
NA PUTU
DO MEDALJE
IYNT 2018.

Voditelji Hrvatskog tima

Domagoj Pluščec, Domagoj Gajski

Donatori i sponzori

Slike

sudionici Državnog turnira mladih prirodoslovaca 2018. i IYNT 2018.

Zbornik izradili

Dunja Vesinger i Domagoj Pluščec

Kolovoz 2018., Zagreb

SADRŽAJ

IZVJEŠTAJ IZ GRUZIJE

Ana Ćenan

U Gruziji je bilo jako lijepo. Sve je bilo drugačije. Najvažniji dio cijelog putovanja bilo je naravno natjecanje. Imali smo pet znanstvenih borbi u kojima smo dali sve od sebe kako bismo pobijedili. Ponekad je konkurencija bila jaka, ali se nismo htjeli predati. Na kraju smo osvojili brončanu medalju na koju smo jako ponosni jer se isplatio naš trud i rad.

Jedno poslijepodne, nakon borbe, smo išli razgledavati glavni grad Gruzije. Tbilisi je pun kontrasta. Ima vrlo modernih i lijepih zgrada i skulptura, ali i siromašnih kućica. Čak smo posjetili i špilje Uplistsikhe u kojima je bilo vrlo zabavno.

Ekipa je bila super. Uvijek smo se smijali i zabavljali iako smo ponekad do kasnih sati radili na prezentacijama. Na borbama smo pomagali jedni drugima i zajedno smišljali strategije.

Sve u svemu iskustvo je bilo dragocjeno jer sam puno naučila i upoznala puno novih prijatelja.

Elena Lukačević

Turnir u Gruziji mi je nešto najbolje što mi se moglo dogoditi u životu. Ekipa za turnir je bila vrlo složna i zabavna, Gruzija mi je ostala u srcu kao najljepša zemlja koju sam posjetila a Gruzijci kao druželjubivi ljudi. Konkurencija je bila jaka ali to nam je dalo iskustvo i zadovoljstvo jer smo se dvaput borili s apsolutnim pobjednicima. Puno toga sam naučila, stekla puno prijatelja i stvorila neke najljepše životne uspomene.

Boravak u Gruziji, iako je trajao 10 dana, prošao je vrlo brzo. Naučili smo trpjeti visoke temperature, nekoliko Gruzijskih riječi, pjevati ruske pjesme i zaključili jedno: ovo se treba ponoviti.

Budućim natjecateljima želim poručiti da se prijave, budu hrabri i uporni, trud se svakako isplati a uspomene i osjećaji su neprocjenjivi.

Luka Mikšić

Ovaj turnir je nešto najljepše što mi se dogodilo u životu. Gruzija je bila predivna i egzotična, ekipa za turnir je bila jedna od najboljih i svi smo se jako dobro slagali i sam turnir je bio uzbudljiv i nezaboravan.

Kako je turnir tekao ekipa se zbližavala i postajala sve bolja i bolja, tj. izvukli smo jedni iz drugih sve ono najbolje. Upoznao sam mnogo intelektualaca iz drugih država i imao čast imati znanstvene borbe sa jednima od najpametnijih iz cijelog svijeta. Sveukupno Gruzija je bila jedno prelijepo iskustvo koje ću pamtiti za život.

Marko Šarić

Gruzija je na mene ostavila vrlo dobar dojam. Bilo je napeto, zabavno, smiješno, zanimljivo… Sve u svemu odlično. Upoznao sam nove ljude s kojima sam razmjenjivao razna iskustva. U Gruziji su cijene poprilično niske što mi se svidjelo. Svake smo večeri imali sastanke na kojima smo raspravljali o strategiji za sutrašnji dan i pripremali te usavršavali prezentacije do kasnih večernjih sati. Što se tiče hrane, hrana je bila ukusna, ali s previše kopra kojega je sadržavalo gotovo svako jelo.

Andrej Todić

Gruzija je moj prvi susret s istokom i jedan kojeg ću pamtiti zauvijek. Smatram da je to zaboravljeni biser koji zaslužuje veću pažnju ostatka svijeta. Vrijeme provedeno u glavnom gradu Tbilisiju držim duboko u svojem srcu i rado se sjećam predivnih prizora. Tbilisi je smješten u dolini tako da pogled s okolnih brda najbolje dočarava njegove ljepote. Noću se atmosfera mijenja i grad postaje potpuno neprepoznatljiv. Jedino što mi je smetalo je vruća klima zbog koje sam često dobivao vizije plavog Jadrana i hladnih tuševa.

Ovaj turnir pomogao mi je da upoznam mlade znanstvenike diljem svijeta i uočim različite pristupe problemima tijekom znanstvenih istraživanja. U mom sjećanju dugo će ostati Rusi koji su se prema mom timu ponašali posebno prijateljski i uživali u provođenju vremena s nama. Otkrio sam da se mladi umovi iz različitih dijelova svijeta mogu sastati i pronaći zajedničku temu o kojoj mogu razgovarati.

S ovog natjecanja odlazim obogaćen znanjem i iskustvom o nečemu što me zaista zanima i može upotpuniti moj život. Brončana medalja samo je simbol koji u sebi sadrži sav rad i trud koji sam uložio u izvedbu eksperimenata tijekom ove godine. Nadam se da je ovo samo početak onoga što mogu postići i odskočna daska u karijeru znanosti.

Domagoj Gajski

Ove godine sam dobio nevjerojatnu priliku voditi hrvatski tim na međunarodno natjecanje mladih prirodoslovaca. To mi je svakako bio jedan od najvećih izazova u životu. Koliko god je bilo zahtjevno pripremati ih i motivirati, toliko mi je bilo i zabavno. Ti učenici svakako nisu upili sve znanje svijeta, ali bili su motivirani raditi i učiti te je to i mene motiviralo im pomoći do samoga kraja. Naučio sam da je najvažniji faktor ovog natjecanja timski rad učenika. Bez obzira na to što su samostalno prezentirali, oponirali i recenzirali tijekom turnira, da nije bilo timskog rada tijekom priprema, teško bi dogurali do brončane medalje. Bili su ravnopravni s prvacima ovogodišnjeg turnira i ove godine im je nedostajalo malo sreće da i sami ponesu zlato kući. Zbog svega navedenog sam ponosan na postignuto te vjerujem da će hrvatski tim osvajati medalje i idućih godina jer u Hrvatskoj učenika motiviranih znanjem ne nedostaje.

SLIKE S DRŽAVNOG TURNIRA MLADIH PRIRODOSLOVACA


4. državni turnir
mladih prirodoslovcev


5 minuta


4. državni turnir

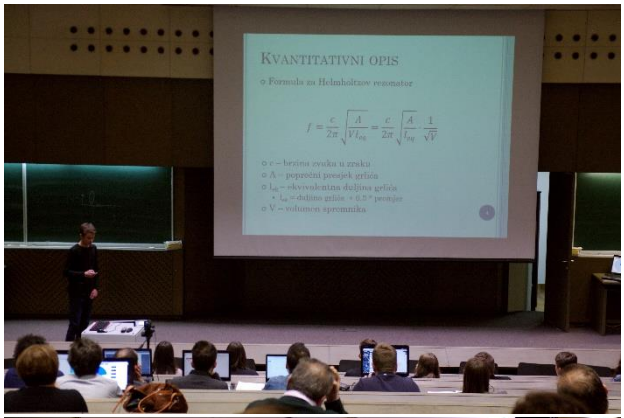

Hvala na pažnji!


IYNT
International Young Naturalists'
Tournament

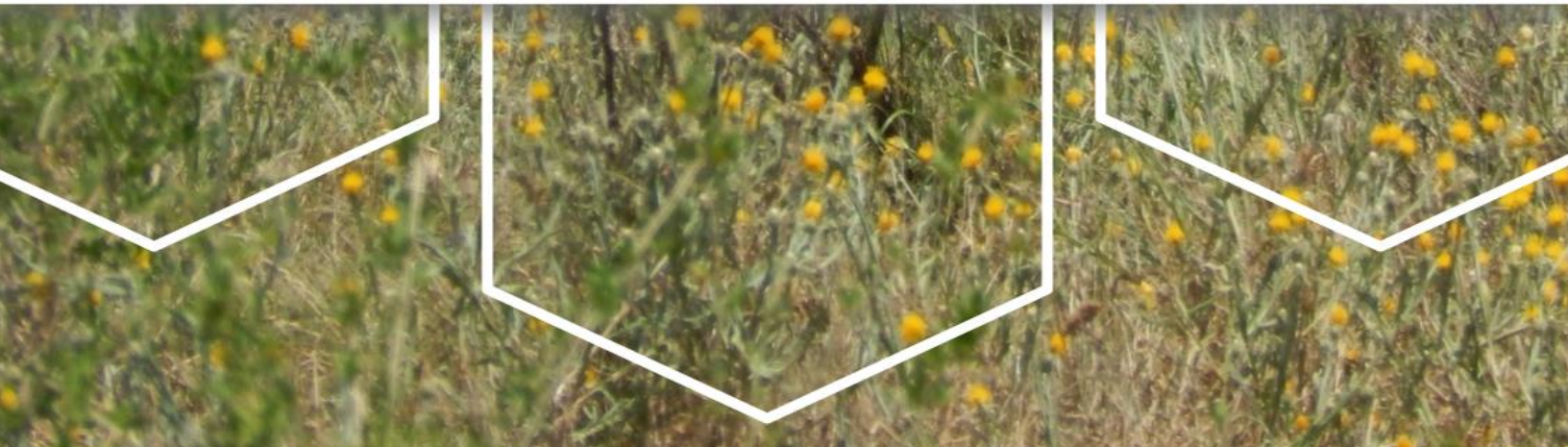

4. državni turnir
mladih prirodoslovaca


ICM
Istraživački centar mladih


MINISTARSTVO ZNANOSTI I OBRAZOVANJA REPUBLIKE HRVATSKE
comping_
LET IT BE PERFECT
ICM
vibiz

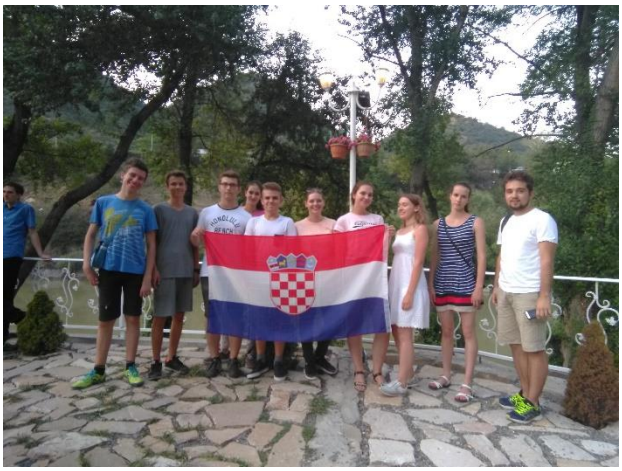

KVANTITATIVNI OPIS
Formula za Helmholtzov rezonator

SLIKE S MEĐUNARODNOG NATJECANJA IYNT 2018 TBILISI, GRUZIJA








comping
LET IT BE PERFECT






6th International Young Naturalists' Tournament 2018

Foundation for Youth Tournaments
Ivane Javakhishvili Tbilisi State University

Foundation *for* Youth Tournaments

Third Place Diploma

This is to certify that the team

Croatia

Grgur Premec	captain
Ana Ćenan	
Elena Lukačević	
Marko Šarić	
Luka Mikšić	
Andrej Todić	
Domagoj Pluščec	leader
Domagoj Gajski	leader

has achieved 3rd place and earned Bronze Medals
at the 6th International Young Naturalists' Tournament

Evgeny Yunosov
Chairman of the General Council,
IYNT

ФОНД ПОДДЕРЖКИ И РАЗВИТИЯ ИНТЕЛЛЕКТУАЛЬНЫХ СОСТЯЗАНИЙ «ТУРНИРЫ ЮНЫХ» * МОСКВА *

George Sharvashidze
Rector,
Ivane Javakhishvili Tbilisi State University

Ilya Martchenko
Speaker of the General Council,
IYNT

Nunu Ovsyannikova
Head of Administration,
Ivane Javakhishvili Tbilisi State University

Tbilisi, July 11, 2018

www.iynt.org

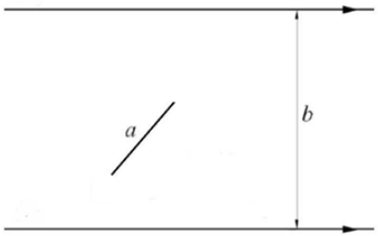
PREZENTACIJE PROBLEMA HRVATSKE EKIPE

1. BUFFON'S NEEDLE

Team Croatia
Reporter: Marko Šarić

1. BUFFON'S NEEDLE

Draw a series of **parallel equally spaced** lines on a horizontal surface. Pick a bunch of sticks (e.g. matches or needles) slightly **shorter** or **longer** than the separation between the lines, and randomly drop them on the surface. It is claimed that the number of times the sticks cross the lines allows estimating the **constant π** to a high precision. What **accuracy** can you achieve?



DEMONSTRATION OF THE PHENOMENON

OUTLINE

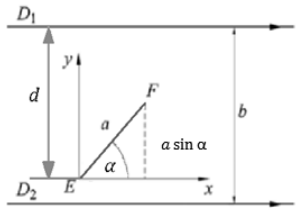
Theoretical introduction
- Probability of crossing the line

Experiment
- Equipment
- Changing needle-track ratio
- Group vs. Single stick
- Height testing
- Program simulations

Results
- Comparison of results

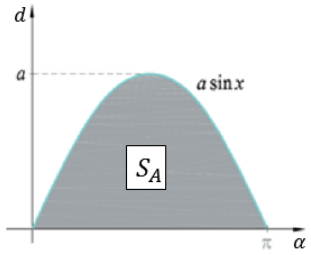
PROBABILITY OF CROSSING THE LINE

- a= stick lenght
- Two parallel lines D_1, D_2 with distance *b*
- $a < b, a = b, a > b.$
- Probability of crossing one line x 2
- Whether the stick cross the line depends of:
  - distance **d**
  - angle **α**



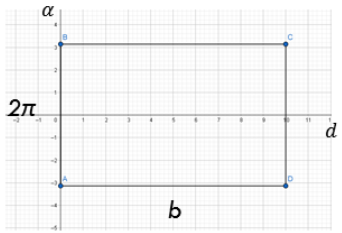
PROBABILITY OF CROSSING THE LINE

$A = \{(\alpha, d): 0 \le \alpha \le \pi, 0 \le d \le b, d < a \sin x\}$



$S_A = 2a$

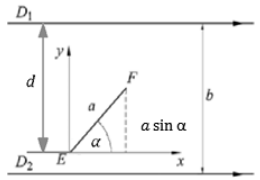
$B = \{(\alpha, d): -\pi \le \alpha \le \pi, 0 \le d \le b\}$



$S_B = 2\pi b$

PROBABILITY OF CROSSING THE LINE

- Provided that $d < a \sin \alpha$ stick will cross the line.



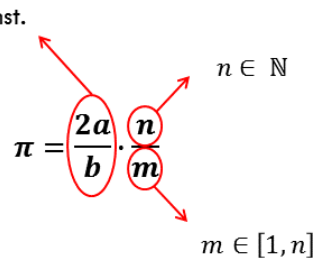
- $S = \frac{S_A}{S_B} = \frac{2a}{2\pi b} = \frac{a}{\pi b} \Rightarrow 2S = \frac{2a}{\pi b}$

$$\Rightarrow \quad \pi = \frac{2na}{mb}$$

- n – *total number of thrown sticks*
- m – *the number of sticks crossing the line*
- a – *lenght of the stick*
- b – *the distance between the lines*

HYPOTHESES

1 **Deviation** will **decrease** by **increasing** number of **throws**.



HYPOTHESES

1 **Deviation** will **decrease** by **increasing** number of **throws**

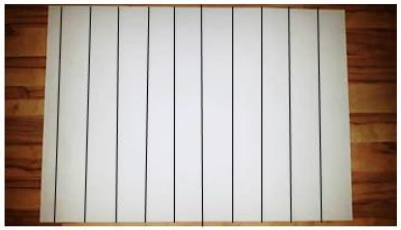
2 **Single** stick throwing is **better** than **group** throwing

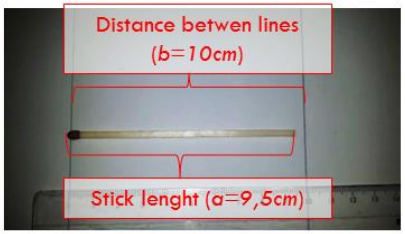
3 **Height** will not affect **accuracy** of results

4 Approximation **accuracy** will **not** depend of **needle-track** ratio (a/b)

EXPERIMENTAL SETUP

- 2700 matches
- one by one →40cm →parallel to the floor
- a=9.5cm
- b=10 cm, 9.5cm, 9 cm





CHANGING A:B RATIO

- n – total number of thrown sticks
- m – the number of sticks crossing the line
- a – lenght of the stick
- b – the distance between the lines

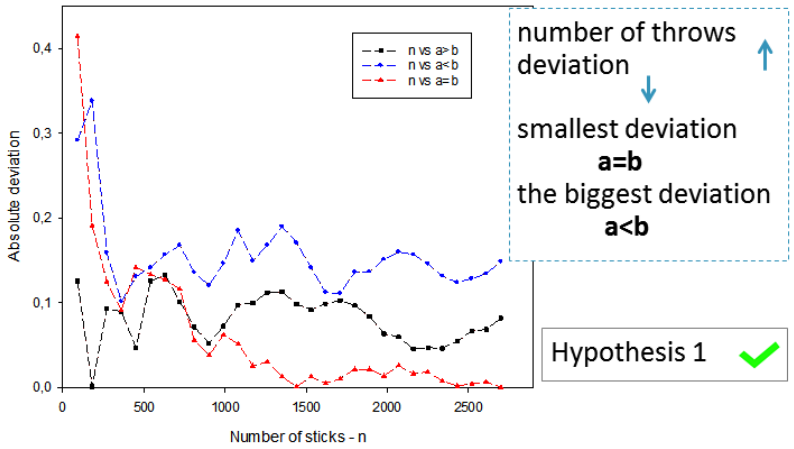
- $\pi = \frac{2na}{mb}$
- X - deviation from π → ideally 0

- $a > b$
- $b = 9cm$
- $X = 0{,}082011\ldots$

- $a < b$
- $b = 10cm$
- $X = 0{,}148593\ldots$

- $a = b \Rightarrow \pi = \frac{2n}{m}$
- $X = 0{,}00023140\ldots$

Change of absolute deviation with number of sticks

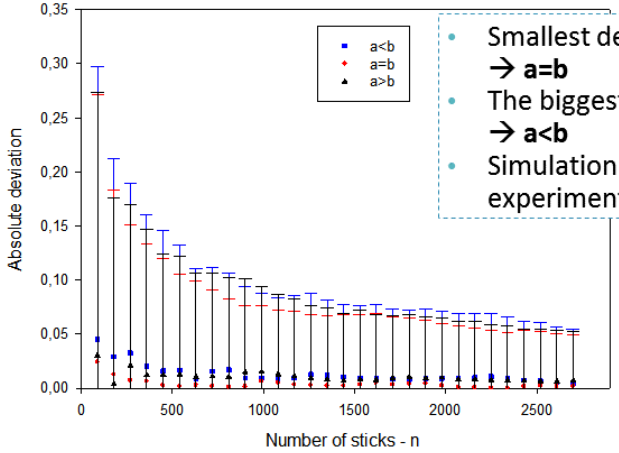


number of throws ↑
deviation ↓

smallest deviation
a=b
the biggest deviation
a<b

Hypothesis 1 ✓

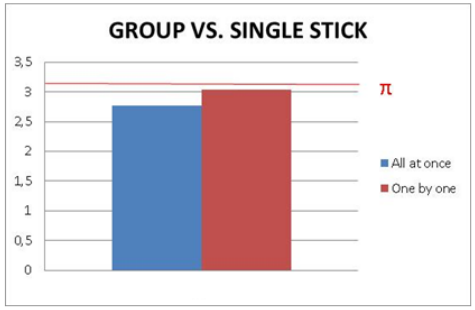
Simulation - Change of absolute deviation with number of sticks



- Smallest deviation → **a=b**
- The biggest deviation → **a<b**
- Simulation fits experimental results

GROUP VS. SINGLE STICK

- I thrown sticks all at once from height of 40 cm and compared results with throwing one by one.



Hypothesis 2 ✓

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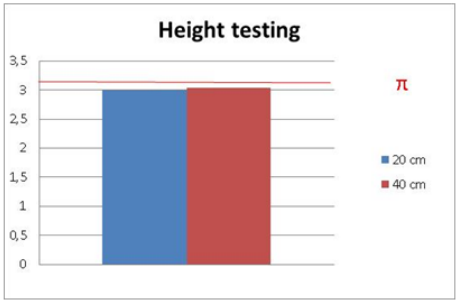
HEIGHT TESTING



- Two heights→ 20 cm, 40 cm
- Height does not affect accuracy of results

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HIGHT EQUAL TO STICK LENGHT

- Height ≤ stick lenght →inaccurate results
- Then we are **controling** will stick cross the line or not.

Hypothesis 3 ✗

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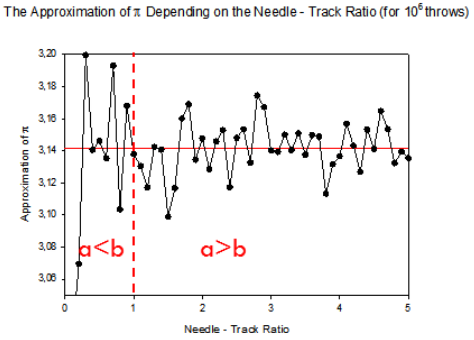
DEPENDANCE ON THE NEEDLE-TRACK RATIO (A/B)

- The program variates the needle length
- The track width is constant
- Approximation accuracy will not depend of needle-track ratio (a/b).



Hypothesis 4 ✓

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CONCLUSION

1 Deviation will decrease by increasing number of throws. ✓

2 Single stick throwing is better than group throwing. ✓

3 Height will not affect accuracy of results.
- Height ≤ stick lenght ✓
- Height > stick lenght ✗

4 Approximation accuracy will not depend of needle-track ratio (a/b). ✓

LITERATURE

- http://www.mathematica-journal.com/issue/v11i1/contents/BuffonsNeedle/BuffonsNeedle.pdf (4.11.2017)
- http://mis.element.hr/fajli/560/09-04.pdf (4.11.2017)
- https://web.math.pmf.unizg.hr/nastava/uuv/files/ch5.pdf (4.11.2017)
- https://www.cut-the-knot.org/fta/Buffon/buffon9.shtml (10.11.2017)

THANK YOU!

