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HOW LIME TREE AFFECTS PEOPLE'S LIVES AND SURROUNDINGS

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**7. A.**

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# **Introduction**

The effects of climate change are being felt all over the world: winters are getting warmer, hurricanes, floods and fires are more frequent, sea levels are rising and entire communities like coral reefs are disappearing. The most common cause of this is man.

I met with the fact of climate change for the first time when I was 10 years old in science class and wanted to contribute to the protection of our planet and actively participate in environmental observation, so I joined the GLOBE program. As part of the GLOBE program, I have been watching the lime tree outside the school for 3 years and I noticed that this year it budburst started 2 weeks before previous years. Looking at the lime tree, I learned a lot about the environment and the nature around us. **I've learned that all ecosystems are connected and we're all dependent on each other.** With this work I want to emphasize this connection between people and nature and to show how much lime tree in front of the school affects us students by producing oxygen.

## Project goal

* Develop awareness of human connection with nature
* Encourage other students to actively participate in environmental protection and nature protection
* Encourage school authorities to plant more trees around the school
* Link mathematics with nature

## Trees and man

The best way to change the world is to change ourselves. So I decided to mathematically calculate how much one lime tree in front of the school means to us and encourage the school to plant more trees. **According**  **to Hewitson,**  **m2** leaves produce **500**  **mL** of oxygen per **hour**, and the average person breathes 12 times per minute in a resting state, and in one breath there is **500 mL of air, of which 79% oxygen (Car, 2011).** I took these facts into when calculation for our lime tree.

## Our lime tree

Our lime tree belongs to the species of small-leaved lime lat. *Tilia cordata.* Small-leaved lime is a deciduous tree that grows up to 18 m. Canopy is dense, in youth conical and symmetrical and later in the form of a hemisphere, rounded and wide. The flowers are pale yellow (5 to 15) collected in a pactous inflorescence with a winged side, pleasant smell. It blooms between June and July. The fruit is a multi-seeded nutmeg pear-shaped, reddish in color. It requires loose, deep, well-drained soil, thrives on other types of soil; adaptable to different soil pH reactions. It likes a sunny to semi-shaded position. Tolerates urban planting conditions; pollution, compacted and alkaline soils, poorly drained soils (Drijen 2020).

 

Picture 1. Picture 2.

## Research questions

* How much lime tree produces oxygen in one hour, in one day and in one year?
* How much oxygen does the average person breathe in one hour, in one day and in one year?

# **Materials and methods**

In order to calculate how much oxygen our lime tree produces in one hour, I took one leaf and calculated it’ s surface using millimeter paper (Picture 3 and 4). In order to get an approximate number of leaves on the lime tree, I took a wire cube with a volume of 2.2 dm3 and counted the leaves in it (Picture 5). Then I calculated the volume of the lime conopy to get the number of cubes in the canopy of lime.

 

Picture 3. Lime tree leaf on millimeter paper Picture 4. Calculate leaf surface



Picture 5. Counting leaves in a cube with a volume of 2.2 dm3

The lime canopy has **the shape of a cone** **(Picture 6.)** so I used the formula for the volume of the cone to calculate the volume of the lime tree. For this calculation, I needed the height of the lime canopy (h) and the radius of the canopy at the base (r).

Picture 6.

**Lime tree**

 **h = 5.64 m, height of lime tree from ground to top is 7.64 m**

 **r = 2m, with of canopy at the base is 4 m**

The volume of the cone (the volume of the lime canopy) is calculated according to the formula:

**V=** $\frac{B ∙ h}{3}$

**B -** cone base (circle surface)

**h –** lime tree canopy height, 5.64 m

V= $\frac{B ∙ h}{3}$ B = r² · π

V= 2$\frac{12.56 ∙ 5.64}{3}$ B= r² · 3.14m

V= 4 $\frac{70.84}{3}$ B= 22 · 3.14m

V= 23.61≈ 24m² B= 12.56 m²

**V= 2 400dm²**

**LIME VOLUME IS 2 400 dm2**

**Number of leaves on lime tree**

Cube edge **1 CUBE = 16 leafs**

a =1.3 dm **NUMBER OF CUBES** =$\frac{VOLUME OF LIME CANOPY}{VOLUME OF CUBE}$

V=a³ $\frac{2400}{2.2}=10909.90$≈ **10,910**

V=1.3³ 10910 · 16 leafs= **174,560**

V= 2,197 dm³≈2.2 dm³

**Lime tree has 174,560 LEAVES**

**Amount of oxygen produced**

**One leaf produces 0.05 mL of oxygen per 1 cm²** **(Hewitson) in one hour**

Average lime tree leaf area:

**P= 42 cm²**

42 · 0.05 = 2.1 mL/h

**SINGLE LEAF = 2.1 mL oxygen/hour**

**WHOLE LIME TREE**

**IN HOUR**

174 560 (number of leaves) · 2.1 = 366 576 ml ≈**367 L/h**

**IN THE DAY**

367 · 24= **8808 L per day**

**ANNUALY**

8808 · 365 **= 3 214 920 L per year**

**Amount of inhaled oxygen (1 person):**

**1 breath**

**1 breath** – 500 mL of air – 79% oxygen

79% of 500 mL

0.79 ̇· 500= **395** **mL** of **oxygen/inhalation**

**IN THE hour**

1 min – 12 breaths

1 hour = 60 minutes

12 **·** 395 mL **·** 60 = **284 400 mL/h**

**IN THE DAY**

**1 day= 24 hours**

 1 hour= 60 min =>24 · 60 = 1440 min in one day

 1 440 · 4 740 = **6 825 600 mL oxygen/day**

**ANNUALY**

 365 · 6 825 600 mL **= 2 491 344 000 mL** $≈$ **2 491 344 L** $≈$ **2.5 ·** $10^{9}$**L/year**

**Our school (434 people)**

**391 students + 43 employees = 434 people in our school**

**IN THE HOUR**

434 · 284 400 **= 123 429 600 mL/h**

**IN THE DAY**

434 ·6 825 600 mL per day = **2 962 310 400 mL or** **2 962 310 L/day**

**ANNUALY**

**2 962 310 l · 434 = 1 081 243 296 L** $≈$ **1.08** **·** $10^{9}$**L/ yearly**

# **Conclusion**

**Our lime** tree produces about **3 214 920 L of oxygen** per year, and employees and students of our school need **about 1 081 243 296 L of oxygen** per year. Which is **about 336 times more than our Lime tree produces.**

I am extremely pleased to have conducted this research to highlight the importance of tree planting and their usefulness and lack in the environment of our school. I am aware that we cannot plant 336 trees in the schoolyard, but I hope that this work will encourage planting at least 2-3 trees around the school in order to be closer to nature.

I enjoyed following and measuring the lime in front of the school and using mathematics. Mathematics is really all around us and the foundation of all natural sciences and I'm always happy when I can apply math knowledge to concrete and life things.

1. **Literature**

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