
2. Calculate the area of one cell, when we know that the radius of the inscribed circle can be calculated using the formula $r = \frac{2S}{o}$, where *S* is the area and *o* is the perimeter of the triangle.

3. How many such cells would fit in a square of 1 dm^2?

4. What are the advantages/disadvantages of this arrangement with triangular cells?

C. Shape of cell: a square

1. Draw in the box what the honeycomb would look like with cells of the shape of a square.



2. Calculate the area of one cell.

3. How many such cells would fit in a square of 1 dm^2?

4. What are the advantages/disadvantages of this arrangement with square cells?

D. Shape of cell: a regular hexagon

1. Draw in the box what the honeycomb would look like with cells of the shape of a regular hexagon.

2. Calculate the area of one cell.

3. How many such cells would fit in a square of 1 dm^2?

4. What are the advantages/disadvantages of this arrangement with hexagonal cells?

Conclusion: what is the best shape for a honeycomb cell and why?

2. Interview Analysis

The teacher teaching this unit is the head of the Da Vinci School on the outskirts of Prague. He has very rich experience of 20 years of teaching mathematics and is also involved in research in didactic of mathematics. The teacher received no pre-service training in work with migrant pupils and no in-service teacher training in the issue before the last 12 months. However, he attended in-service teacher training conference in Prague at Charles University organized within the frame of the M4M project.

Da Vinci school, where the lesson was conducted, is a private school where individual needs of each of the learners is respected.

The teacher has experience of teaching migrant pupils and he believes the greatest obstacles in these classrooms are language, vocabulary and motivation of the pupils. Yet, he sees that migrant pupils bring new impulses to the classroom and make the whole group more sensitive to cultural issue as well as respect other cultures more. Having migrant pupils in the classroom made the teacher increase initial support for migrant pupils, making sure they are able to follow and join in.

The lesson was conducted with eight pupils aged 17-18. Two of them had migrant background and were in the Czech Republic more than a year.

The objectives of the lessons were to revise basic geometric shapes, to calculate lengths and areas, to make a link between geometry and nature.

The work included pair work. The unit was well received by the pupils. Some of them struggled with use of correct formulas in an equilateral triangle. The atmosphere in the lesson was very good and pupils were ready to discuss.

The inclusion of open problems allowed individual pace of pupils in their work.

The cross-curricular character of the activity is its plus, it is linked to biology.

Overall, he was very positive about the activity, its progress and outcome.

3. Improvement Suggestions

Since some of the students struggled with formulas, it might be a good idea to revise and e.g. write on the whiteboard formulas that are needed for further work.