Team Croatia
Reporter:Marko Šarić

IYNT Tbilisi 2018

ADDITIONAL SLIDES (CODE #1)

```
from random import randrange        #modules needed for certain functions to work
from math import sin, radians
import numpy
import statistics

track_width   = 900000        #the track width and needle length are constant
needle_length = 950000
number_of_tosses = 90

dic = dict()


for i in range(100):
    number_of_intersections = 0

    for j in range(1, 31):
        for k in range(number_of_tosses):
            distance = randrange(0, track_width + 1)            #the distance from a line
            angle = randrange(3600000)                          #the angle between the line and the needle
            angle /= 10000                                      #rounding up to 4 decimals

            vertical_component = needle_length * sin(radians(angle))     #the vertical component of the needle's length

            if distance + vertical_component >= track_width:
                number_of_intersections += (vertical_component - (track_width - distance)) // track_width + 1

            elif distance + vertical_component <= 0:
                number_of_intersections += (abs(vertical_component) - distance) // track_width + 1

        #Python's display of the formula

        approximation_of_pi = (2 * number_of_tosses * j * needle_length) / (number_of_intersections * track_width)
        array = dic.get(j * number_of_tosses,[])
        array.append(approximation_of_pi)

##        print("Number of tosses: {}     Approximation of pi: {}".format(number_of_tosses, approximation_of_pi))
    dic[j * number_of_tosses] = array
avgd={}
stde={}
for k in dic:
    avgd[k] = numpy.mean(dic[k])
    stde[k]= statistics.stdev(dic[k])

for k in avgd.keys():
    print(str(k)+
          "\t"+str(avgd[k]).replace('.',',')
          +"\t"+str(stde[k]).replace('.',','))
```

ADDITIONAL SLIDES (CODE #2)

```
from random import randrange        #modules needed for certain functions to work
from math import sin, radians

track_width = 10000        #the track width and needle length are constant
needle_length = 7000

tosses = [1, 5, 10, 25, 50, 75, 100, 250, 500, 750, 1000]

for index in range(0, 11):
    number_of_intersections = 0
    number_of_tosses = tosses[index]

    for i in range(number_of_tosses):
        distance = randrange(0, track_width + 1)          #the distance from a line
        angle = randrange(3600000)                        #the angle between the line and the needle
        angle /= 10000                                    #rounding up to 4 decimals

        vertical_component = needle_length * sin(radians(angle))     #the vertical component of the needle's length

        if distance + vertical_component >= track_width:
            number_of_intersections += (vertical_component - (track_width - distance)) // track_width + 1

        elif distance + vertical_component <= 0:
            number_of_intersections += (abs(vertical_component) - distance) // track_width + 1

    #Python's display of the formula
    approximation_of_pi = (2 * number_of_tosses * needle_length) / (number_of_intersections * track_width)

    print("Number of tosses: {}     Approximation of pi: {}".format(number_of_tosses, approximation_of_pi))
```


Way of throwing	Totalnumber ofthrownsticks/n	Numberofsticksc rossingtheline/m	x $-$ *Estimate* π
All at once	2700	1835	2.7715…
Oneby one	2700	1693	3.0301…

Height	Totalnumberofthrownsticks/n	Numberofsticksc rossingtheline/m	x $-$ *Estimate* π
20 cm	2700	1712	2.9965…
40 cm	2700	1693	3.0301…

- $a > b$
- m= 1863
- $b = 9cm$
- $X = 0{,}082011\ldots$

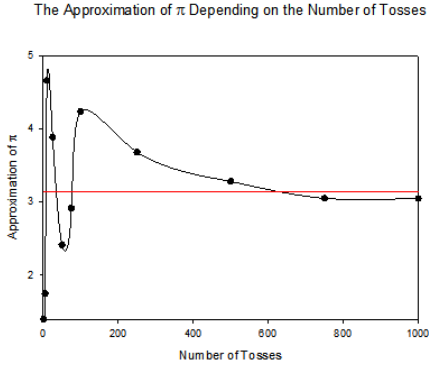
- $a = b \Rightarrow \pi = \frac{2n}{m}$
- $m = 1719$
- $X = 0{,}00023140\ldots$

- $a < b$
- m= 1714
- $b = 10cm$
- $X = 0{,}1114686\ldots$

DEPENDANCE ON THE NUMBER OF THROWS

The program variates the number of throws of the needle

It repeats the experiment for 1, 5,10, 25, 50, 75, 100, 250, 500, 750 and1000 throws



ADDITIONAL SLIDES (CODE #3)

```
from random import randrange        #modules needed for certain functions to work
from math import sin, radians

track_width = 10000    #the track width is constant

for needle_length in range(0, 50001, 1000):
    number_of_intersections = 0

    for number_of_tosses in range(10000):
        distance = randrange(0, track_width + 1)          #the distance from a line
        angle = randrange(3600000)                        #the angle between the line and the needle
        angle /= 10000                                    #rounding up to 4 decimals

        vertical_component = needle_length * sin(radians(angle))     #the vertical component of the needle's length

        if distance + vertical_component >= track_width:
            number_of_intersections += (vertical_component - (track_width - distance)) // track_width + 1

        elif distance + vertical_component <= 0:
            number_of_intersections += (abs(vertical_component) - distance) // track_width + 1

    #Python's display of the formula
    approximation_of_pi = (2 * number_of_tosses * needle_length) / (number_of_intersections * track_width)

    print("Ratio of the needle length and the track width: {}     Approximation of pi: {}".format(needle_length / track_width, approximation_of_pi))
```

PROGRAMMING

- In order to completely randomize the fall of the needle, I devised a program in the programming language Python
- The program randomises the position between two lines where the needle must fall and its orientation when it falls
- These values manifest as the minimal distance of the needle from the line and the angle between the needle and the line
- The action of falling is repeated a thousand times

2. ALL ROADS LEAD TO ROME

Team Croatia

Reporter: Andrej Todic

1

2. ALL ROADS LEAD TO ROME

Open a **random** Wikipedia article and click on the **first** link in the article. Keep clicking on the **first** link of each following article. It is argued that you will quickly end up on the page **Philosophy**. **Investigate** whether this is true. How can one **describe** such an observation?

OUTLINE

Theoretical introduction
- Facts about Wikipedia
- Special: Random Feature

Experiment
- Use of Programming
- Loop Occurences

Results
- Results (with and without modifications)
- Description

WIKIPEDIA

- Multilingual web-based encyclopedia
- Articles can be modified by volunteers
- 261 different languages
- 15 million pages → about 5 million in English

EXAMPLE

Science

From Wikipedia, the free encyclopedia

This article is about the general term. For other uses, see Science (disambiguation).

Science (from Latin *scientia*, meaning "knowledge")[2][3]:58 is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.[a]

Latin

From Wikipedia, the free encyclopedia
(Redirected from Latin language)

For other uses, see Latin (disambiguation).

Latin (Latin: *lingua latīna*, IPA: [ˈlɪŋgʷa laˈtiːna]) is a classical language belonging to the Italic branch of the Indo-European languages. The Latin alphabet is derived from the Etruscan and Greek alphabets, and ultimately from the Phoenician alphabet.

SPECIAL:RANDOM

- Generates random articles
- Each page in the Wikipedia database has a unique index
- An article is chosen by choosing a random index
- Used to take random samples from the Wikipedia database

/wiki/Special:Random → random Wikipedia article

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HYPOTHESES

- **Hypothesis 1:**

  More than half of all articles will lead to *Philosophy*

- **Hypothesis 2:**

  If it's possible to reach *Philosophy*, it can be done in **under 50 clicks**

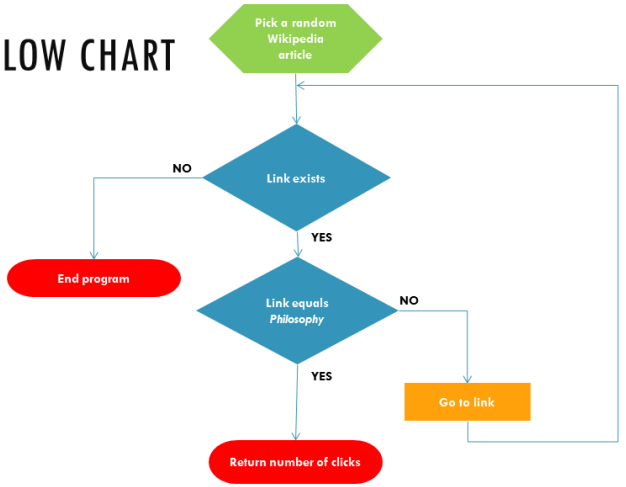
7

TESTING

- Automated using **Programming**
- Web **client** using the programming language Python
- **Automatically** searches Wikipedia

8

FLOW CHART



9

TESTING

- Program checks if randomly picked web pages lead to *Philosophy*
- Output consists of
  - Address of the starting web page
  - Number of clicks to reach *Philosophy*
- Wikipedia article doesn't lead to Philosophy

Number of clicks is set to -1

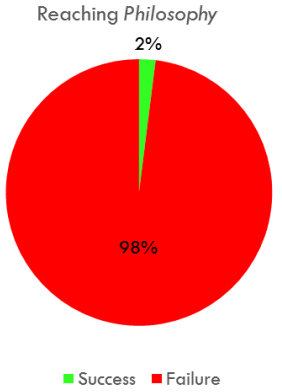
10

INFINITE LOOPS

First links of randomly chosen articles:
- lead to *Philosophy*

OR
- lead to already visited articles

- Second outcome means all the articles would have to be visited again
- Test is stuck in a loop



11

WHEN LOOPS OCCUR

Science

From Wikipedia, the free encyclopedia

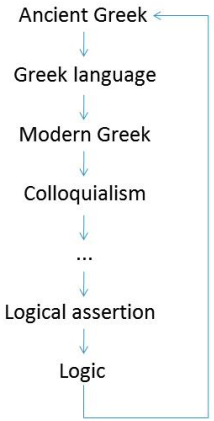
This article is about the general term. For other u

Science (from Latin *scientia*, meaning "knowledge")[testable explanations and predictions about the unive

Contemporary science is typically subdivided into the and societies, and the formal sciences like mathemat disciplines cannot be tested with physical observatio engineering and medicine may also be considered to university, a college, or a research institute.

From classical antiquity through the 19th century, sci fact, in the West the term "natural philosophy" encom astronomy, medicine, among many others [7]:3[b] In th

- First link is often about the etymology of a word



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MODIFICATION

- Ignoring the first links connected to infinite loops, such as:
  - "/wiki/Mathematics"
  - "/wiki/Truth"
  - "/wiki/Greek"
  - "/wiki/Latin"
- Moving on to the next link
- Possible to reach *Philosophy* more often

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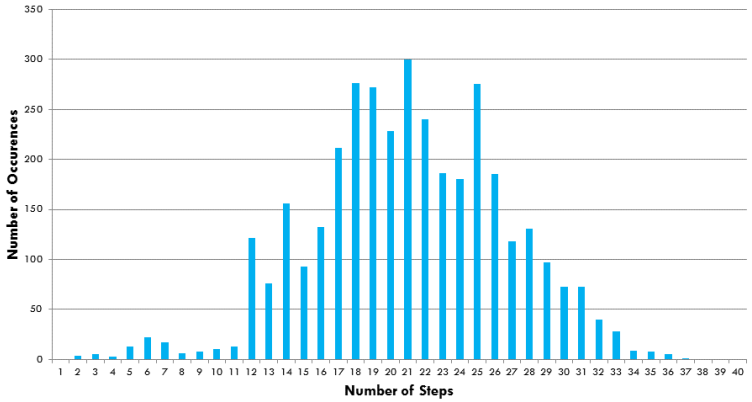
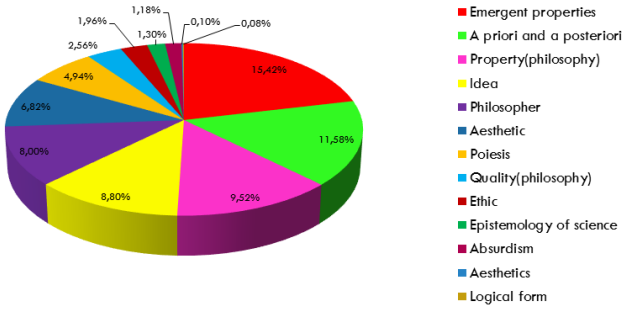
RESULTS

28% which fail lead to:
- Main Page
- Page without links

RESULTS



RESULTS



RESULTS

- Experiment repeated for 5000 randomly chosen articles
- Average number of clicks ≈ 21

HOW CAN ONE DESCRIBE SUCH AN OBSERVATION?

Philosophy (from Greek φιλοσοφία, philosophia, literally „love of wisdom") is the study of **general** and **fundamental** problems concerning matters such as existence, knowledge, values, reason, mind, and language.

Wikipedia

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CONCLUSION

- If the task from the assignment is followed literally, it rarely leads to *Philosophy*
  - The number of links which lead to *Philosophy* is too small to make a conclusion
- If first links which lead to loops are ignored
  - Both hypotheses are correct
  - Hypothesis 1:
    More than half of all articles will lead to *Philosophy*
  - Hypothesis 2:
    If it's possible to reach *Philosophy*, it can be done in under 50 clicks
- Philosophy – general and fundamental

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POSSIBILITIES FOR FUTURE WORK

- Downloading all Wikipedia articles for individual testing
- Drawing a tree diagram which represents all the connections to *Philosophy*
- Speeding up the program
- Testing for articles other than *Philosophy*

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LITERATURE AND SOURCES

- https://en.wikipedia.org/wiki/Wikipedia:FAQ/Technical#random, accessed on: 01.02.2018., 17:56
- https://computer.howstuffworks.com/internet/basics/wiki1.htm, accessed on: 01.02.2018, 16:34
- http://www.findingdulcinea.com/guides/Technology/Wikipedia.xa1.html, accessed on: 01.02.2018. 15:22

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THANK YOU!

Team Croatia

Reporter: Andrej Todic

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ADDITIONAL SLIDES

```
import http.client
from html.parser import HTMLParser

dic = {}
link_test = ''
dic_num = {}

failure = 0
sum_of_steps = 0

file_1 = open("output_5.txt", "w")
file_2 = open("direct_links_5.txt", "w")

class MyHTMLParser(HTMLParser):
    href_var = ''
    flag_1 = 0
    num = 0
    l = []
    flag_2 = 1
```

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ADDITIONAL SLIDES

```
def handle_starttag(self, tag, attrs):
    if tag == 'p':
        self.flag_1 = 1

    if tag == 'td':
        self.flag_2 = 0

    if tag == 'a' and self.flag_1 and self.flag_2:
        for name, value in attrs:
            if name == "href" and self.num == 0:
                if "IPA" not in value and "." not in value and "#" not in value:
                    if "Latin" not in value and "Greek" not in value
                        if "Mathematic" not in value and value != "/wiki/Truth":
                            self.href_var = value
                            self.l.append(self.href_var)
                            self.num += 1

def handle_endtag(self, tag):
    if tag == 'p':
        self.flag_1 = 0

    if tag == 'td':
        self.flag_2 = 1
```

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ADDITIONAL SLIDES

```
for number_of_iterations in range(10000):
    link = '/wiki/Special:Random'
    counter = 0
    flag = 0
    array = []

    while link != '/wiki/Philosophy':
        conn = http.client.HTTPSConnection("en.wikipedia.org")
        allow_redirects = True
        conn.request("GET", link)
        r1 = conn.getresponse()

        while r1.status != 200: #status 200 means that the link has been found
            link = r1.getheader('Location')
            conn.close()
            conn = http.client.HTTPSConnection("en.wikipedia.org")
            conn.request("GET", link)
            r1 = conn.getresponse()
```

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ADDITIONAL SLIDES

```
if flag == 0:
    starting_link = link
    flag = 1

if link in dic_num.keys():
    counter += dic_num[link]
    break

if link in dic.keys():
    link = dic[link]

else:
    code = str(r1.read())
    parser = MyHTMLParser()
    parser.feed(code)

    link_test = parser.href_var

    if link_test == '/wiki/Philosophy':
        direct_link = link

    dic.update({link : link_test})
    link = link_test


counter += 1
conn.close()
```


ADDITIONAL SLIDES

```
    if link in array:
        counter = -1
        break

    array.append(link)

dic_num.update({starting_link : counter})
file_1.write('Address: {}'.format(starting_link))
file_1.write('\t')
file_1.write('Number of clicks: {}'.format(counter))
file_1.write('\n')

if counter == -1:
    failure += 1

else:
    sum_of_steps += counter
    file_2.write(direct_link)
    file_2.write('\n')
```


ADDITIONAL SLIDES

```
file_1.write('\n')
file_1.write('\n')
file_1.write('Number of iterations: {}'.format(number_of_iterations))
file_1.write('\n')
file_1.write('Average number of clicks: {}'.format(sum_of_steps / (number_of_iterations - failure)))
file_1.write('\n')
file_1.write('Probability of success: {}'.format((number_of_iterations - failure) / number_of_iterations))
file_1.close()
file_2.close()
```

PROBLEM 3:ANNOYING FOREGROUND OBJECT

Team Croatia
Reporter: Luka Mikšić

PROBLEM 3:ANNOYING FOREGROUND OBJECT

- Look at a flat photograph. What **methods** allow you to tell which objects were **closer** and which were **farther** from the camera when the shot was taken? **Design and create** a photograph that violates the intuitive judgment of relative distances. "

2

DEMONSTRATION OF THE PHENOMENON

Smaller object
4 cm

Bigger object
5 cm

3

8

OUTLINE

Theoretical introduction
- The perceived size of an object
- Lenses

Experiment
- Experiment 1-Ratios
- Experiment 2-Re-enactment of experiment
- Experiment 3-Ratios 2

Results
- Discussion- designed experiment
- Conclusion

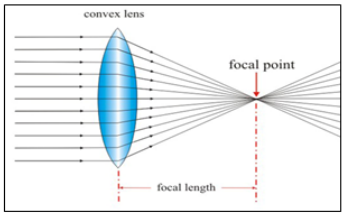
4

THEORETICAL SLIDE

The perceived size of an object depends on:
- the visual angle subtended by the object- the visual angle is decided by the size of an object and its distance from the observer
- perspective (the Ames Distorted Room)

5

LENSES

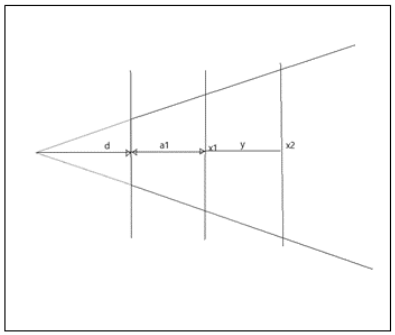


- there are 2 types of lenses: concave and convex
- they are the ones used in cameras

PERSPECTIVE PROJECTION

- $y = (d + a1) \times \left(\frac{x2}{x1} - 1\right)$

- y-from smaller to bigger cube
- d- imaginary value (distance behind)
- a1-from camera to smaller cube
- x1-size of smaller cube
- x2-size of bigger cube



HYPOTHESIS

1. Manipulate the human perception of size by moving **bigger objects further** away from the camera and putting **smaller objects closer**
2. I could make a **ratio** in witch we can **observe and predict** at what distance we would need to move away the bigger objects so they seem smaller
3. I will try to **re-enact** the Ames Distorted Room

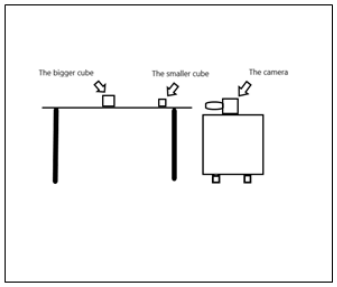
1ST EXPERIMENTAL SETUP

- 6 paper cubes➔1 to 6 cm tall
- Different distances from the camera
- Cubes- in **ratios** and kept **moving away** the bigger one by 5 cm until it seemed the same size as the smaller one

Setup for 1st experiment

2ND EXPERIMENTAL SETUP

- Camera and cubes➔ same level
- $y = (d + a1) \times \left(\frac{x2}{x1} - 1\right)$



The setup for 2nd experiment

10

MEASURING EXAMPLE➔ 1ST METHOD

- Ratio-4:5
- **Basic distance of 20 cm from the camera**

Comparison at the same distance

5 cm separated

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MEASURING EXAMPLE➔ 2ND METHOD

- 4:5- 40 cm from the camera
- 12,5 cm separated

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MEASURING EXAMPLE➔ 3RD METHOD

- I focused the camera on the further object
- Blurriness made the closer object seem larger

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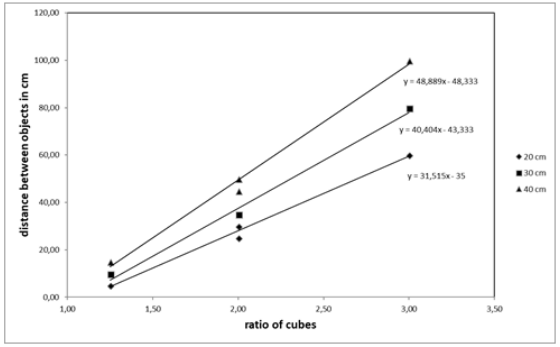
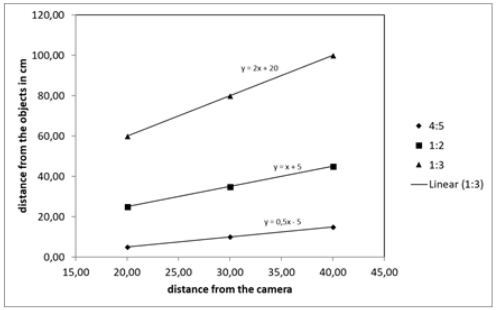
RESULTS



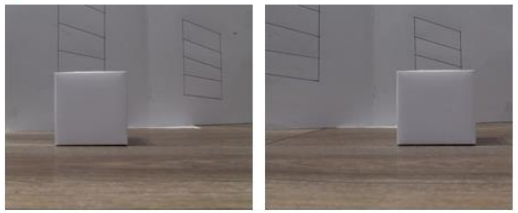
- d- calculated from graph

RESULTS



- Linear growth of distance between the objects with the distance from the camera

RE-ENACTMENT OF THE AMES DISTORTED ROOM



- Ames Distorted Room re-enactment doesn't work- the environment isn't familiar

CONCLUSION

1st method

- we can deceive human judgment of distance
- moving bigger objects farther

2nd method

- putting the camera at he same angle as cubes- more effective

3rd method

- focusing of the farther object we blur the closer one-it seems bigger
- The experiments confirms the theory

LITERATURE

- http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/lenseq
- http://glasnost.itcarlow.ie/~powerk/GeneralGraphicsNotes/projection/perspective_projection

THANK YOU!

Team Croatia
Reporter: Luka Mikšić

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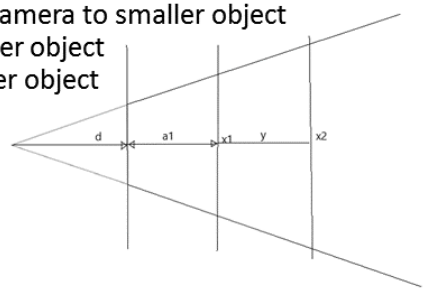
THE FORMULA USED-EXPLANATION

- $y = (d + a1) \times \left(\frac{x2}{x1} - 1\right)$
- Y-distance from smaller to bigger object
- D- imagine value(distance behind the camera)
- A1-distance from camera to smaller object
- X1-talness of smaller object
- X2-tallness of bigger object



20

4. MAKING QUARK

Team Croatia
Reporter: Ana Ćenan

1. MAKING QUARK

Quark, cottage **cheese**, and similar varieties of white acid-set cheese can be **produced** from **milk**. **Investigate** this **process** experimentally and study the **properties** of the resulting **product.**

2

OUTLINE

Theoretical introduction
- Quark cheese
- Chemical composition

Experiment
- Making of cheese
- Analysis

Results
- Chemical analysis
- Microbiological analysis

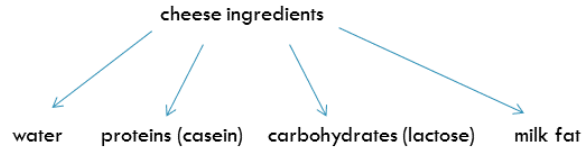
3

QUARK CHEESE

- Made out of milk
- Soft in consistency
- White color
- Fresh cheese

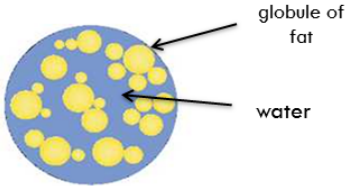
4

BASIC INGREDIENTS



5

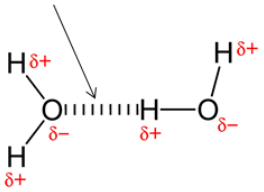
INGREDIENTS



- Milk fat – globules
  - flavour ingredients
  - vitamins dissolved
- Lactose - composed of glucose and galactose
  - lactic acid

Lactose

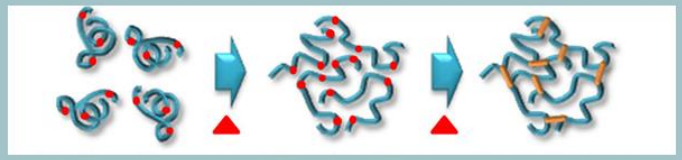
Hydrogen bond



- Protein (casein) - amino acid
  - coagulation
- Water – bounded
  - unbounded

DEMONSTRATION OF THE PHENOMENON

- Cheese production - coagulation of protein (curdling):
  - by the acid action (acetic acid) - sour curd



MAKING OF CHEESE MATERIALS AND METHODS

- Three types of milk (cow, goat, sheep)
- V(milk) = 3.5 L

PROCEDURE:

1. Heated up to boiling point
2. 30 ml of acetic acid (vinegar)
3. Whey was separated
4. Water squeezed out by applying weight

ANALYSIS OF CHEMICAL PROPERTIES

- Dry matter
- Milk fat
- pH
- Proteins

desiccator

analytical scale

centrifuge

test tubes

pH-meter

MICROBIOLOGICAL ANALYSIS

- Tested for:

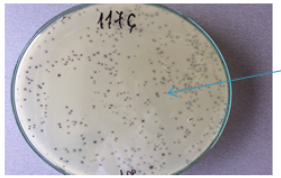
- Escherichia coli
- Enterobacteria
- Salmonella spp
- Listeria monocytogenes
- Staphylococcus aureus
- Yeasts
- Mold

medium for listeria and salmonella

petri dishes with samples

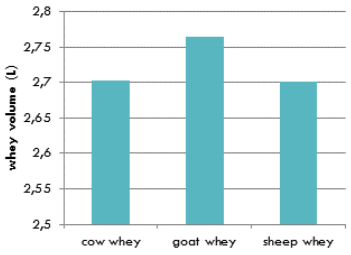
RESULTS - MICROBIOLOGICAL ANALYSIS

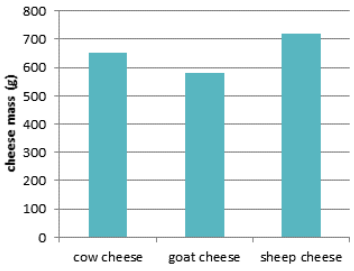
- Escherichia coli, Salmonella spp, Listeria monocytogenes, Staphylococcus aureus, yeast, mold – **absent** ☺
- Enterobacteria – low quantities found in cow cheese ($5.0x10^2$) ☹
- According to rule **food safety criteria** regulations all of the cheeses except cow cheese were **safe** to **eat**



colonies of bacteria found in cow cheese

RESULTS - WHEY VOLUME AND CHEESE MASS





RESULTS - CHEMICAL ANALYSIS

	Dry matter	Milk fat	pH	Proteins
Cow cheese	48,47%	27%	6,36	18.25%
Goat cheese	49,21%	26%	6,15	20.16%
Sheep cheese	49,55%	13%	6,09	21.34%

CONCLUSION

- Cow cheese → the most nutritious one
- Sheep cheese has the most dry matter and proteins, but has a small amount of milk fat
- Even a small amount of enterobacteria can be harmful
- Pasteurization is necessary to avoid food poisoning

LITERATURE

Lj.Tratnik, R. Božanić (2012): Mlijeko i mliječni proizvodi. Udžbenik, Hrvatska mljekarska udruga, Zagreb

Stilinović B., Hrenović J. (2009): Praktikum iz bakteriologije. Kugler, Zagreb, p. 199.
Juretić, N., 2002: Osnove biljne virologije, Školska knjiga, Zagreb, 319 str.

Prescott, L.M., Harley, J.P., Klein, D.A., 1996: Microbiology. WCB McGraw Hill, Boston.
Atlas, R. M., 1997: Principles of Microbiology. WBC McGraw-Hill, Boston.
Nester, E. W., Anderson, D. G., Roberts, C. E., Pearsall, N. N., Nester, M. T., 2001: Microbiology. McGraw-Hill, Boston.

Patrick F. Fox (February 28, 1999). Cheese: chemistry, physics and microbiology, Volume 1. Springer, 1999. p. 1. ISBN 978-0-8342-1338-8. Retrieved March 23, 2011.

THANK YOU!

Team Croatia
Reporter: Ana Ćenan

COAGULATION OF PROTEIN

- The basic difference in cheese production process is in coagulation of protein (curdling):

1. By the acid action sour curd is formed:

a) By milk souring under the influence of mesophilic culture (lactic acid bacteria and fermentation)

b) By addition of acetic or citric acid

2. By the action of proteolytic enzymes (this is usually used in making semi-hard and hard cheeses)

3. By the action of heat from 90 °C to 95 °C to in production of whey cheese

Microbiological analysis

	Cow milk	Goat milk	Cow whey	Goat whey	Cow cheese	Goat cheese
Escherichia coli	<1	<1	<1	<1	<10	<10
Enterobacteriaceae	$1.6 \cdot 10^2$	$7.6 \cdot 10^2$	$1.6 \cdot 10^1$	<1	$5.0 \cdot 10^2$	<10
Salmonella spp	absent	absent	absent	absent	absent	absent
Lichteria monocytogenes	absent	absent	absent	absent	absent	absent
Aerobic mesophilic bacteria	$1.9 \cdot 10^2$	$9.1 \cdot 10^2$	$2.3 \cdot 10^2$	9	$1.3 \cdot 10^4$	<10
Staphylococcus aureus	$2.1 \cdot 10^2$		<1		<10	<10
Yeasts	$1.1 \cdot 10^2$	<1	<1	<1	<10	<10
Mold	<1	<1	<1	<1	<10	<10

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KJELDAHL METHOD - PROTEINS

- method for the quantitative determination of nitrogen

- Degradation: $Sample + H_2SO_4 \longrightarrow (NH_4)_2SO_4(aq) + CO_2(g) + SO_2(g) + H_2O(g)$
- Liberation of ammonia: $(NH_4)_2SO_4(aq) + 2NaOH \longrightarrow Na_2SO_4(aq) + 2H_2O(l) + 2NH_3(g)$
- Capture of ammonia: $B(OH)_3 + H_2O + NH_3 \longrightarrow NH_4^+ + B(OH)_4^-$
- Back-titration: $B(OH)_3 + H_2O + Na_2CO_3 \longrightarrow NaHCO_3(aq) + NaB(OH)_4(aq) + CO_2(g) + H_2O$

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PROCESS OF DETERMINING MILK FAT

- weighing 3 grams of each cheese
- putting them in special test tubes with measures
- adding isomeric alcohol and sulfuric acid
- putting the sample in the centrifuge
- separation of the milk fat

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BACTERIAL GROWTH MEDIUM

- agar plates ➔ agar and nutrients
- unicellular organisms, blood serum, ammonium salts or glucose can be added

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PH METER

- Measures the concentration of hydroden ions in the sample

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5.COLLISION

Team Croatia
Reporter: Grgur Premec

THEORY

A highly **elastic super ball collides** with a **rigid surface**. How can one determine the collision time? Propose **various techniques** and **compare** the experimental results.

- Explore different measuring methods
  - Analyse the results
  - Compare the methods

2

OUTLINE

Theoretical introduction
- Collision theory
- Accuracy and precision

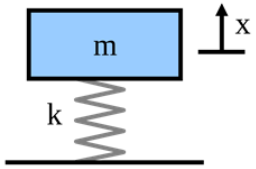
Experiment
- Ball as a switch
- Piezo element
- Force sensor

Results
- Individual results
- Comparison

3

THEORY

- Mass on a spring
- Collision time
  - Depends on the **mass** and the **stiffness** of the **ball** and **the impact surface**
  - Doesn't depend on the velocity



$$t = \pi\sqrt{\frac{m}{k}}$$

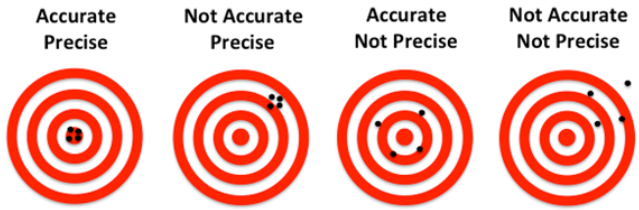
m - mass

k - elasticity coefficient

4

MEASUREMENT ERRORS

- Precision
  - The spread of individual data points
- Accuracy
  - The difference of data points and the actual value



5

HYPOTHESES

1. For a given measuring method the data points won't differ by much (parameters kept as constant as possible)

6

HYPOTHESES

1. For a given measuring method the data points won't differ by much (parameters kept as constant as possible)
2. Different measuring methods may exhibit significant differences

7

HYPOTHESES

1. For a given measuring method the data points won't differ by much (parameters kept as constant as possible)
2. Different measuring methods may exhibit significant differences
3. The DIY methods (electrical switch, piezo) will be less precise than the professional equipment (electronic dynamometer)

8

EQUIPMENT

- Elastic bouncy ball (Super Ball)
  - Diameter = 42.5 mm
  - Mass = 36 g
  - Coefficient of restitution 0.9341 ± 0.0066
    - Measured on ceramic tiles

$$e = \sqrt{\frac{h_{after\ impact}}{h_{before\ impact}}} = \sqrt{\frac{78.1\ cm}{89.5\ cm}} = 0.9341$$

9

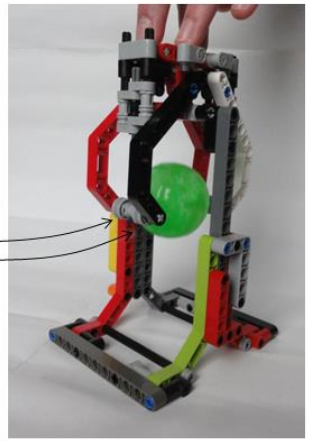
EQUIPMENT

- DSO Nano V2 **oscilloscope**
  - For measuring impact duration
  - 10 µs resolution

10

EQUIPMENT

- Lego ball dropping mechanism
  - Constant height (75 mm)
  - Precise landing
  - Roller bearings



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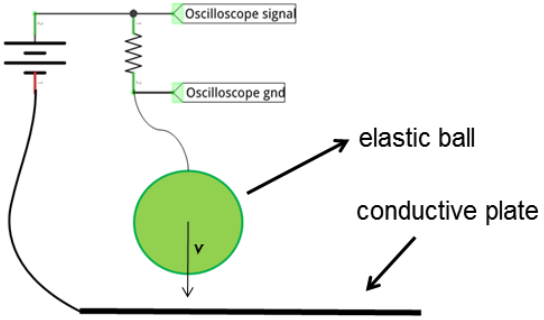
METHOD 1: CONDUCTIVE BALL

- Measuring the **time** interval during which the **circuit is closed**



- Problem: the ball is not conductive

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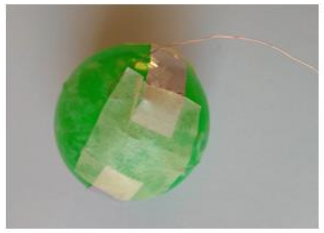
METHOD 1: FIXING THE PROBLEM

- Ball as a switch
  - Wrapped in a thin strip of aluminum foil
  - Connected to the electrical circuit with 0.25 mm wire
    - Very small influence on the the collision



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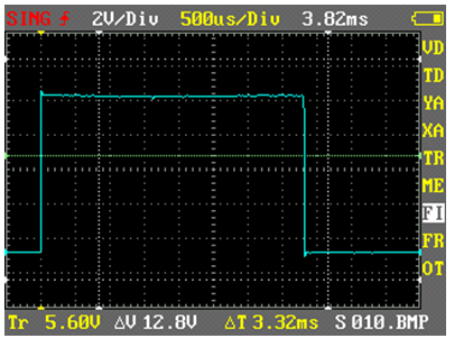
METHOD 1: MEASUREMENT EXAMPLE

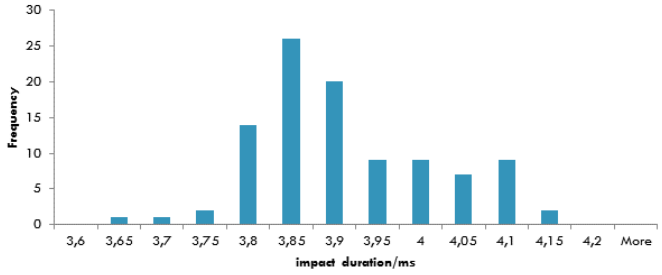


Oscilloscope screenshot

- 100 measurements
- Impulses
  - Clean edges
  - Square shape

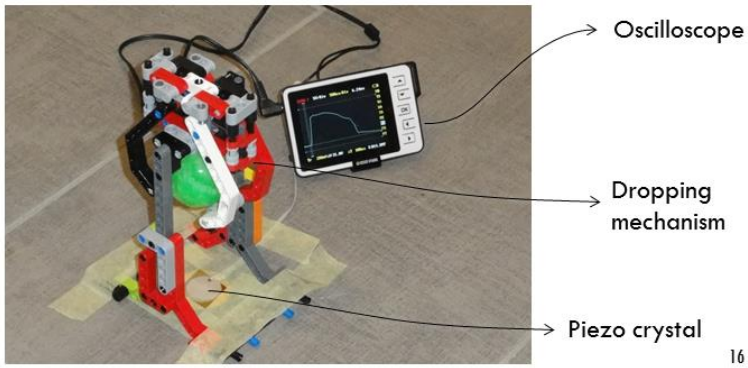
METHOD 1: RESULTS

- Results
  - Mean: 3.89 ms
  - Standard deviation 0.106 ms



METHOD 2: EXPERIMENTAL SETUP

- Floor: ceramic tiles on concrete

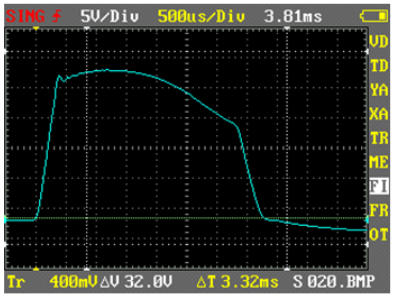


METHOD 2: EXPERIMENTAL SETUP

- Piezoelectric crystal
  - Taped to the floor and centered under the mechanism
  - Wires secured to the floor
    - Movement of wires deformes the crystal so voltage is induced

METHOD 2: MEASUREMENT EXAMPLE

- 100 measurements
- Impulses not as rectangular



Oscilloscope screenshot

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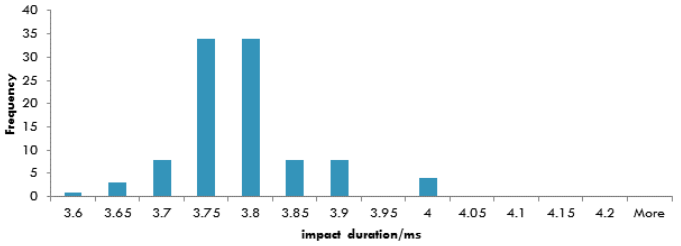
METHOD 2: RESULTS

- Results
  - Mean: 3.77 ms
  - Standard deviation: 0.07 ms
- Narrower distribution



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8

METHOD 3: FORCE SENSOR

- Vernier force sensor
  - Measuring force during collision
  - Professional equipment

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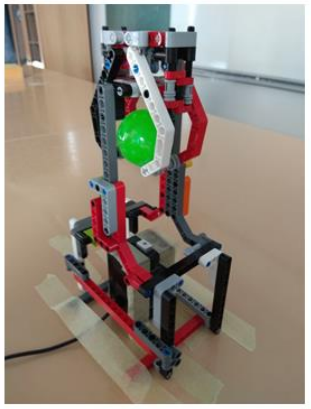
METHOD 3: EXPERIMENTAL SETUP

- Force sensor
  - Taped to the floor
  - Centered precisely under the ball
- Modified ball dropping mechanism
  - Accomodate for additional sensor height



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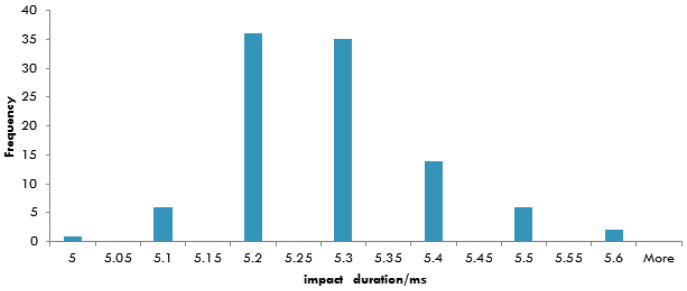
METHOD 3: RESULTS

- Mean: 5.291 ms
- Standard deviation: 0.143 ms
- Wider distribution



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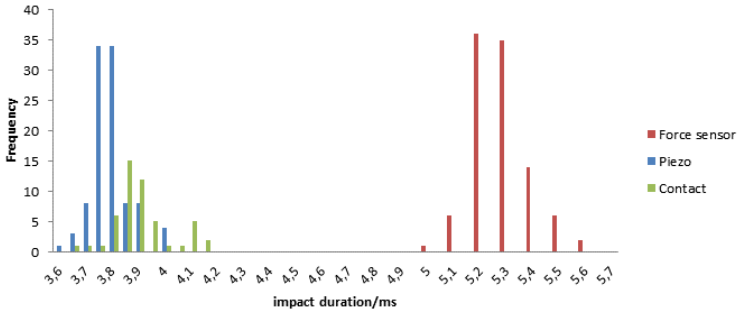
COMPARISON



- The piezo and the contact measuring methods give similar results, the force sensor is different
  - Force sensor is less rigid or accurate

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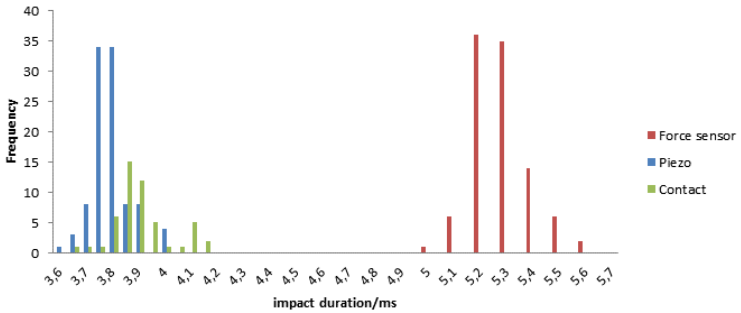
COMPARISON



- The piezo is the most precise (tightest distribution), followed by the contact sensor and than the force sensor

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CONCLUSION

- For a given measuring method the data points won't differ by much (parameters kept as constant as possible) ✓
  - All of the methods have small standard deviations
- Different measuring methods may exhibit significant differences ✓
  - The force sensor has the widest distribution
  - The impact plate seem to have some flex that influences the impact duration
- The DIY methods (electrical switch, piezo) will be less precise than the professional equipment (electronic dynamometer) ✗
  - The piezo element was the most precise method

25

LITERATURE

https://commons.wikimedia.org/wiki/File:Mass_spring.svg

Walker, Jearl (2011). Principles of Physics (9th ed.). Hoboken, N.J. : Wiley. ISBN 0-470-56158-0.

Thornton, Stephen T.; Marion, Jerry B. (2003). Classical Dynamics of Particles and Systems (5th ed.). Brooks Cole. ISBN 0-534-40896-6.

John R Taylor (2005). Classical Mechanics. University Science Books. ISBN 1-891389-22-X.

Grant R. Fowles; George L. Cassiday (2005). Analytical Mechanics (7th ed.). Thomson Brooks/Cole. ISBN 0-534-49492-7.

https://www.dnasoftware.com/our-products/copycount/precision-and-accuracy/

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THANK YOU!

Team Croatia
Reporter: Grgur Premec

IYNT Tbilisi 2018

COEFFICIENT OF RESTITUTION

- Measuring stick
- Filmed in slow motion
  - 120 fps using a phone
- Dropped from the same height

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ADDITIONAL SLIDES

- Done some other cool stuff, but couldn't put everything in the presentation?
- The whole theory behind your problem can't fit into five slides?
- You have an idea what your opponent might ask?
- Put it all in the additional slides!
- Their number is unlimited :)

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6. EYE COLOR

Team Croatia
Reporter: Ana Ćenan

6. EYE COLOR

In certain human populations, genetics allows predicting inheritance of **eye color** among **family members**. In other **populations** of the present day World, nearly **everyone** has **the same eye color**. What **information** is it possible to determine about the eye colors in both distant and **close ancestors**, **descendants**, and relatives of one living **person**?

2

OUTLINE

Theoretical introduction
- Mendel's Laws
- Basics about eye colour

Experiment
- Methods and measurements
- Data processing

Results
- **Conclusions**

3

MENDEL´S LAWS

- Law of segregation
- One allele we get from our **mother** and one from our **father**
- **Homozygous** – identical pair of alleles
- **Heterozygous** – two different alleles
- **Two types of alleles:**
  - dominant
  - recessive

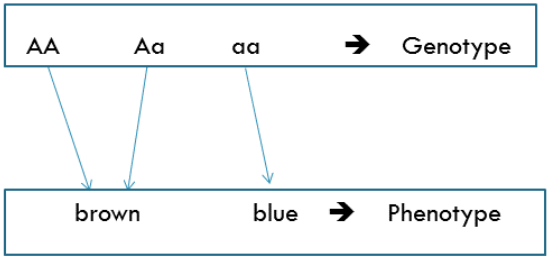
4

EYE COLOR

- Heritable characteristic determined by production of melanin in the iris
- **Blue** eye color – **recessive** characteristic
- **Brown** eye color – **dominant** characteristic

5

GENOTYPE VS PHENOTYPE



6

HYPOTESES

1. Eye color is **not** determined by **one gene only**
2. **Inheritance** of eye color does **not depend** on the **gender** of a person

7

METHODS AND MEASUREMENTS

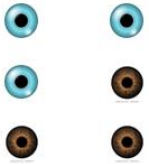
- **Questionnaire**
- 5th to 8th grade students
- One questionnare – one family
- Categorized to **three groups** by parent´s eye color

questionnaire

8

QUESTIONNARE GROUPS

- blue-blue
- blue-brown
- brown-brown



questionnare sorted by categories

9

RESULTS

DESCRIPTION	TOTAL (n)
NUMBER OF QUESTIONNARS	163
NUMBER OF CHILDREN	475
NUMBER OF GIRLS	215
NUMBER OF BOYS	260

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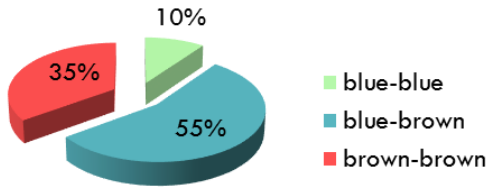
RESULTS

- percentage of children in different parental groups



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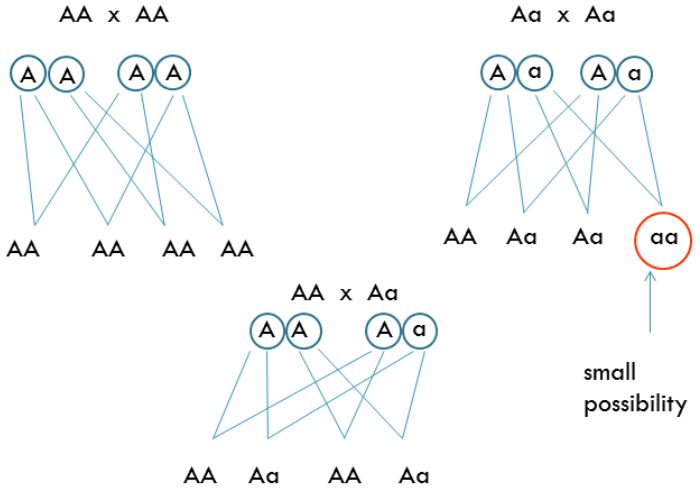
BROWN-BROWN



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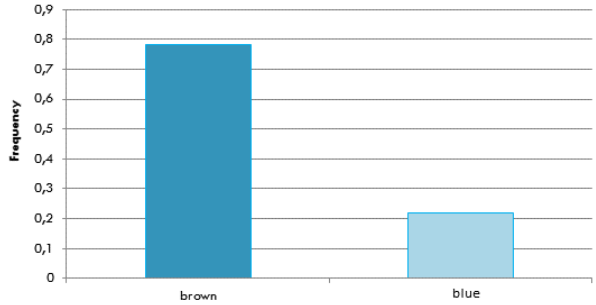
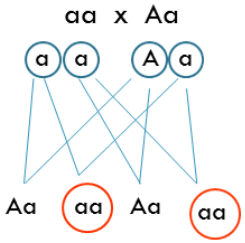
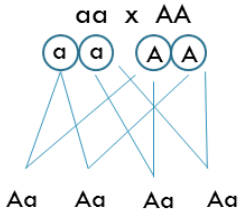
RESULTS: BROWN-BROWN



13

BLUE-BROWN





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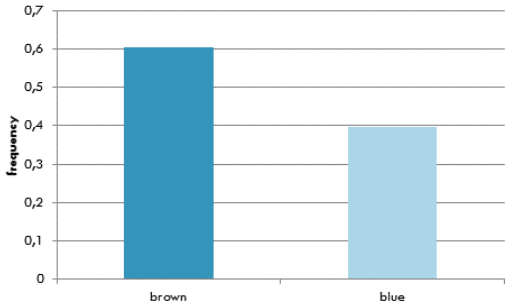
RESULTS: BLUE-BROWN GROUP



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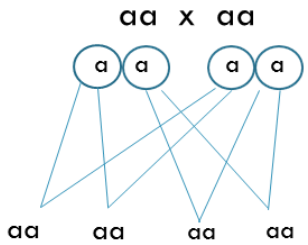
BLUE-BLUE



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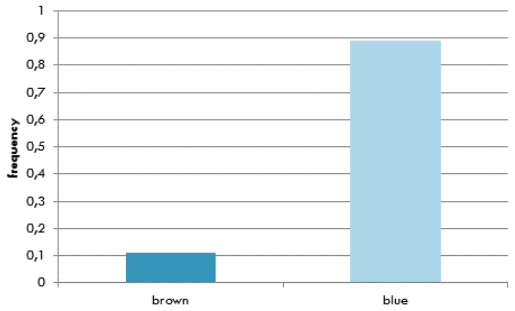
RESULTS: BLUE-BLUE GROUP



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IS THERE ANY DIFFERENCE BETWEEN GENDER?

brown-brown	male	female	sum	
brown	59 58	70 71	129	
blue	15 16	21 20	36	$\chi^2 = 0{,}1438$
	74	91	165	

brown-blue	male	female	sum	
brown	79 72	81 88	160	
blue	40 47	65 58	105	$\chi^2 = 3{,}1246$
	119	146	265	

blue-blue	male	female	sum	
brown	2 2	3 3	5	
blue	20 20	20 20	40	$\chi^2 = 0$
	22	23	45	

- Expected value
- Observed value

- Degrees of freedom: 1
- there is no difference between males and females

CONCLUSION

- Eye color does not depend on one gene ✓
- The inheritance of eye color does not depend on gende ✓
- For future research: determination of the genotype

LITERATURE

1. http://www.genetika.biol.pmf.unizg.hr/pogl2.html (1. 12. 2017.)
2. http://www.genetika.biol.pmf.unizg.hr/pogl3.html (5. 12. 2017.)
3. Cochran, William G. (1952). "The Chi-square Test of Goodness of Fit". The Annals of Mathematical Statistics. 23: 315–345. doi:10.1214/aoms/1177729380. JSTOR 2236678

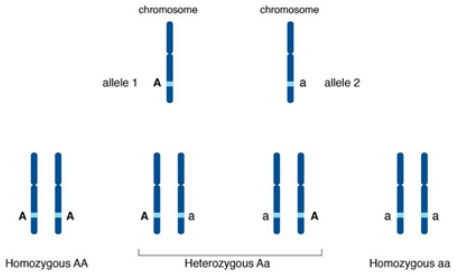
THANK YOU!

Team Croatia
Reporter: Ana Ćenan

IYNT Tbilisi 2018

ALLELES

- Genetic sequence
- An alternative form of a gene
- Located on a lokus of a chromosome



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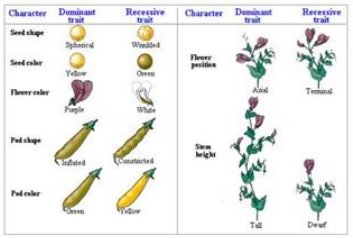
GREGOR MENDEL

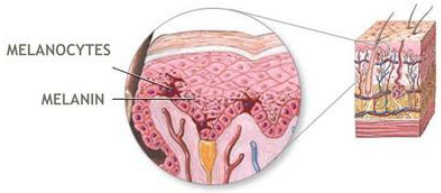
- Known as the "father of modern genetics„
- Experimented with pea plants
- Studying seven traits of pea plants
- His paper was criticized at the time
- It was later rediscovered



23

MELANIN

- Natural pigment
- Found in nails, skin, iris and hair
- Produced in melanocytes – the specialised group of cells



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X^2 TEST

Chi-Square (χ^2) Distribution
Area to the Right of Critical Value

Degrees of Freedom	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01
1	—	0.001	0.004	0.016	2.706	3.841	5.024	6.635
2	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210
3	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345
4	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277
5	0.554	0.831	1.145	1.610	9.236	11.071	12.833	15.086
6	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812
7	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475
8	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090
9	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666
10	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209
11	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725
12	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217
13	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688
14	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141
15	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578
16	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000
17	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409
18	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805
19	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191
20	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566
21	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932
22	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289
23	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638
24	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980
25	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314
26	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642
27	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963
28	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278
29	14.257	16.047	17.708	19.768	39.087	42.557	45.722	49.588
30	14.954	16.791	18.493	20.599	40.256	43.773	46.979	50.892

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

25

Problem 7: Worms

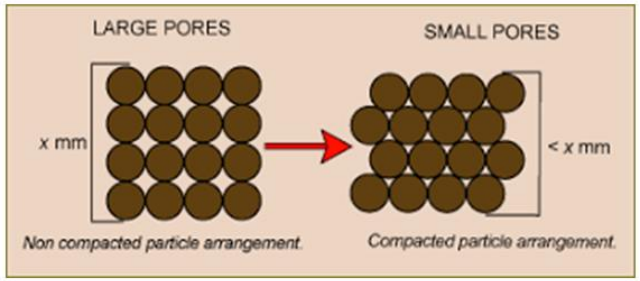
Team Croatia
Reporter: Luka Mikšić

Problem 7: Worms

- „Earthworms change the **mechanical** properties of soil and make the soil more **porous.** Investigate this process and introduce **quantitative parameters.** "

2

DEMONSTRATION OF THE PHENOMENON



3

OUTLINE

Theoretical introduction
- Earth worms
- Common earthworm (*Lumbricus terrestris Linnaeus*, 1758)

Experiment
- Experiment 1
- Experiment 2

Results
- Percentage of water and water flow
- Porosity

4

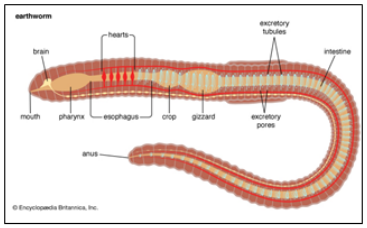
Earth worms

- Oligochaetes→subclass of the Clitellate
- Habitation: **land waters and the land**
- live in the sediment or in the ground

5

Common earthworm (*Lumbricus terrestris Linnaeus*, 1758)

- processes large amounts of organic substances mixed with soil in the digestive tract
- creating humus important in the process of mineralization of organic matter
- enable **better airiness**, **texture** and soil **structure**



6

HYPOTHESES

Greater number of worms➔

- increase in porosity
- increase in humidity
- increase in water flow

There is going to be a **optimal number** and **limit** of the worms

7

First experiment

- 3 wooden boxes 25x25x30 cm
- each box-clay soil mixed with herbal material (400 g) and humus (100 g)
- 1st box- earthworms, 2nd- 25 and the 3rd- 50
- Temperature was 20 ° C (± 2°)
- During 28 days 500ml of water was added every 48 hours

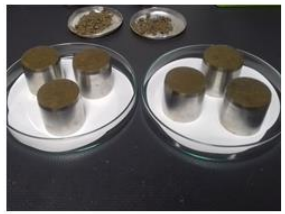
8

FIRST EXPERIMENT

- Sampling → Kopecky cylinder
- Measurements:

Porosity formula: $P = (1-\frac{p_v}{p_s}) \times 100$

p_v-volume density
p_s-solid soil density



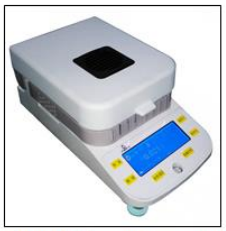
Kopecky cylinder

9

FIRST EXPERIMENT

Humidity- by drying the soil and weighing it

Water flow- by using the permeameter

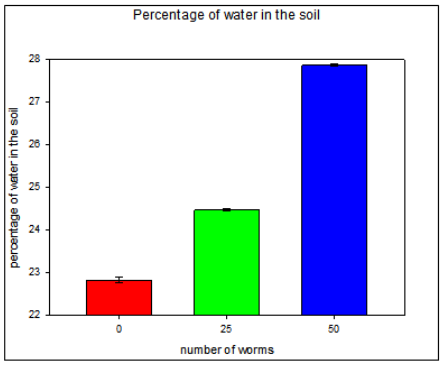


infrared halogen moisture analyser

10

laboratory permeameter by Eikelkamp

RESULT-PERCENTAGE OF WATER IN THE SOIL



1st and 2nd box
→water evaporated faster because capillarity established

3rd box
→earthworm activity and their secretion of slime disarranged the establishment of capillarity and water evaporated slower

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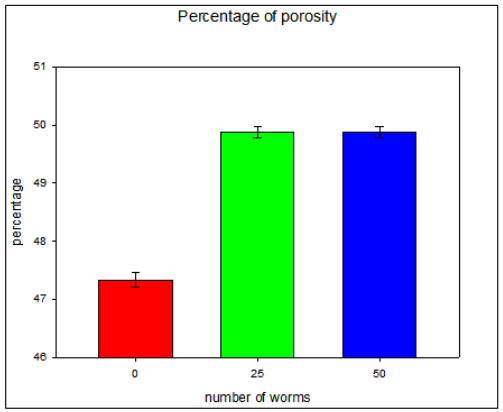
PERCENTAGE OF POROSITY



1st box → no earthworms
= control (47.3%)

2nd box → 25 earthworms
= increase in the porosity of the soil for 2.55%

3rd box → 50 earthworms
= no difference in porosity comparing to 2nd box

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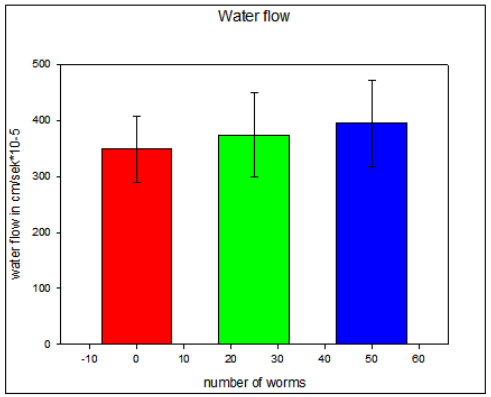
WATER FLOW



1st box → no earthworms
= control(286.8 cm/sek*10-5)

2nd box → 25 earthworms
= increase in the water flow by 14 cm/sek*10-5

3rd box → 50 earthworms
= increase in the water flow by 18.2 cm/sek*10-5

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CONCLUSION

- The greater number of earthworms **increased water flow** and **percentage of water** in the soil making greater area of the soil rich with the minerals from the water and increasing chance of life in the area
- Maximum porosity was reached with 25 worms
- 50 worms destroyed each another's pores and the result was the same as with the 25 worms

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POSSIBILITIES OF FURTHER WORK

- Research how do worms effect the soil in time periods?
- Research how do the worms effect different types of soil ?
- Discover the perfect ratio of soil and worms?

15

LITERATURE

- http://www.gf.uns.ac.rs- 24.4.2018
- http://www.vguk.hr/- 24.4.2018
- http://ljesnjak.pfos.hr/~jdanijel/literatura/OBsK/OBsK-_07%20Osnovne%20znacajke%20tla.pdf-24.4.2018

16

THANK YOU!

Team Croatia
Reporter: Luka Mikšić

KOPECKY CYLINDER

- The cylinder has a cover and a mesh of the appropriate diameter on
- both sides. When the sample is taken, the cylinder is placed on the
- ground with a sharp edge and the top of the cylinder is lightly hammered
- to pass through the ground, then the ground around the cylinder is ripped
- to make the sample easier to separate. On both sides of the cylinder, the
- sample is straight and covered with a mesh and lid.

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WATERFLOW MEASURING

- Waterflow is measured in certain conditions where water flows through a sample of soil in the permeameter.
- The sample of soil is put in the cylinder which is under constant pressure and water is flowing.

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POROSITY MEASURING

- DEFINITION: Soil density is a number that shows how many times a volume of soil is weighing or lighter than of the same volume of water. We differentiate the volume density of soil (ρ) and the density of solid particles (ρ v). Relationship between mass of completely dry soil (Mst) and its volume in natural state represents the volume density of soil (100 cm 3 for Kopeck cylinder), and if ground mass is distributed with its pore volume (Vt) then it is the density of solid particles of soil

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POROSITY MEASURING

- Volumetric density □v = Mst / 100, g / cm 3. The values of the volume density with the depth increase and are usually within the range of 1.0 to 1.6 Solid particles density Determination method: Fully dry soil, dried at 105 ° C, is crushed in tarionica, sifted through the sieve, and then pull 10 g into the ceramic bowl. 30 ml of distilled water and cooking is added with a light mixing with a glass burner stomach for the purpose of removing air. The soil and water suspension must be cooled, transferred to a pycnometer, supplemented by a pycnometer distilled water, close with the clogged mash, temper and dip.

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POROSITY MEASURING

- The pierced piknometer is filled with boiled distilled water, it also temperates and is effective. The volume of non-porous soil mass is calculated according to the following equation: Vt = (Tp + 10) - Tpt, cm 3 where: Tp - weight of the pycnometer with water Tpt - weight of the pycnometer with water and soil together. P = 10 / Vt, g / cm 3 Hard particle density values range from 2.4 to 2.9. Fair and volume density soils have a very wide application in practice, so they are used, for example, to calculate the weight organic soil layer, then in calculating physiologically active nutrients in the soil, for calculation of hydropedological constants, transformation of mass. % moisture in soil in volume, calculating the amount of organic matter in soil, total porosity and the like.

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SECOND EXPERIMENT

- measuring the water flow in a simpler way
- 5 containers ➔ same soil conditions as in the first experiment, but containers with holes at the bottom
- 3 worms in each of them, every 3 days - 500 ml of water in the soil to see how much water passed through
- From these results we can see how does water flow change over time

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8. FAIR COIN

Team Croatia
Reporter: Marko Šarić

8. FAIR COIN

In many cases, disputes are resolved with a **coin toss**. It is presumed that this procedure gives **equal chances** of winning to both sides. Investigate how the chances depend on the **tossing mechanism** and the **coin properties.**

DEMONSTRATION OF THE PHENOMENON

https://dribbble.com/shots/3535524-Coin-Toss-Animation

OUTLINE

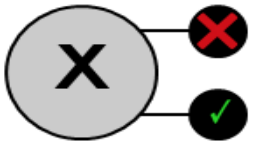
Theoretical introduction
- Bernoulli's distribution
- Statistical test χ^2

Experiment
- Equipment and setup
- Changing parameters:
- Height, Bulge, Hole
- Throwing method

Results

BERNOULLI'S DISTRIBUTION

- used in modeling random features that can have exactly **two values**



- p - **probability** of success $X = \begin{pmatrix} 0 & 1 \\ q & p \end{pmatrix}, p \in \langle 0,1 \rangle$

$$q = 1 - p$$

STATISTICAL TEST χ^2

$$\chi^2 = \sum \frac{(f_0 - f_t)^2}{f_t}$$

- 2 options → 1° of freedom
- $D_i < 0{,}05\ (5\%) \rightarrow \chi^2 < 3{,}841$

f_0 - observed frequency
f_t - expected frequency
χ^2 - deviation of expected frequency

6

HYPOTHESIS

1 Tossing **height** is **not important** when tossing coins.

2 By **increasing** the **number of throws** the **deviation** will **decrease**.

3 When throw coins **vertically** chanses of winning will be **closer** to 50:50, than the **horizontally** tossing.

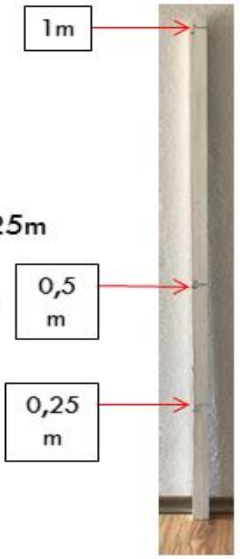
4 If the coin has a **bulge** on one side it will more often turn to the **other side** and if we toss a coin **without the bulge** the deviation will be **smaller**.

5 **Hole** in the middle will **not** have **affect** on chanses of winning for any side.

7

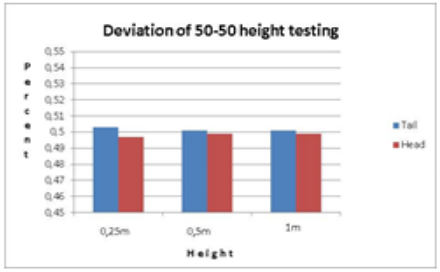
EXPERIMENTAL SETUP

- Three heights: 1m, 0.5 m, 0.25m
- Free fall (tail facing up)
- 10 lipa coin → 1000 throws



8

HEIGHT TESTING



- Height does not affect chances of winning

Height testing			
1m	χ^2=0,004	χ^2<3,841	✓
0,5m	χ^2=0,004	χ^2<3,841	✓
0,25m	χ^2=0,036	χ^2<3,841	✓

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VERY SMALL HEIGHT

- 10 lipa coin
  20 mm in diameter
- Free fall
  (head facing up)
- 100 throws → the head appeared 100 times

Hypothesis 1 ✗

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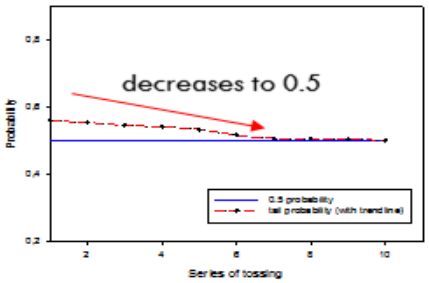
PROBABILITY-TOSS NUMBER DEPENDENCE



By increasing the number of throws the deviation decreases.

Hypothesis 2 ✓

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WAY OF THROWING

- 10 lipa coin → 1000 throws → 0,5m
- horizontally

- vertically

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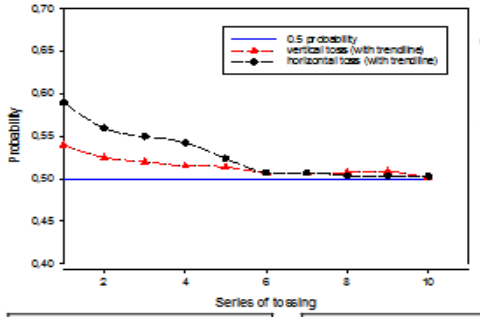
HORIZONTALLY VS VERTICALLY



- **Tail** appeares more **often** on **horizontal** toss
- In horizontal throws **side** which is facing **up** is **more probable** to appear

Hypothesis 3 ✓

horizontally			vertically		
χ^2 =0,016	χ^2 < 3,841	✓	χ^2 =0,004	χ^2 < 3,841	✓

>

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COIN WITH A BULGE VS SYMMETRICAL COIN

- **quarter American dollar** with a bulge on the head side (George Washington)
- **hundred Italian lira** (from 1955 to 1989) without a bulge
- 0,5 m → 1000 throws

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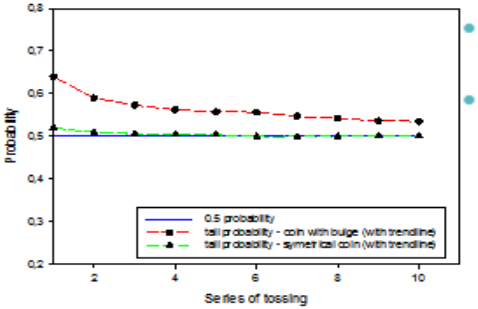
COIN WITH A BULGE VS SYMMETRICAL COIN



- Head is heavier so the tail faces up more often
- Symmetrical coin fals on both sides with the almost same frequency

vertically		
$\chi^2 = 4{,}9$	$\chi^2 > 3{,}841$	✗

Hypothesis 4 ✓

Symmetrical coin		
$\chi^2 = 0{,}004$	$\chi^2 > 3{,}841$	✓

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COIN WITH A HOLE

- **five-crown Norwegian coin** → hole in the middle
- 0,5 m → 1000 throws horizontally (tail facing up)

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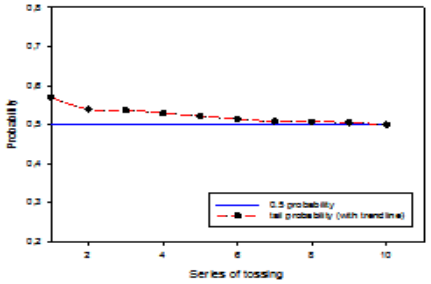
COIN WITH A HOLE



- Hole in the coin does not affect the outcome

Hypothesis 5 ✓

Coin with a hole		
$\chi^2 = 0{,}004$	$\chi^2 > 3{,}841$	✓

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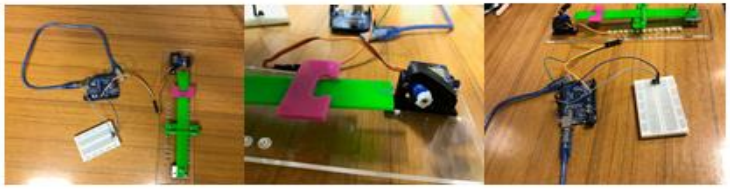
EXPERIMENTAL SETUP



- 1kuna coin→ 500 throws
- 363-tail
- 137-head

Coin with a hole		
$\chi^2 = 102{,}152$	$\chi^2 > 3{,}841$	✗

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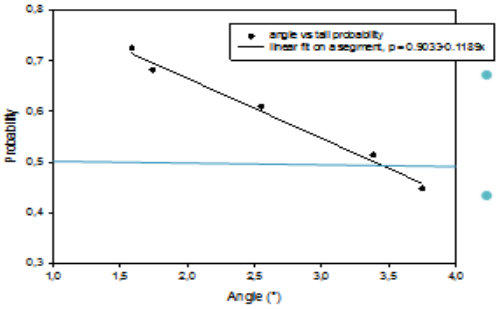
DEVIATION-ANGLE DEPENDENCE



- By increasing the angle side which is facing down gets more probable to appear.
- 3,38732°→ chances of winning for this setup are 50:50

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CONCLUSION

1-Tossing height is not important when tossing coins. ✗

- Height of throwing does not affect the result until it is smaller than coins diameter.

2-By increasing the number of throws the deviation will decrease. ✓

3-When throw coins vertically chanses of winning will be closer to 50:50, than the horizontally tossing. ✓

20

CONCLUSION

4-If the coin has a bulge on one side it will more often turn to the other side and if we toss a coin without the bulge the deviation of 50:50 will be smaller. ✓

5-Hole in the middle will not have affect on chanses of winning for any side. ✓

By increasing the angle of coin toss side which is facing down gets more probable to appear.

21

LITERATURE

- https://ldap.zvu.hr/~oliverap/VjezbeIzStatistike/8_Hi-kvadrat%20vje%C5%BEbe.pdf (1.3.2018.)
- https://www.mathos.unios.hr/uvis/poglavlje2.pdf (30.1.2018.)

THANK YOU!

Team Croatia
Reporter: Marko Šarić

IYNT Tbilisi 2018

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ADDITION

k	0,99	0,98	0,95	0,90	0,80	0,50	0,20	0,10	0,05	0,02	0,01	0,001
1	0,000	0,001	0,004	0,016	0,064	0,455	1,642	2,706	3,841	5,412	6,635	10,828
2	0,020	0,040	0,103	0,211	0,446	1,386	3,219	4,605	5,991	7,824	9,210	13,816
3	0,115	0,185	0,352	0,584	1,005	2,366	4,642	6,251	7,815	9,837	11,345	16,266
4	0,297	0,429	0,711	1,064	1,649	3,357	5,989	7,779	9,488	11,668	13,277	18,467
5	0,554	0,752	1,145	1,610	2,343	4,351	7,289	9,236	11,070	13,388	15,086	20,515
6	0,872	1,134	1,635	2,204	3,070	5,348	8,558	10,645	12,592	15,033	16,812	22,458
7	1,239	1,564	2,167	2,833	3,822	6,346	9,803	12,017	14,067	16,622	18,475	24,322
8	1,646	2,032	2,733	3,490	4,594	7,344	11,030	13,362	15,507	18,168	20,090	26,124
9	2,088	2,532	3,325	4,168	5,380	8,343	12,242	14,684	16,919	19,679	21,666	27,877
10	2,558	3,059	3,940	4,865	6,179	9,342	13,442	15,987	18,307	21,161	23,209	29,588

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MASS AND SIZE OF A COIN

- 5 kuna coin
- 1 kuna coin
- 10 lipa coin

- 1000 throws vertically
- 0,5 m

	Mass	Diameter
10 lipa	3,25 g	20 mm
1 kuna	5 g	22,5 mm
5 kuna	7,4 5 g	26,5 mm

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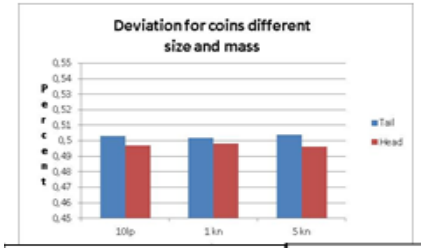
MASS AND SIZE OF A COIN

- Mass and size of a coin do not affect the outcome



10lp			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	503	500	0.018
head	497	500	0.018
		χ^2:	0.036

1kn			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	502	500	0.008
head	498	500	0.008
		χ^2:	0.016

5kn			
f	f_0	f_1	$\frac{(f_0-f_t}{f_t}$
Tail	504	500	0.032
head	496	500	0.032
		χ^2:	0.064

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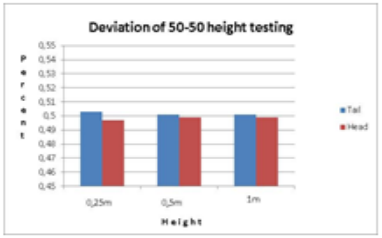
First height (0.25m)			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	503	500	0.18
Head	496	500	0.18
		χ^2:	0.036

Third height (1m)			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	501	500	0.002
Hea d	499	500	0.002
		χ^2:	0.004

Second height (0,5m)			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	501	500	0.002
Hea d	499	500	0.002
		χ^2:	0.004



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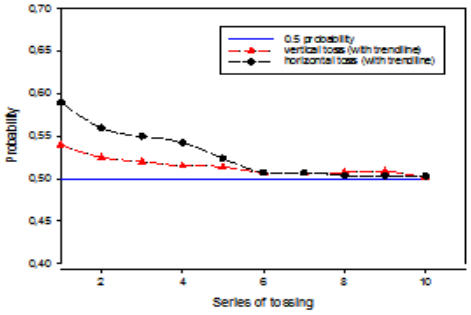
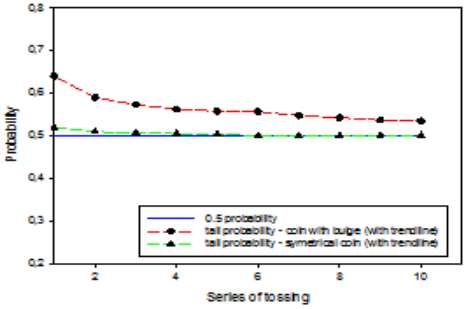


First way: Parallel to the floor			
f	f_0	f_1	$\frac{(f_0-f_t}{f_t}$
Tail	502	500	0.008
head	498	500	0.008
		χ^2:	0.016

Second way: vertical to the floor			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	501	500	0.002
head	499	500	0.002
		χ^2:	0.004

28



Coin with a bulge			
f	f_0	f_1	$\frac{(f_0-f_t)^2}{f_t}$
Tail	535	500	2.45
head	465	500	2.45
		χ^2:	4.9

Symmetrical coin			
f	f_0	f_1	$\frac{(f_0-f_t}{f_t}$
Tail	501	500	0.002
head	499	500	0.002
		χ^2:	0.004

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ANGLES

1,5840

1,7364

2,5554

3,393

3,775

9. BOTTLE TONE

Team Croatia
Reporter: Grgur Premec

9. BOTTLE TONE

Take an empty bottle and **blow air** across its mouth to produce a sound.
Now **fill the bottle with some water** and study how the **sound changes.**

OUTLINE

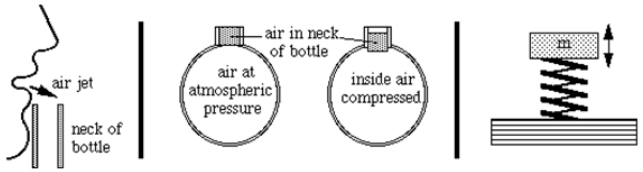
Theoretical introduction
- Helmholtz resonance
- Parameters

Experiment
- Changing volume
- Changing neck length

Results
- Results
- Discussion and comparison

WHY A TONE IS PRODUCED

- The bottle is effectively a **Helmholtz resonator**
  - The air in the neck acts as a weight
  - The air in the bottle acts as a spring
- Losses: friction, heat, sound
- The air blown over the bottle keeps the oscillations going



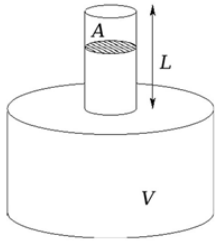
QUANTITATIVE DESCRIPTION

- Helmholtz resonator formula

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{V l_{eq}}} = \underbrace{\frac{c}{2\pi}\sqrt{\frac{A}{l_{eq}}}}_{k} \cdot \frac{1}{\sqrt{V}}$$

c – speed of sound in air
A – neck cross-section
l_{eq} – neck equivalent length (neck length + 0.3 · diameter)
V – bottle volume

PARAMETERS



- **Volume of air** in the bottle (V)
- **Neck dimensions** (A, L)
  - Hard to measure accurately for most bottles
- **Speed of sound**
  - Unchanged

- Two bottles
  - Influence of **different** bottle **necks**
  - Experiment **repeatability test**

6

HYPOTHESES

- The **frequency** will **rise** when **water is added** into the bottle
- The **frequency** will be **inversely proportional** to the **square root** of the **volume of the air** in the bottle
- The **coefficient** obtained from the **first experiment** will describe the frequency for **different neck lengths** reliably

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{V l_{eq}}}$$

7

EXPERIMENTAL SETUP

- Two glass bottles with a volume of 0.5 L
- 10 mL syringe
- Ruler

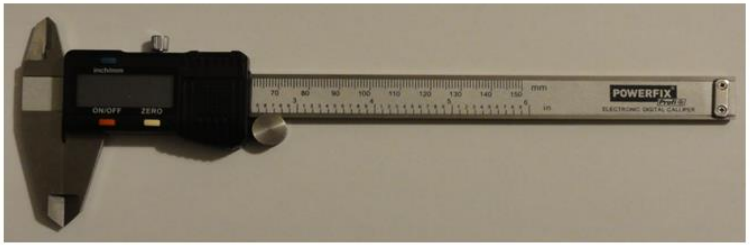
Bottle A

Bottle B

8

EXPERIMENTAL SETUP

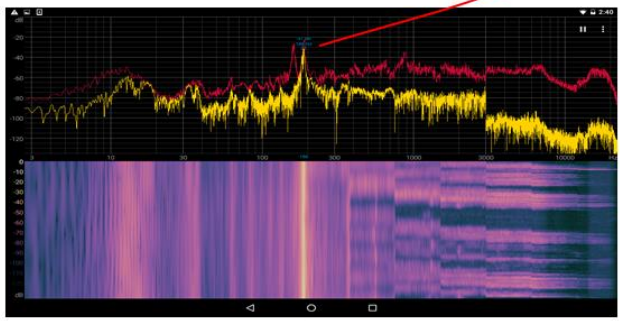
- Digital calipers



9

EXPERIMENTAL SETUP

- A tablet with the Spectroid application
- ±1 Hz accuracy, ±0.5 Hz precision



MEASURING PROCESS

- Water - 20 mL increments
- Air blown over the bottle to produce a **clean tone**
  - Frequency **didn't depend** on the blowing force
  - Measured on the tablet
- Stopped measuring when a **clean tone** could no longer be produced
  - Bottle A - 420 mL
  - Bottle B - 440 mL
- Mouth dimensions
  - Measured with the ruler and the calipers

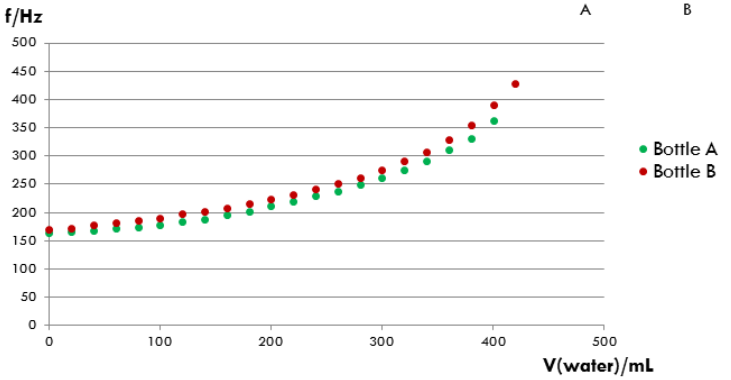
BOTTLE DIMENSIONS

$$k = \frac{c}{2\pi}\sqrt{\frac{A}{l_{eq}}}$$

	Bottle A	Bottle B
Mouth diameter/cm	2.60	2.04
Mouth cross section/cm	5.31	3.27
Neck length/cm^2	7.3	5.2
Equivalent neck length/cm	8.08	5.81
Theoretical coefficient of proportionality/(cm$^{3/2}$/s)	4400	4100

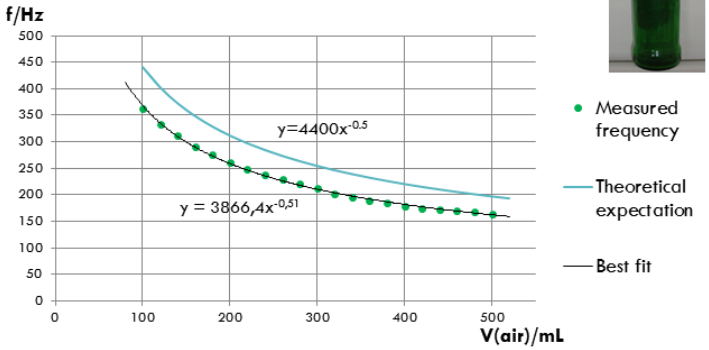
- The bottles have the **same volume**, so **bottle A** is expected to produce **higher frequencies**
- I was able to measure the neck of bottle B much more accurately

MEASUREMENT RESULTS



- The points describe a curve nicely, no sudden changes

DISCUSSION – BOTTLE A



- Small error of the exponent (2%), large error of the coefficient (12.1%)

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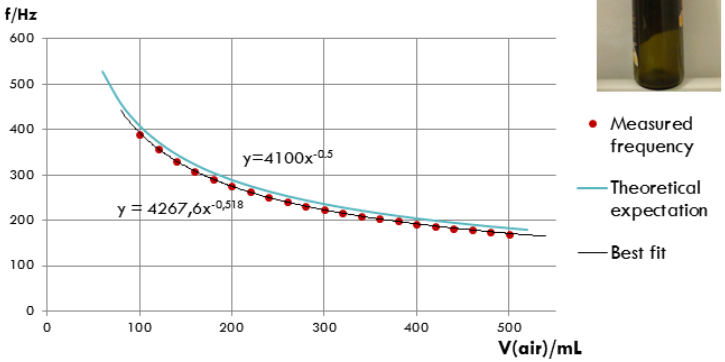
DISCUSSION – BOTTLE B



- Small error of the exponent (2%) and the coefficient (4.1%)

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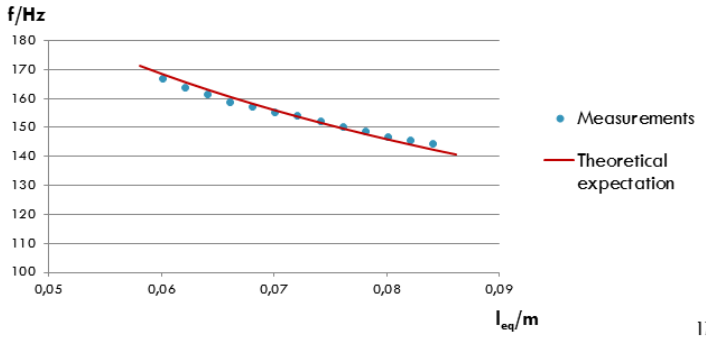
NECK LENGTH CHANGING

- 3D printed neck extender
  - Designed in Autodesk Fusion 360
  - Disks for matching the neck diameter
- Steps of 2 mm
- 5 measurements for each length

16

RESULTS

- Excellent prediction using the coefficient from previous measurements (1.3% max error)



17

CONCLUSION

- The **frequency** will **rise** when **water** is **added** into the bottle ✓
- The frequency will be **inversely proportional** to the **square root** of the **volume** of the air in the bottle ✓
- The **coefficient** obtained from the **first experiment** will describe the frequency for **different neck lengths** reliably ✓
- The **weak point** is measuring the **neck dimensions**
  - It has an **irregular shape** on most bottles
  - If it has a regular shape, the results are very close to the theoretical expectations

18

LITERATURE

- http://www.sarazhandpans.com/handpan-resonance-and-wave-interference/
- http://www.plastixportal.co.za/css_pages/nissei_asb.html
- https://people.seas.harvard.edu/~jones/cscie129/nu_lectures/lecture3%20/ho_helmholtz/ho_helmholtz.html
- https://newt.phys.unsw.edu.au/jw/Helmholtz.html
- https://en.wikipedia.org/wiki/Helmholtz_resonance
- Kulišić: Mehanika i toplina, 1988, Školska knjiga

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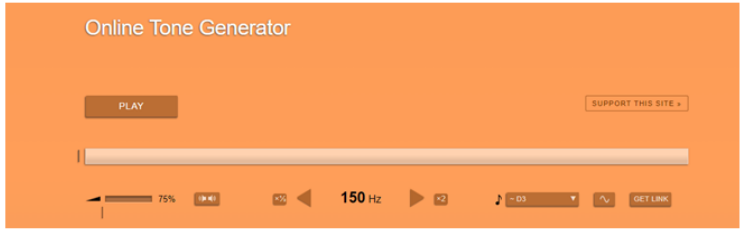
THANK YOU!

Team Croatia
Reporter: Grgur Premec

IYNT Tbilisi 2018

TESTING ACCURACY

- Online tone generator (accuracy checked with oscilloscope)
- Max 1 Hz error throughout the bottle frequency range



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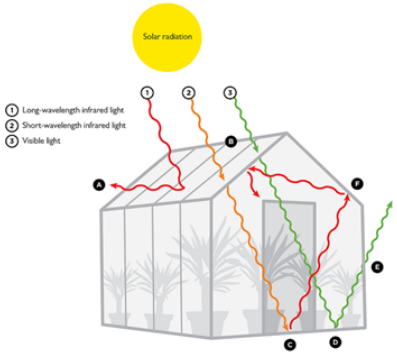
10. GREENHOUSE

Team Croatia
Reporter: Elena Lukačević

10. GREENHOUSE

A hot object placed in the open air would gradually **cool down.** We can slow down this process by containing the object in a greenhouse. Compare **different mechanisms of heat loss** by the object and explain how **the presence of a greenhouse affects** them.



2

OUTLINE

Theoretical introduction
- What is heat and how it can be transfered?
- Newton's law of cooling

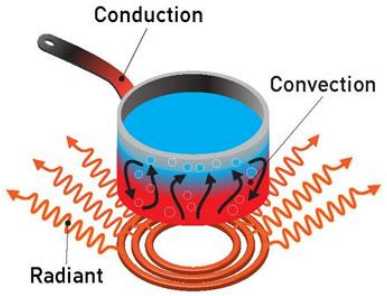
Experiment
- Setup

Results
- Graphs
- Conclusion

3

TYPES OF HEAT LOSS

- Radiation
- Conduction
- Convection



4

RADIATION

$$Q = A_t \cdot \varphi_{in,vis} \cdot (1 - albedo) = h_2 \cdot A_s \cdot (T_p - T_0)$$

A_t - radiated surface

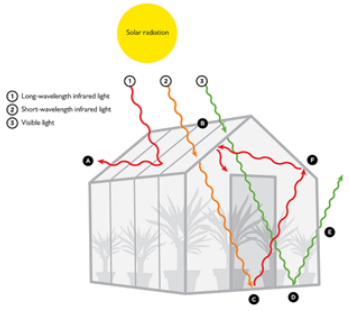
$\varphi_{in,vis}$ - radiation of visible and invisible spectre

$albedo$ – measure of diffuse radiation (0- black body)

h_2 - heat transfer coefficent

A_s- surface of object

$$Q \propto \Delta T$$



5

CONVECTION AND CONDUCTION

Newton's law of cooling:

$$T(t) = T_{\text{env}} + (T(0) - T_{\text{env}})\, e^{-rt}$$

While r is bigger, temperature is lower

T_{env} - temperature of environment
T(0) - initial temperature
r - time constant
t - time

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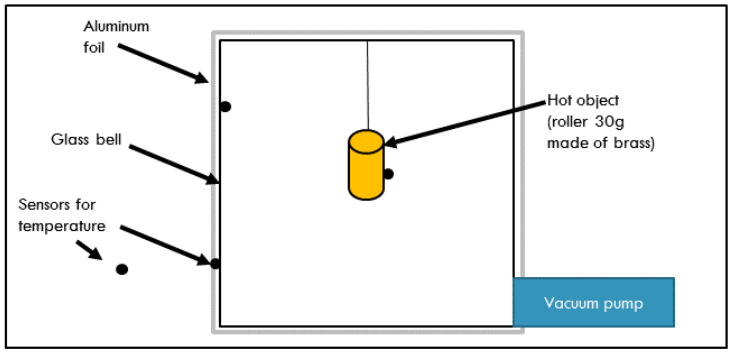
EXPERIMENT - RADIATION



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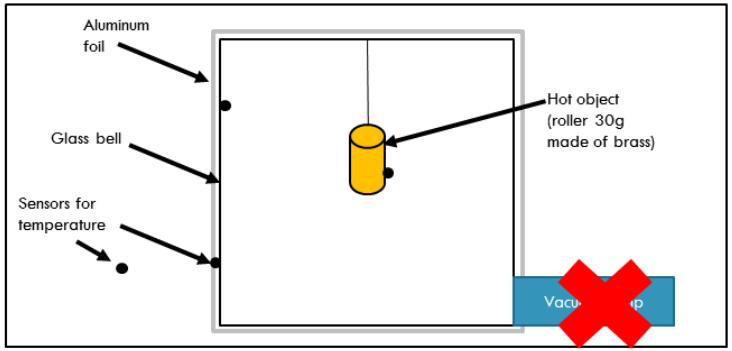
EXPERIMENT - CONVECTION



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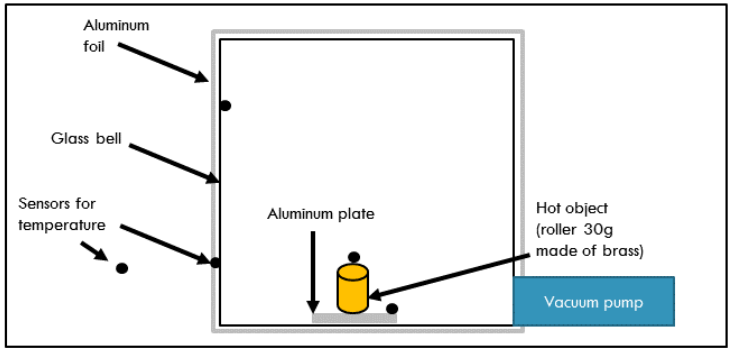
EXPERIMENT - CONDUCTION



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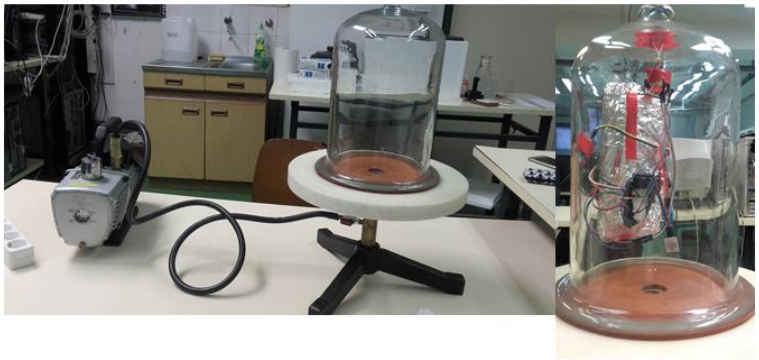
EXPERIMENT SETUP



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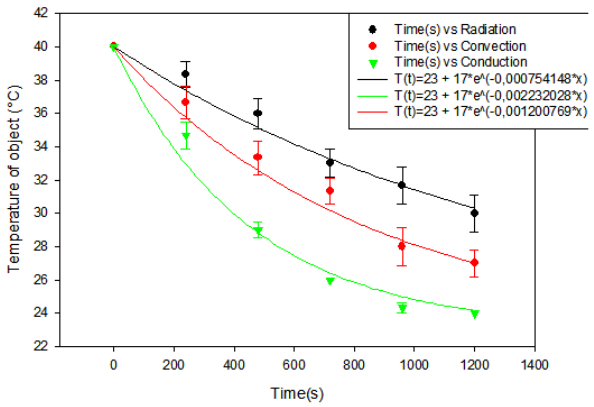
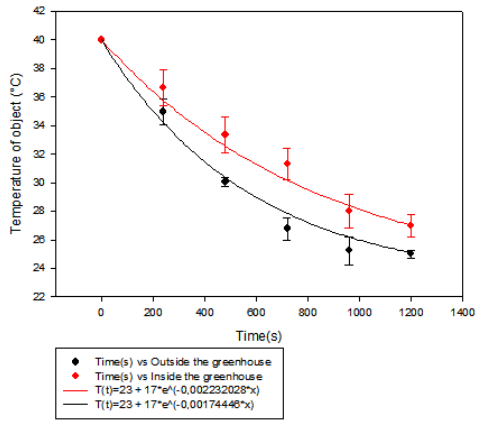
Mechanisms of heat loss



Conduction is the fastest type of heat loss because of touch while radiation is the slowest type of heat loss.

11

Inside the greenhouse vs. outside the greenhouse



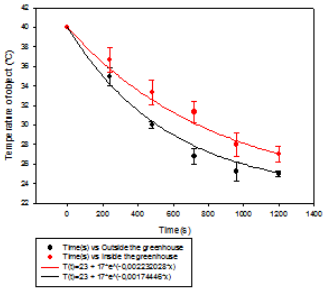
The object in a greenhouse is cooling slower than outside the greenhouse.

12

CONCLUSION

- Radiation is the slowest type of heat transfer.
- Greenhouse is making heat loss slower by preserving the infrared waves.

Inside the greenhouse vs. outside the greenhouse



13

LITERATURE

- Frank Incropera; Theodore L. Bergman; David DeWitt; Adrienne S. Lavine (2007). *Fundamentals of Heat and Mass Transfer* (6th ed.) (11.5.2018.)
- http://demonstrations.wolfram.com/NewtonsLawOfCooling/ (11.5.2018.)
- Mladen Paić; Toplina i termodinamika (1994.), Zagreb (11.5.2018.)
- Dubravko Horvat, Mehanika i toplina (2002.), Zagreb (11.5.2018.)

THANK YOU!

Team Croatia
Reporter: Elena Lukačević

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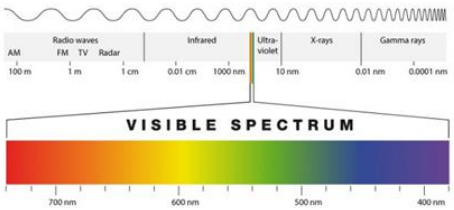

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11. FAME

Team Croatia

Reporter: Andrej Todic

1

11. FAME

Some people in the **modern World** are considered '**famous**' since they frequently appear in the news, TV, and **social media**. Suggest a **quantitative parameter** of such 'fame', and build **lists** of persons that are sorted according to this parameter.

OUTLINE

Theoretical introduction
- Ideas on Creating a Quantitative Parameter
- Examining What Affects the Parameter

Experiment
- The Methods of Calculating Fame

Results
- Graphs Showing the Results for Each Method

CREATING A QUANTITATIVE PARAMETER

- Fame is a difficult term to define
- It's even harder to measure it
- A lot of ways to interpret this task
- Measuring fame with the trace it leaves on the Internet

SEARCH ENGINES

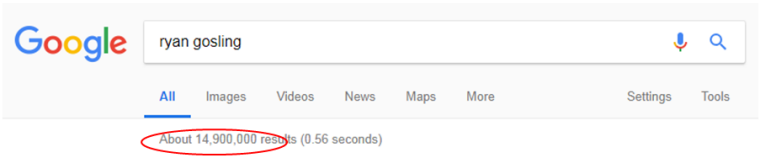
- Occurences of a person's name on the Internet represent how famous a person is
- Articles about the person, social media profiles and forums
- Four most popular search engines (Google, Yahoo, Bing, Aol)
- Advantage to results from more popular search engines

Google

Bing

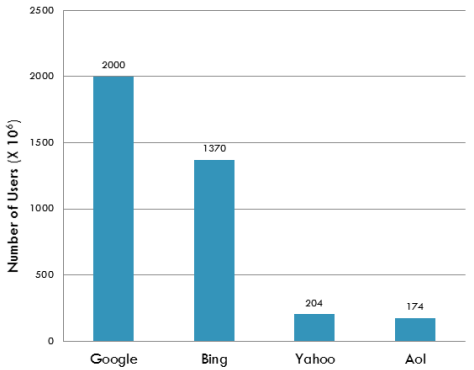
YAHOO!

Aol.



- All the used search engines show the approximate number of results

6



Comparison of Search Engines Based on the Number of Monthly Users

Based on data found on:
https://expandedramblings.com/index.php/yahoo-statistics/
https://www.statista.com/topics/4294/bing/
https://expandedramblings.com/index.php/aol-statistics/
https://www.theverge.com/2017/5/17/15654454/android-reaches-2-billion-monthly-active-users

7

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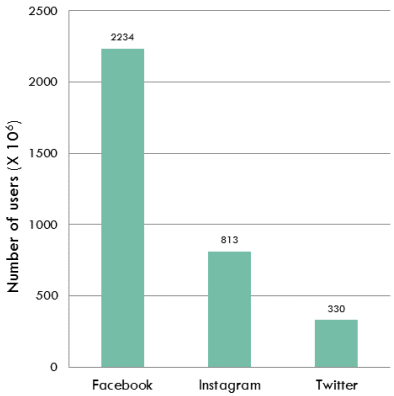
SOCIAL MEDIA

- Used by famous people in the modern world
- Followers on the three most popular **social media platforms** (Facebook, Instagram, Twitter)
- Assumption: popularity is correlated with the followers on social media
- Advantage to more popular social media platforms

8

- All used social media platforms show how many followers an account has

9



Comparison of Social Media Platforms Based on the Number of Active Users

Based on data found on:
https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/

10

QUANTITATIVE PARAMETER

- Used number of active users to differentiate the importance of each result
- Needed to calculate the **fame parameter**
- Linking the coefficient with:
  - number of results for each search engine
  - number of followers for each social media platform

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QUANTITATIVE PARAMETER

- Formula used to determine a person's level of fame:

$$f = \log \frac{\sum_i N_i \cdot k_i}{\sum_i k_i}$$

$$i \in \{Google, Yahoo, Bing, Aol, Facebook, Instagram, Twitter\}$$

N – number of results on search engines or followers

k – number of active users (in millions)

f – fame parameter

12

TESTING THE PARAMETER

- People famous in different fields (actors, singers, sportspeople, politicians...)
- Calculation of quantitative parameter
- Sorting people by value of parameter for both methods

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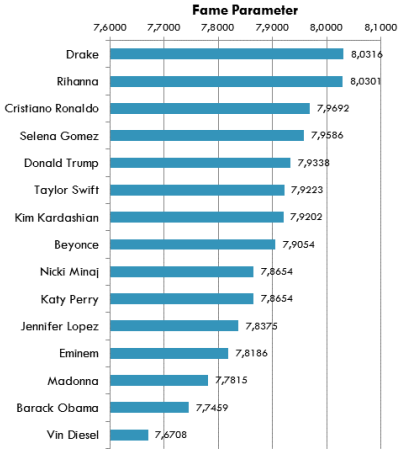
RESULTS – FIRST METHOD

Ranking	Person	Fame Parameter
1	Drake	8,0316
2	Rihanna	8,0301
3	Cristiano Ronaldo	7,9692
4	Selena Gomez	7,9586
5	Donald Trump	7,9338
6	Taylor Swift	7,9223
7	Kim Kardashian	7,9202
8	Beyonce	7,9054
9	Nicki Minaj	7,8654
10	Katy Perry	7,8654
11	Jennifer Lopez	7,8375
12	Eminem	7,8186
13	Madonna	7,7815
14	Barack Obama	7,7459
15	Vin Diesel	7,6708



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DIFFERENT METHOD

- Randomly picked person in the test - reference
- Its results compared with all the other results
- Fame parameter of a person represented by relation between their results and the results of the reference
- Different ranking made that way

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DIFFERENT METHOD

- Formula used to get the quantitative parameter:

$$f = \frac{\sum_i \frac{N_i}{R_i} \cdot k_i}{\sum_i k_i}$$

$$i \in \{Google, Bing, Yahoo, Aol, Facebook, Instagram, Twitter\}$$

R – number of results or followers for the reference person

- Inefficient if there is no fame comparison between multiple people

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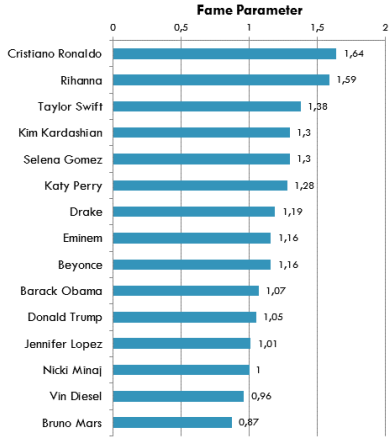
RESULTS – SECOND METHOD

Ranking	Person	Fame Parameter
1	Cristiano Ronaldo	1,64
2	Rihanna	1,59
3	Taylor Swift	1,38
4	Kim Kardashian	1,3
5	Selena Gomez	1,3
6	Katy Perry	1,28
7	Drake	1,19
8	Eminem	1,16
9	Beyonce	1,16
10	Barack Obama	1,07
11	Donald Trump	1,05
12	Jennifer Lopez	1,01
13	Nicki Minaj	1
14	Vin Diesel	0,96
15	Bruno Mars	0,87



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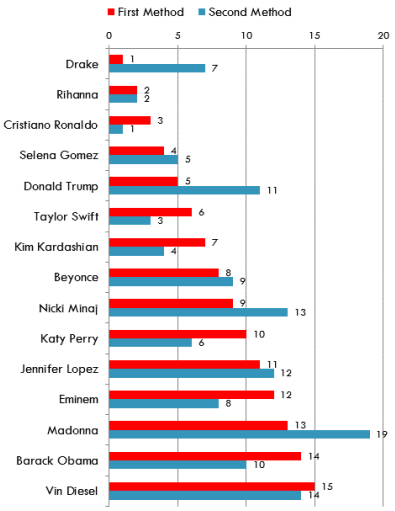
COMPARISON OF METHODS

Person	Ranking	
Drake	1	7
Rihanna	2	2
Cristiano Ronaldo	3	1
Selena Gomez	4	5
Donald Trump	5	11
Taylor Swift	6	3
Kim Kardashian	7	4
Beyonce	8	9
Nicki Minaj	9	13
Katy Perry	10	6
Jennifer Lopez	11	12
Eminem	12	8
Madonna	13	19
Barack Obama	14	10
Vin Diesel	15	14



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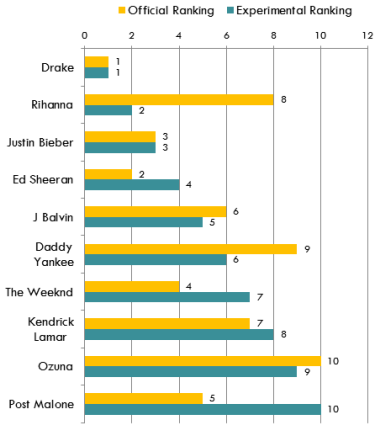
COMPARISON – PARAMETER VS SPOTIFY LIST

- Results differ because

Some musicians aren't famous only for their music (media and social influence)



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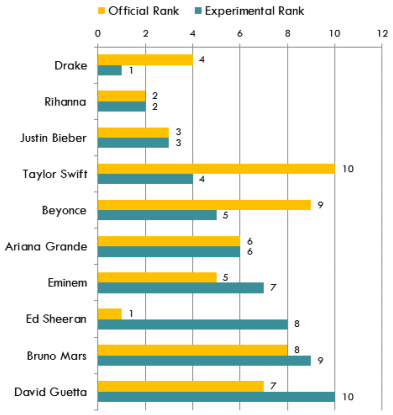
NUMBER OF SPOTIFY FOLLOWERS

Rank	Name	Fame Parameter
1	Ed Sheeran	7,6682
2	Rihanna	8,0301
3	Justin Bieber	7,9673
4	Drake	8,0316
5	Eminem	7,8186
6	Ariana Grande	7,8766
7	David Guetta	7,4748
8	Bruno Mars	7,6301
9	Beyonce	7,9054
10	Taylor Swift	7,9223



20

CONCLUSION

- Different ways to measure how famous a person is
- Presence of social media and search engines influences popularity

- Differences of the methods:
  - First method is used to get the exact value of the fame parameter
  - Second one shows how famous a person is in relation to another
  - It's more useful when calculating more people

- Compared our rankings with other rankings which exist

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POSSIBILITIES FOR FUTURE WORK

- Conducting a survey to compare experimental ranking with personal opinions

LITERATURE

- https://dictionary.cambridge.org/dictionary/english/fame,accessed on 02.05.2018. 17:21
- https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users, accessed on 13.05.2018., 18:45
- https://expandedramblings.com/index.php/yahoo-statistics/, accessed on 28.06.2018., 13:50
- https://www.statista.com/topics/4294/bing/, accessed on 28.06.2018., 13:54
- https://expandedramblings.com/index.php/aol-statistics/, accessed on 28.06.2018., 14:07
- https://www.theverge.com/2017/5/17/15654454/android-reaches-2-billion-monthly-active-users, accessed on 28.06.2018., 14:23

THANK YOU!

Team Croatia

Reporter: Andrej Todic

ADDITIONAL SLIDES

Name	Google Results	Bing Results	Yahoo Results	Aol Results	Facebook Followers	Instagram Followers	Twitter Followers	Fame parameter
Kim Kardashian	186000000	25800000	27700000	28100000	29222714	110630197	59810066	7,9202
Dwayne Johnson	25100000	6480000	15300000	15300000	57519268	104391818	12874574	7,5982
Jackie Chan	38100000	5050000	11900000	11900000	62068324	2145777	1429210	7,5061
Taylor Swift	148000000	12600000	29600000	28800000	69765457	107420627	85594016	7,9223
Cristiano Ronaldo	125000000	8350000	19700000	19800000	120488221	125036888	72684768	7,9692
Bruno Mars	64800000	10500000	24800000	24900000	54075224	19333287	42726529	7,6301
Serena Williams	42700000	5730000	13500000	13500000	5212048	7999301	10915703	7,2268
Celine Dion	34300000	10300000	24500000	24500000	21421337	2215936	812542	7,2992
Vin Diesel	33800000	4120000	9780000	9730000	97455920	48159292	197751	7,6708
Jennifer Lopez	148000000	11100000	26200000	26300000	41887674	74284925	45442865	7,8375
Donald Trump	250000000	14500000	34700000	34700000	24533023	8777399	51232010	7,9338
J.K. Rowling	30100000	1720000	6210000	9050000	5533789	104699	14396751	7,0642
Barack Obama	102000000	11400000	27000000	27100000	53350338	17268544	102542825	7,7459
Michelle Obama	31000000	8090000	19000000	19100000	17058333	20399219	10675855	7,2887
Neil deGrasse Tyson	5770000	1230000	2760000	2090000	4345837	580762	12759069	6,6027

ADDITIONAL SLIDES

Name	Google Results	Bing Results	Yahoo Results	Aol Results	Facebook Followers	Instagram Followers	Twitter Followers	Fame parameter
Michael Phelps	14000000	2980000	7400000	7450000	8280464	3371024	2239810	6,9021
Bella Thorne	20500000	2780000	6820000	6790000	9546463	17742177	6985332	7,0789
Elon Musk	65600000	5040000	12500000	12600000	512704	7738726	21905117	7,3445
Nicole Scherzinger	19600000	1590000	3850000	3930000	7453574	3561163	5771907	6,9554
Nicki Minaj	164000000	11800000	26000000	26000000	40537556	87381191	21356662	7,8654
Paris Hilton	103000000	7450000	18200000	18200000	7503160	8865738	18089061	7,5504
Lindsay Lohan	66600000	5160000	12600000	12700000	5516605	6486122	9347542	7,3666
Tim McGraw	12000000	3400000	8450000	8460000	7900546	1972444	30920940	6,9348
Oprah Winfrey	27300000	4840000	12000000	12100000	11765739	14576405	42573978	7,2190
Tiger Woods	27600000	7660000	19100000	19100000	2920418	1183813	6438290	7,0638
Valentino Rossi	24700000	1560000	3890000	3890000	13210700	5325349	5629113	7,0952
Ronda Rousey	18200000	3630000	3600000	3820000	11275168	10538847	3657652	7,0378
Heidi Klum	36200000	3130000	7730000	7730000	4096480	4648901	5393299	7,1218
Conor McGregor	21400000	4700000	11700000	11700000	7679413	23659914	7244145	7,1131
Wiz Khalifa	34600000	2970000	7370000	7400000	39077176	20338462	33914536	7,4284

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ADDITIONAL SLIDES

Name	Google	Bing	Yahoo	Aol	Facebook	Instagram	Twitter	Fame parameter
Jessica Alba	84800000	5120000	12500000	12500000	5172280	13122163	9657713	30,23
Chris Brown	87800000	9280000	23100000	23100000	41031549	43243958	28918465	49,06
John Krasinski	10500000	1090000	2580000	2740000	300514	1463044	1751767	3,88
Sylvester Stallone	20800000	2190000	5430000	5440000	6216339	6317350	2810982	9,88
Eminem	116000000	10600000	26500000	26500000	84557837	19884127	22951533	68,45
Queen Latifah	11700000	1340000	3280000	3330000	7378564	3822662	8324283	7,17
Madonna	178000000	11900000	29800000	29700000	16756514	11195164	2276013	63,4
Alicia Keys	29200000	4630000	11600000	11500000	31508074	12610563	30956737	23,59
Jimmy Fallon	53000000	7060000	17600000	17600000	2563374	11813283	51169526	23,41
Jimmy Kimmel	66600000	4480000	11200000	11200000	1483183	1866257	11596988	22,47
Megan Fox	47400000	3580000	8690000	8700000	48124698	5531245	1348673	31,07
Katy Perry	130000000	10600000	26300000	26300000	64927190	70140436	10517028	75,93
Christina Aguilera	69200000	4840000	11400000	12200000	22416345	5231045	17288325	30,48
Naomi Campbell	23000000	1320000	3230000	3270000	1815420	5241476	636147	8,39
Chris Pratt	29300000	3300000	8180000	8200000	3961305	18713030	5658574	13,73
Cara Delevingne	32300000	2610000	5080000	5110000	6115628	41280738	10465572	17,36

27

ADDITIONAL SLIDES

Name	Google	Bing	Yahoo	Aol	Facebook	Instagram	Twitter	Fame parameter
Melissa McCarthy	8630000	1540000	3800000	3830000	835901	6881491	984398	4,38
Mike Pence	11100000	4260000	4250000	4450000	2071122	558785	6310064	5,17
Tom Hanks	21500000	4040000	10100000	10100000	7113892	5080098	15516562	11,87
Amy Schumer	12700000	2740000	2670000	2900000	2679346	6932063	4749471	6,08
Seth Rogen	10900000	1230000	2890000	3090000	4244978	5666534	7615614	6,06
Justin Timberlake	74200000	6870000	17100000	17200000	35686220	50150380	66033754	44,70
Arnold Schwarzenegger	28500000	3360000	8360000	8380000	16289809	14435349	4461996	16,87
Gal Gadot	28100000	2320000	5670000	5680000	10159482	20805061	1842461	14,83
Margot Robbie	30100000	2550000	6240000	6250000	1609916	14583298	1086752	12,09
Nathan Fillion	3760000	745000	1780000	1890000	689582	836022	3633214	1,95
Zoe Saldana	13400000	1480000	3630000	3660000	2208420	3414567	833222	5,71
Rosario Dawson	12800000	973000	2360000	2370000	1047307	939668	673362	4,60
Patrick Stewart	6920000	1180000	2870000	2940000	1264171	1213039	3106987	3,28
Chris Hemsworth	23100000	1670000	4080000	4190000	6328201	18831657	3537591	11,72
Tom Cruise	37000000	5710000	14200000	14200000	11631631	1605063	6821967	17,77

28

ADDITIONAL SLIDES

Name	Google	Bing	Yahoo	Aol	Facebook	Instagram	Twitter	Fame parameter
Rihanna	62500000	2630000	6520000	6520000	2438325	20556369	7014748	109,3
Camilla Cabello	30500000	2470000	6060000	6120000	2630235	1709307	2385803	22,47
Kylie Minogue	307000000	12400000	30800000	30800000	34407754	42349656	37382726	11,08
Drake	121000000	10400000	25900000	25900000	18130774	22998521	20168597	110,56
Ed Sheeran	54900000	10800000	26900000	26900000	7308788	17789320	9318925	49,12
The Weeknd	19100000	1250000	3090000	3120000	6011558	14647800	4911167	26,3
Gisele Bundchen	54600000	2560000	6340000	6360000	3122045	20687552	13315753	9,85
Victoria Beckham	26800000	2130000	5320000	5310000	10134208	11132925	10967951	20,73
Pharrell Williams	157000000	11600000	28800000	28700000	59709996	115511246	15201767	13,69
Beyonce	179000000	10800000	26500000	26600000	59868983	138205981	56798299	83,25
Selena Gomez	15400000	1060000	2600000	2600000	13847431	4451649	1058798	93,47
Michelle Rodriguez	19700000	1340000	3290000	3340000	1223098	886970	694214	9,82
Antonio Banderas	20600000	1370000	3280000	3350000	14269486	14425605	10980498	6,8
Victoria Justice	22800000	1270000	1240000	1400000	23513694	24079238	15030327	13,16
Sergio Ramos	22800000	1270000	1240000	1400000	23513694	24079238	15030327	17,53

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ADDITIONAL SLIDES

Name	Google	Bing	Yahoo	Aol	Facebook	Instagram	Twitter	Fame parameter
Eden Hazard	12300000	1070000	2580000	2660000	8899107	13233161	5352050	8,59
Alexis Sanchez	11800000	1050000	1000000	1180000	4963454	9369586	2739700	6,32
Luis Suarez	26400000	1220000	1170000	1370000	18807573	27814744	14687319	17,45
Kristen Bell	17000000	2420000	5900000	5900000	629003	6408120	2380889	7,16
Lindsey Stirling	9050000	1600000	3930000	3980000	3627425	1381317	558037	4,76
Ellen DeGeneres	29100000	4770000	11800000	11900000	29295884	54007124	78039640	29,83
Cameron Dallas	12100000	996000	2410000	2480000	3756917	20860198	16564704	8,27
Bill O'Reilly	8840000	2930000	17600000	17700000	1906107	13973	2859655	7,11
Idris Elba	10300000	1410000	3420000	3560000	4263390	1941343	2551491	5,35
Jennifer Aniston	78600000	6300000	15300000	15300000	9019430	5716306	15320201	29,75
Carlos Mencia	449000	252000	690000	617000	453154	26593	46377	0,43
Anthony Bourdain	36100000	5030000	12500000	12500000	1878443	2995932	7524731	14,27
Ian McKellen	5870000	934000	2220000	2330000	4799446	1832842	3937907	4,05
Emma Watson	81400000	7820000	19000000	19100000	34313049	47069332	29137835	44,67

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ADDITIONAL SLIDES

Name	Google	Bing	Yahoo	Aol	Facebook	Instagram	Twitter	Fame parameter
Jamie Oliver	21200000	7600000	19000000	19000000	6668508	6396117	7067523	13,43
Gordon Ramsay	16600000	4030000	10100000	10100000	7714797	4353810	6910123	10,2
Floyd Mayweather	18100000	2640000	6570000	6560000	13552430	20280525	8124140	13,52
Mike Tyson	15400000	2090000	5220000	5210000	7702760	6532481	5484721	8,93

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ADDITIONAL SLIDES

Ranking	Name	Google Results	Bing Results	Yahoo Results	Aol Results	Facebook Followers	Instagram Followers	Twitter Followers	Fame parameter
1	Drake	307000000	12400000	30800000	30800000	34407754	42349656	37382726	8,0316
2	Ed Sheeran	121000000	10400000	25900000	25900000	18130774	22998521	20168597	7,6682
3	Justin Bieber	173000000	12000000	28400000	28200000	76426002	100614205	106558019	7,9673
4	The Weeknd	54900000	10800000	26900000	26900000	7308788	17789320	9318925	7,3741
5	Post Malone	26600000	2970000	6970000	6970000	2400380	11048373	3896398	7,0254
6	J Balvin	62400000	2390000	5230000	5230000	19596458	22802628	5813536	7,4357
7	Kendrick Lamar	38100000	4210000	9710000	9680000	8549752	9571084	10881044	7,2121
8	Rihanna	241000000	15700000	28600000	28500000	75546760	63205839	88569106	8,0301
9	Yankee	46900000	6680000	15900000	16000000	28382445	21748770	11820832	7,4349
10	Ozuna	36000000	3040000	7010000	7130000	4037010	9342547	458667	7,1277

32

ADDITIONAL SLIDES

Ranking	Name	Google Results	Bing Results	Yahoo Results	Aol Results	Facebook Followers	Instagram Followers	Twitter Followers	Fame parameter
1	Ed Sheeran	121000000	10400000	25900000	25900000	18130774	22998521	20168597	7,6682
2	Rihanna	241000000	15700000	28600000	28500000	75546760	63205839	88569106	8,0301
3	Justin Bieber	173000000	12000000	28400000	28200000	76426002	100614205	106558019	7,9673
4	Drake	307000000	12400000	30800000	30800000	34407754	42349656	37382726	8,0316
5	Eminem	116000000	10600000	26500000	26500000	84557837	19884127	22951533	7,8186
6	Ariana Grande	159000000	12000000	28400000	28500000	32403922	122648593	57667557	7,8766
7	David Guetta	40400000	3310000	7720000	7650000	49310432	8497102	22161202	7,4748
8	Bruno Mars	64800000	10500000	24800000	24900000	54075224	19333287	42726529	7,6301
9	Beyonce	157000000	11600000	28800000	28700000	59709996	115511246	15201767	7,9054
10	Taylor Swift	148000000	12600000	29600000	28800000	69765457	107420627	85594016	7,9223

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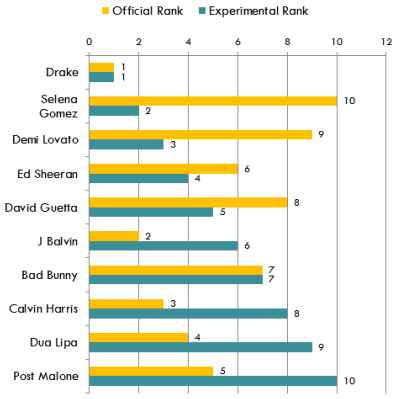
MUSICIANS BY NUMBER OF MONTHLY SPOTIFY STREAMS

Rank	Name	Fame Parameter
1	Drake	8,0316
2	J Balvin	7,4357
3	Calvin Harris	7,2084
4	Dua Lipa	7,1387
5	Post Malone	7,0254
6	Ed Sheeran	7,6682
7	Bad Bunny	7,2395
8	David Guetta	7,4748
9	Demi Lovato	7,6927
10	Selena Gomez	7,9586



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ADDITIONAL SLIDES

Ranking	Name	Google Results	Bing Results	Yahoo Results	Aol Results	Facebook Followers	Instagram Followers	Twitter Followers	Fame parameter
1	Drake	307000000	12400000	30800000	30800000	34407754	42349656	37382726	8,0316
2	J Balvin	62400000	2390000	5230000	5230000	19596458	22802628	5813536	7,4357
3	Calvin Harris	32400000	3510000	8260000	8180000	13351311	10085198	13283794	7,2084
4	Dua Lipa	36900000	2670000	6150000	6160000	2844471	13723398	2315581	7,1387
5	Post Malone	26600000	2970000	6970000	6970000	2400380	11048373	3896398	7,0254
6	Ed Sheeran	121000000	10400000	25900000	25900000	18130774	22998521	20168597	7,6682
7	Bad Bunny	51300000	1960000	4050000	4030000	3033946	12187416	509763	7,2395
8	David Guetta	40400000	3310000	7720000	7650000	49310432	8497102	22161202	7,4748
9	Demi Lovato	86200000	10400000	24900000	24800000	35891972	68929498	57269320	7,6927
10	Selena Gomez	179000000	10800000	26500000	26600000	59868983	138205981	56798299	7,9586

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13. INVENT YOURSELF: BLOOD PRESSURE

Team Croatia
Reporter: Ana Ćenan

INVENT YOURSELF: BLOOD PRESSURE

- Study the accuracy of various methods to measure blood pressure. Propose an interesting study involving blood pressure and pulse.

"Study the **accuracy** of **various methods** to measure blood pressure and investigate the change in **pulse** and **blood pressure** caused by **the change of body position.**"

OUTLINE

Theoretical introduction
- Blood pressure
- Heart rate

Experiment
- Accuracy of BP measuring devices
- Effects of BMI and physical activity on BP and pulse

Results and conclusion
- Graphical presentation
- Statistical analysis

BLOOD PRESSURE (BP)

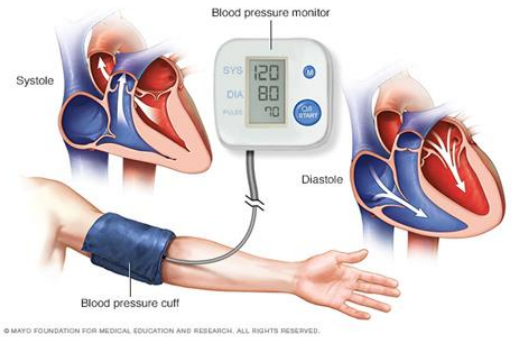
- The **pressure** which occurs on the **walls of the blood vessels** (arteries) during blood circulation
- Measured in millimeters of mercury – mmHg
- Vital sign
- **Normal** in a resting adult is **120/80 mmHg**

HEART RATE

- The **number** of **contractions** of the heart muscle per minute
- Varies depending on activity, sleep, anxiety, stress, illness
- The **normal** resting heart rate in adult is range from **60 to 100** beats per minute (bpm)

DEMONSTRATION OF THE PHENOMENON

- **Systolic** pressure - the **highest** arterial pressure
- **Diastolic** pressure - the **lowest** arterial pressure



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HYPOTHESES

1. Upper arm BP monitor is the **most accurate**
2. **Heart rate** and **BP differ** between people who play **sport** and those who don't
3. **BMI** has an **effect** on the **blood pressure**
4. **BMI** has an **effect** on the **heart rate**

7

MEASURING DEVICES

Omron M3 BP monitor

Omron wrist BP monitor

Riester Big Ben Round

Pulse oximeter

8

EXPERIMENT 1- ACCURACY

- 30 students
- 14 years old
- physical activity
- 5 measurements with each BP measuring device

9

EXPERIMENT 2

- 49 students (14-15 years old)
- Omron M3 BP monitor
- measured 3 different position
- **Divided to sports and non-sports**
- **Body mass index (BMI)**

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RESULTS: EXPERIMENT 1

BP measuring device	Accuracy (%)
Omron wrist BP monitor	95.3
Omron M3 BP monitor	91.1
Riester Big Ben Round	93.3

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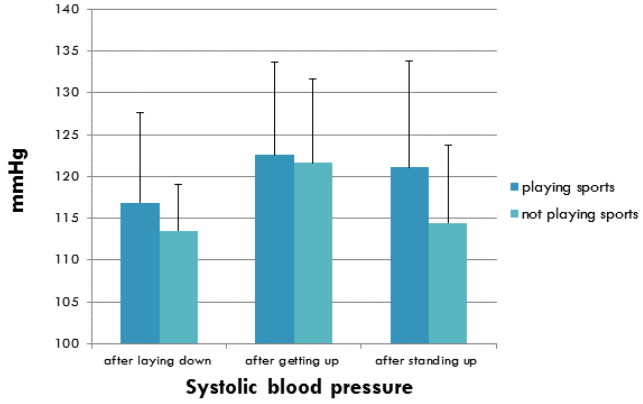
RESULTS: EXPERIMENT 2



- Students who did not play sports had lower blood pressure

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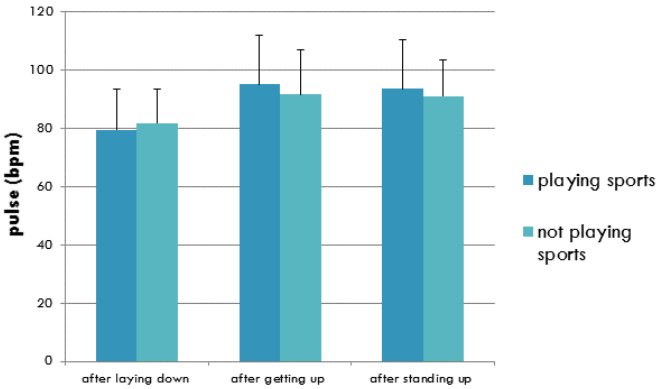
RESULTS: EXPERIMENT 2



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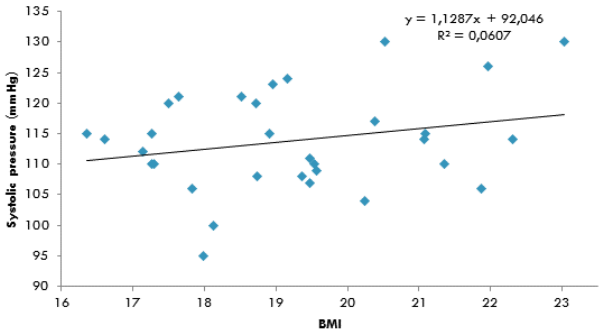
RESULTS: EXPERIMENT 2
EFFECT OF BMI ON BLOOD PRESSURE



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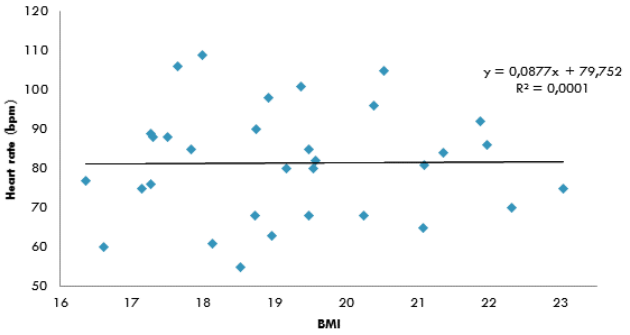
RESULTS: EXPERIMENT 2
EFFECT OF BMI ON HEART RATE



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CONCLUSION

- The most accurate BP measuring device is Omron wrist BP monitor
- There is a significant difference between people who play sports and those who don't
- BMI does not effect blood pressure and pulse

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LITERATURE

1. Gidding SS, Barton BA, Dorgan JA, et al. Higher self-reported physical activity is associated with lower systolic blood pressure: the Dietary Intervention Study in Childhood (DISC), Pediatrics , 2006, vol. 118 (pg. 2388-93)
2. Silke B, McAuley D. Accuracy and precision of blood pressure determination with the Finapres: an overview using re-sampling statistics. J. Hum. Hypertens. 1998;12:403–409. doi: 10.1038
3. *Hall, John (2011). Guyton and Hall textbook of medical physiology (12th ed.). Philadelphia, Pa.: Saunders/Elsevier.*

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THANK YOU!

Team Croatia
Reporter: Ana Ćenan

ANALYSIS OF VARIANCE

Sum of squares within groups (SSW)
21500
Total sum of squares (SST)
22471
SUM of squares between groups
971
Final calculation
323,6666667
149,3055556
2,167813953
F(2,144)=2,17; p<0.05

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SAMPLE

Doing sports	Gender: Male	Gender: Female
YES	16	10
NO	6	17

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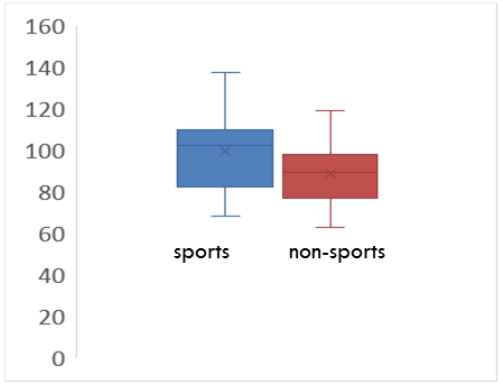
RESULTS: EXPERIMENT 2



- Significant difference in pulse measurements
- Females

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STATISTICAL ANALYSIS: T-TEST

- H_0 – there is no difference between sports and non-sports group
- H_A – there is a difference between sports and non-sports group

- Wilcoxon-Mann-Whitney sum rank test (non-parametric t-test)
- non-paired, two-sided
- significance level: 5%

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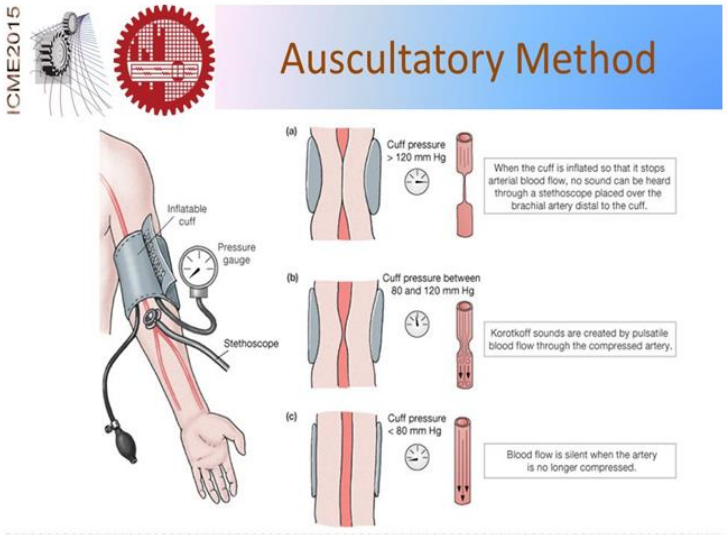

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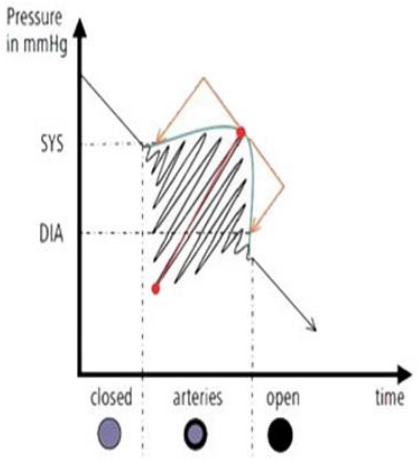

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Blood Pressure Stages

Blood Pressure Category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Low blood pressure (Hypotension)	less than 80	or	less than 60
Normal	80-120	and	60-80
Prehypertension	120-139	or	80-89
High Blood Pressure (Hypertension Stage 1)	140-159	or	90-99
High Blood Pressure (Hypertension Stage 2)	160 or higher	or	100 or higher
High Blood Pressure Crisis (Seek Emergency Care)	higher than 180	or	higher than 110

Source: American Heart Association

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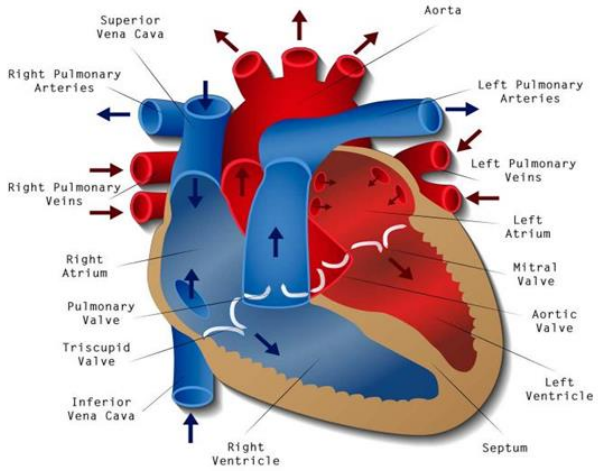
Diagram of human heart



CARDIAC CYCLE

- all four chambers of heart are in diastole
- atrial diastole - the atria is filling with blood
- ventricular diastole – the pressure in the ventricles drops below the pressure in the atria

  - valves opens

- atrial systole – the atria begin to contract
- ventricular systole – ventricles contract causing the pressure to rise which closes the valves
  -the pressure rises and aortic and pulmonary valve open forcing blood to the blood vessels

PROBLEM 14
DENDROCHRONOLOGY

Team Croatia
Reporter: Luka Mikšić

PROBLEM 14: DENDROCHRONOLOGY

- „Annual growth rings of trees are often used to date important historical events or **environmental conditions** of the past. How does the climate **influence** the **growth** of different species of **trees** from the same area?"

2

OUTLINE

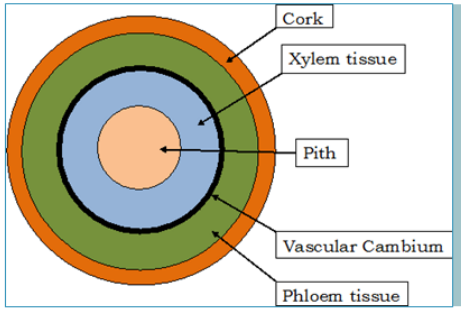
Theoretical introduction
- Tree rings and dendrochronology
- Location- Kaštanski gaj

Experiment
- Comparison of different oak species
- Comparison of climate with the tree rings

Results
- Results of oak trees
- Results of the maple tree

3

CREATION OF TREE RINGS



4

TREE RINGS

- Tree ring- radial **growth** of a wooden stem during **one vegetation period**
- Xylem cells:
  - spring → larger, rarely distributed, lighter in colour
  - autumn → smaller, thickly distributed, darker in colour

→Microscopic image of tree rings

5

DENDROCHRONOLOGY

- **examines** the events that have occurred in the **past**
- dendrochronologists can make a **reliable chronology** of a region's **climate**
- Cross-dating
  - comparing the **similarity** of tree ring length using samples from the same **area**

6

OAK COMMUNITY-KAŠTANSKI GAJ

Samples of :

- **turkey** oak (*Quercus cerris*)
- **sessile** oak (*Quercus petraea*)
- **downy** oak (*Quercus pubescens*)
- **field maple** (*Acer campestre*)

- All three types of **oak** trees ➔ specific microclimate conditions

Conditions	Kaštanski gaj
Above sea level	350 m
Exposure of the surface	S-SW
Inclinations	7°-15°

7

EXPERIMENT SLIDES

- used a **core drill**
- studied the samples using **stereo microscope**
- multiple series of **repeated measurements** (10)
- **temperature** and **rainfall** data from the State Hydrometeorological Institute

Measuring setup

Core drill

8

HYPOTHESIS

1. Within the same species of tree, the tree rings are about the same **length**
2. **Variability** will occur in **various** species of **oak** trees
3. **Rainfall** and **average annual temperature** will have different effects different tree species
4. **Proportionality** between climate changes and tree growth can be seen
5. The maple tree will have **different** results than the oak trees

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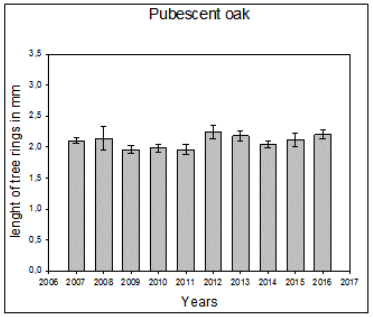
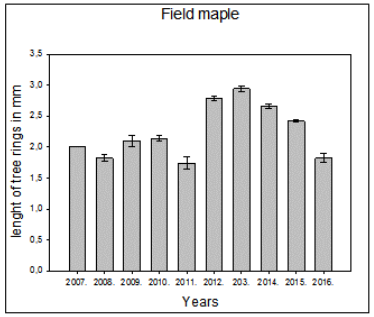
COMPARISON - TREE RING LENGTH DEVIATION





- Small deviation of measurements
- Biggest deviation in 2008. ➔ unknown biological factors

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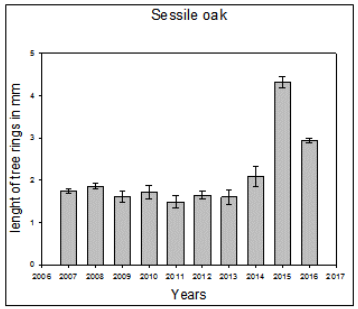
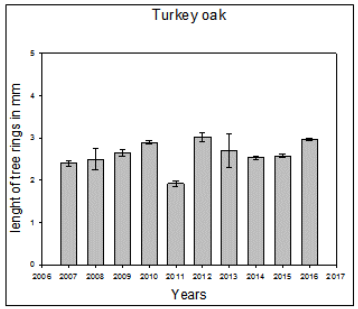
COMPARISON - TREE RING LENGTH DEVIATION



Small deviation of measurements

The deviation is biggest in 2014.



Small deviation of measurements

The deviation is biggest in 2013. and 2008.

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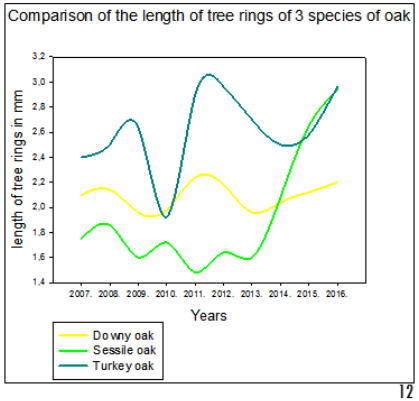
COMPARISON - AVERAGE ANNUAL TREE RING LENGTH - OAK

- **Turkey** oak and **downy** oak react **similarly**
- **Sessile** oak
  - **different** from these two
  - length **rises** significantly after year **2013.**



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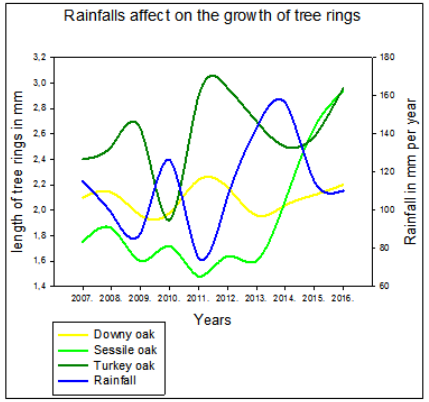
COMPARISON – AVERAGE TREE RINGS VS CLIMATE

- **Downy** oak and **Turkey** oak
  - **reverse proportional** with the rainfall
- **Sessile** oak
  - **no correlation** with the rainfall



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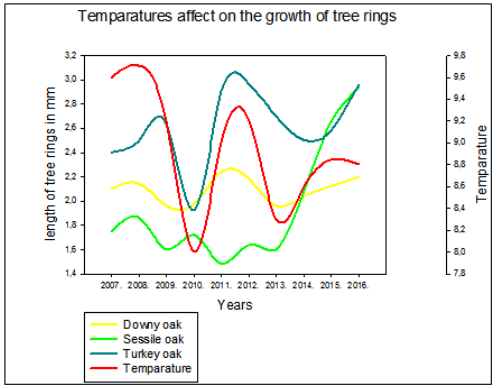
COMPARISON – AVERAGE TREE RINGS VS CLIMATE

- **Downy** and **turkey** oak
  - **grow proportionally** to the temperature
- Sessile oak
  - **no correlation** with the temperature



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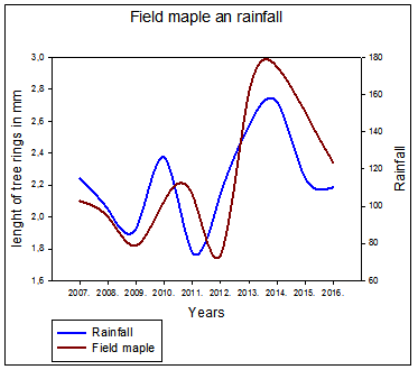
COMPARISON – AVERAGE TREE RINGS VS CLIMATE



- growth is **proportional** with the rainfall

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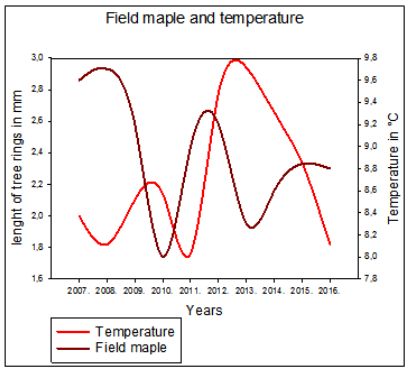
COMPARISON – AVERAGE TREE RINGS VS CLIMATE



- growth is **reversely proportional** with the temperature

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CONCLUSION

1. **Within the same species of tree, the tree rings are about the same length** ✓
   - ➔ error in measurement is small
2. **Variability will occur in various species of oak trees** ✓
   - ➔ sessile oak acted completely different
3. **Rainfall and average annual temperature will have different effects on different tree species** ✓
   - ➔ oaks different then maple

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CONCLUSION

4. **Proportionality between climate changes and tree growth can be seen** ✓

   ➔ downy, turkey oak and field maple

5. **The maple tree will have different results than the oak trees** ✓

   ➔ maple acted reversely proportional to the oaks

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POSSIBILITIES OF FURTHER WORK

- Study tree rings from a **longer** time **period**
- Collect samples of the **same** tree **species** from **different climate** conditions and compare their reaction

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LITERATURE

- Begović K., Čupić S., 2016. Klimatski odaziv obične smreke (*Picea abies* L. (H.Karst.)) na području sjevernog Velebita, Studentski rad, Šumarski fakultet, Zagreb
- Draženović J., 2013. Termofilna zajednica hrasta kitnjaka i crnog graba u zapadnom dijelu Žumberačke gore, Učenički rad, Gimnazija Karlovac, Karlovac
- Idžojotić M., 2004. Listopadno drveće i grmlje u zimskom razdoblju, Sveučilište u Zagrebu, Šumarski fakultet, Zagreb
- Idžojotić M., 2009. Dendrologija lista, Sveučilište u Zagrebu, Šumarski fakultet, Zagreb
- Ogrin D., 1998. Dendrokronologija in dendroklimatologija planine pri jezeru v JulijskihAlpah, Geografski vestnik, 70 (59 - 73)
- Poljanšek S., 2013. Dendrologija črnega bora...na območju zahodnega dela Balkanskog polotoka, Dokt. disertacija, Univerza v Ljubljani, Biotehnička fakulteta, Ljubljana
- Šilić Č., 1973. Atlas drveća i grmlja, Zavod za izdavanje udžbenika, Sarajevo

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THANK YOU!

Team Croatia
Reporter: Luka Mikšić

IYNT Tbilisi 2018

DOWNY OAK

- deciduous wood from the beech family
- predominantly in the coastal and sub-Mediterranean
- they prefer warm habitats, on poorer land they grow smaller
- leaves - simple, oblong egg, heart-shaped basis
- bark - in youth greyish, later has black, deep, tiny, indentations
- fruit - 3 to 4 walnuts (acorns) on a short stalk, the dome covers one third

https://www.plantea.com.hr/hrast-medunac/

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TURKEY OAK

- deciduous wood from the beech family
- predominantly in the continental area
- grows on hillsides in deciduous forests on the ground with poorly acidic reactions
- leaves - simple, oblong elliptical, wedge-shaped base
- crust - thick, dark grey, deeply longitudinally furrowed
- fruit - mostly individually, rarely in groups, capsules with a multitude of hairy, bent bunches

https://www.plantea.com.hr/hrast-cer/

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SESSILE OAK

- deciduous wood from the beech family
- growing in mountainous continental areas
- corresponds to a fresh soil, thrives weaker on soil acid reaction
- leaves- simple elliptical, wedge-shaped base (triangular), rounded top
- bark - grey-brown, deep longitudinal and radial furrowed
- fruit - three walnut (acorns) of small shells together sit on a very short stalk

https://www.plantea.com.hr/hrast-kitnjak/

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FIELD MAPLE

- Maple is a deciduous shrub or tree from the family *Sapindaceae*
- Widespread in central, western and southern Europe, south west Asia and north Africa
- Corresponds well to soft, deep, fertile, humid and basic soil
- Leaves-opposed, simple, lobed characteristic, cut to five lobes, long and wide
- Bark-initially smooth and thin, light grey to brown, gets dark with age, whitish, irregularly cracks

https://www.plantea.com.hr/javor-klen/

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KAŠTANSKI GAJ

15. LASER POINTER

Team Croatia
Reporter: Grgur Premec

15. LASER POINTER

Construct an optical device that uses a **laser pointer** and allows contactless **determination of thickness**. How precisely can you measure the **width** of a **single hair** using such device?

2

OUTLINE

Theoretical introduction
- Waves and interference
- Diffraction pattern

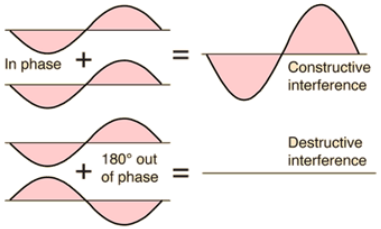
Experiment
- Experimental setup
- Measurement method

Results
- Laser
- Microscope

3

WAVES AND INTERFERENCE

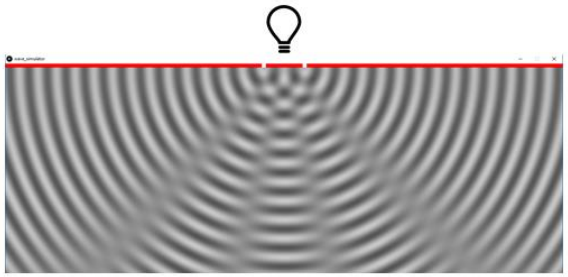
- Light
  - Wave – particle duality
- Interference
  - Constructive and destructive



4

WAVE SIMULATOR

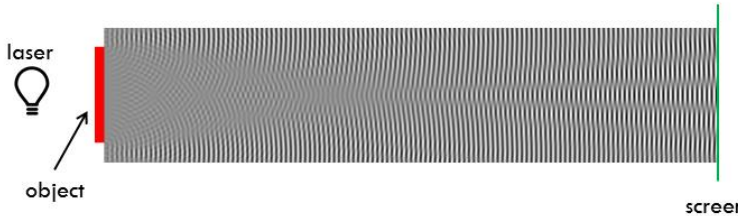
- Developed a visualization tool in Processing (Java)
- Pixel – sum of waves from many point sources
- Black/white – min/max displacement from equilibrium



5

DIFFRACTION

- Light bends around objects
- The waves interfere
  - Light and dark bands
  - Object size must be comparable to the wavelength of light



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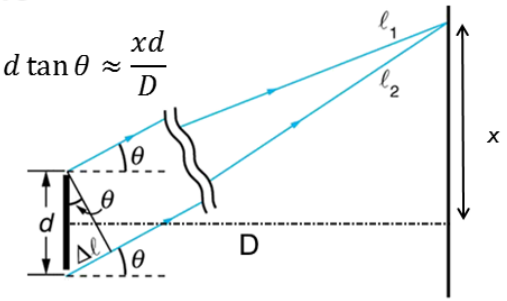
EQUATIONS

$$\Delta l = d \sin\theta \approx d \tan\theta \approx \frac{xd}{D}$$

$$d = \frac{n\lambda D}{x}$$

$$\lambda = \frac{dx}{nD}$$



d - object size
D - distance to wall
x - distance from center line to n^{th} diffraction line
n - number of diffraction lines
λ - wavelength of light

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HYPOTHESES

- The method will be **accurate** for **very thin objects** (tens of micrometers)
- The method will be **precise**
  - The only differences between the measurements will be caused while measuring the distance with a ruler

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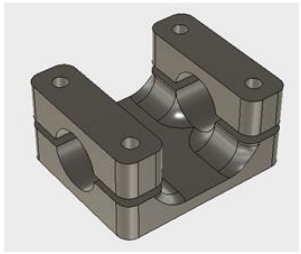
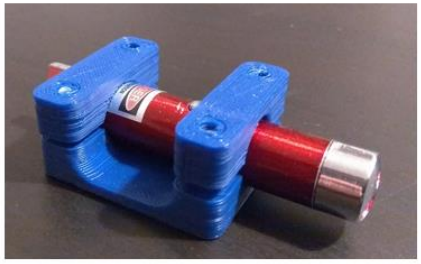
EXPERIMENTAL SETUP

- Laser
  - 3D printed holder
    - Designed in Autodesk Fusion 360
    - Printed on a Malyan M150





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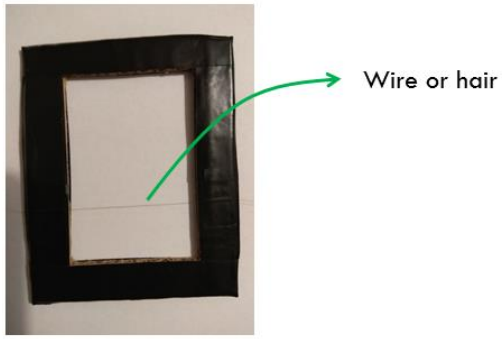
EXPERIMENTAL SETUP

- Cardboard frame
  - Objects to be measured are taped across it



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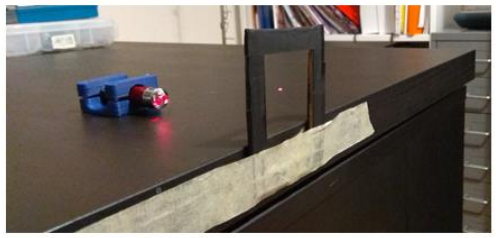
EXPERIMENTAL SETUP

- Table parallel to the floor
  - The frame was fixed to the table horizontally
- Object to be measured is horizontal
- Distance to wall = 2,44 m



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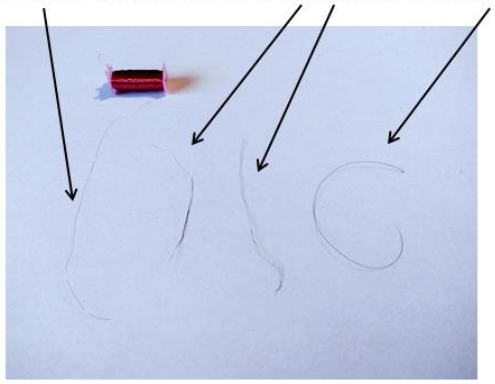
OBJECTS FOR MEASURING

- Thin copper wire, two kinds of artificial fur and human hair



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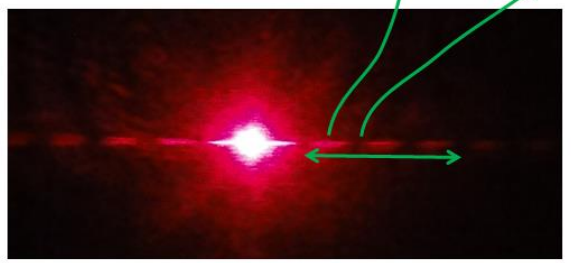
MEASURING

- Completely dark room
- Measuring with a pen and a ruler
  - The distance between 3 dark areas
  - Each measurement repeated 10 times



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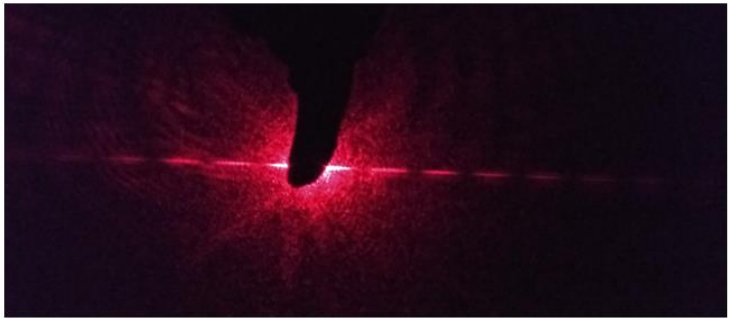
WHILE MEASURING

- Blocking the center spot with finger



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LASER RESULTS

$$d = \frac{n\lambda D}{x}$$

Object	Measured distance (x)	Object thickness (d)
Human hair	63.3 mm ± 0.8 mm	74.0 µm ± 1.0 µm
Artificial fur 1	27.5 mm ± 0.9 mm	170.4 µm ± 3.2 µm
Artificial fur 2	27.1 mm ± 0.7 mm	172.9 µm ± 3.9 µm
Copper wire	81.7 mm ± 0.8 mm	57.3 µm ± 0.6 µm

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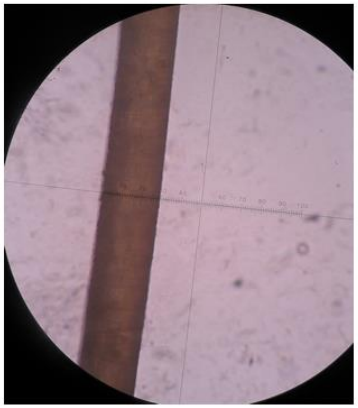
MICROSCOPE MEASURING

- Alternative method
  - Compare the accuracy
  - "True" thickness
- Binocular microscope
  - 400x magnification
  - A measuring scale in the eyepiece
- 2.5µm divisions (on 400x magnification)



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MICROSCOPE RESULTS

Object	Object thickness	Difference from laser
Human hair	72.5 µm ± 0.625 µm	-1.5 µm (2.07%)
Artificial fur 1	175 µm ± 0.625 µm	4.64 µm (2.65%)
Artificial fur 2	172.5 µm ± 0.625 µm	-0.37 µm (0.21%)
Copper wire	57.5 µm ± 0.625 µm	0.16 µm (0.28%)

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CONCLUSION

- The method will be **accurate** for **very thin** objects (tens of micrometers) ✓
  - Maximum difference from the real value 5.64µm (2.65%)
    - **Real value** obtained through **microscope** measurements
  - Objects between about 60 and 170 µm
- The method will be **precise**
  - **Maximum error** across all measurements: 2.9% ✓

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LITERATURE

Abbie Tippie, Tammy Lee, "Experiments with Diffraction", http://www2.optics.rochester.edu/workgroups/berger/EDay/EDay2008_Diffraction.pdf

Glenn Elert, "Diameter of a Human Hair"

Flinn Scientific, "Measuring by Laser Diffraction"

https://physicsofamerica.weebly.com/the-doppler-effect-and-sound-interference.html

https://www.clasohlson.com/uk/Laser-Pointer-Keyring/40-7967

http://philschatz.com/physics-book/contents/m42508.html

http://hyperphysics.phy-astr.gsu.edu/hbase/phyopt/slits.html#c1

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THANK YOU!

Team Croatia
Reporter: Grgur Premec

WAVE SIMULATOR CODE

```
int wavelength = 50;
int slitW = 200;
int slitD = 100;
int slitN = 1;

void setup()
{
  size(1500, 800);
  background(255);

  stroke(255, 0 , 0);
  fill(255, 0 , 0);
  rect(0, 0, width, 10);

  stroke(255);
  fill(255);
  for (int i = 0; i < slitN; i++)  {
    rect((width - slitN * slitW - (slitN - 1) * slitD) / 2 + i * (slitW + slitD), 0, slitW, 10);
  }
}

void draw()
{
  for (int x = 0; x < width; x++)  {
    for (int y = 0; y < height; y++)  {
      float amp = 0;
      for (int i = 0; i < slitN; i++)  {
        for (float j = (width - slitN * slitW - (slitN - 1) * slitD) / 2 + i * (slitW + slitD); j < (width - slitN * slitW - (slitN - 1) * slitD) / 2 + i * (slitW + slitD) + slitW; j = j + 0.1)
        {
          amp += sin((sqrt(y*y + (j-x)*(j-x)) / wavelength) * 2*PI);
        }
      }
      stroke(amp/20+127);
      point(x, y+10);
    }
  }
  noLoop();
}
```

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FORMULA WITH NO APPROXIMATION

$$a^2 = D^2 + \left(x - \frac{d}{2}\right)^2$$

$$b^2 = D^2 + \left(x + \frac{d}{2}\right)^2$$

$$\downarrow$$

$$b = a - n\lambda$$

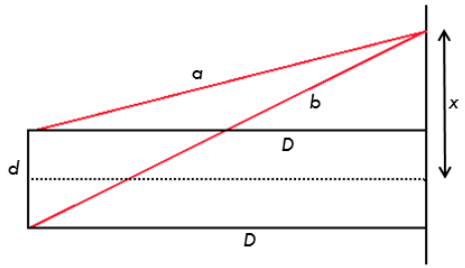
$$(a - n\lambda)^2 = D^2 + \left(x + \frac{d}{2}\right)^2$$

$$\downarrow$$

$$\sqrt{D^2 + \left(x - \frac{d}{2}\right)^2} = \sqrt{D^2 + \left(x + \frac{d}{2}\right)^2} - n\lambda$$

$$\downarrow$$

$$d = \frac{n\lambda\sqrt{4D^2 + 4x^2 - n^2\lambda^2}\sqrt{4x^2 - m^2}}{4x^2 - m^2}$$



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FORMULA COMPARISON

Without approximation	With approximation	Realtive difference
74.01224584	74.00947867	0.0037%
170.3575659	170.3563636	0.00071%
172.8720335	172.8708487	0.00069%
57.34506475	57.34149327	0.0062%

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ISTRAŽIVAČKI CENTAR MLADIH