



Na putu do medalje

IYNT 2018.



Voditelj Hrvatskog tima

Danko Marušić

Donatori i sponzori

comping

LET IT BE PERFECT

EXPORTDRVO

FER
UNIVERSITY OF ZAGREB
FACULTY OF
ELECTRICAL
ENGINEERING
AND COMPUTING



KARLOVAC

Grad Slatina



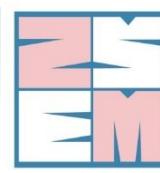
KAROLINA ŠIMEK MATO OSTOJIĆ

RAVEL Projektiranje
Nadzor
Gradjenje

Sedam IT



XV. GIMNAZIJA ZAGREB



zagrebačka
škola ekonomije
i managementa
zagreb school
of economics
and management

ELEMENT



Meridijani
Izdavačka kuća



Mozaik knjiga **Školska knjiga**

Slike

sudionici IYNT 2016. te IYNT 2017.

Dokument izradili

Dunja Vesinger, Domagoj Pluščec i Una Pale

Kolovoz 2017., Zagreb

SADRŽAJ

IZVJEŠTAJ IZ KINE.....	4
SLIKE S DRŽAVNOG TURNIRA MLADIH PRIRODOSLOVACA.....	5
SLIKE SA MEĐUNARODNOG NATJECANJA IYNT 2017., NANJING, KINA	9
PREZENTACIJE PROBLEMA HRVATSKE EKIPE	18
Problem 1. Invent yourself: Good guesses	19
Problem 3. Invent yourself: Curved mirrors.....	26
Problem 4. Invent yourself: Language barriers	30
Problem 5. Invent yourself: IYNT grades	35
Problem 7. Growing through asphalt	42
Problem 9. Salt production.....	47
Problem 10. Rijke's tube.....	53
Problem 11. Grow light.....	57
Problem 12. Milk	64
Problem 16. Paper wrinkles.....	69
Problem 17. Tornado machine	76

IZVJEŠTAJ IZ KINE

„Kina je bila jedno novo sasvim drugačije iskustvo. Bilo je zabavno upoznavati nove ljudе i novu kulturu. Natjecanje je bilo napeto, ali ponosna sam na tim i voditelje zbog kojih imamo broncu u rukama. Stekla sam puno novog: znanja, iskustva, prijatelja i uspomena :)"

Elena

"Zaista je zanimljivo bilo upoznati daleku Kinu i njenu kulturu. Nisam mogla ni predvidjeti kako će sve to izgledati dok nismo sletili u zračnu luku u Shanghaiju. Sve u svemu jako neobično, pomalo kaotično, ali lijepo na svoj način. No, hrana i nije bila tako loša iako je većini kolega iz tima to bio veliki kulturni šok..."

Fokus je ipak bio na turniru, nije bilo toliko vremena za razgledavanje. Veliko iskustvo mi je bilo i pripremati radove za ovaj turnir, a još posebniye "boriti se" na samom turniru.

Naučila sam kako funkcionirati u timu, raspavljati s drugim ekipama na pristojan način, argumentirajući, prepoznati probleme i postaviti pitanja. I naravno, kako biti donekle normalan s malo spavanja...

Naučila sam ponešto i o sudcima, o tome kako različiti ljudi jako različito ocjenjuju i gledaju potpuno druge stvari kod znanstvenog rada.

Nikada neću zaboraviti prijateljsku utakmicu hrvatskog i iranskog tima. Nakon znanstvene borbe smo unatoč jakoj kiši odlučili zaigrati nogomet sa šest cura iz Irana, a pridružili su nam se i voditelji.

Najljepše mi je na turniru bilo družiti se s članovima drugih timova, shvatila sam da smo svi mi isti i da se dobro razumijemo, jer nas zanima znanosti i svijet koji nas okružuje, da to ne ovisi o tome odakle dolazimo."

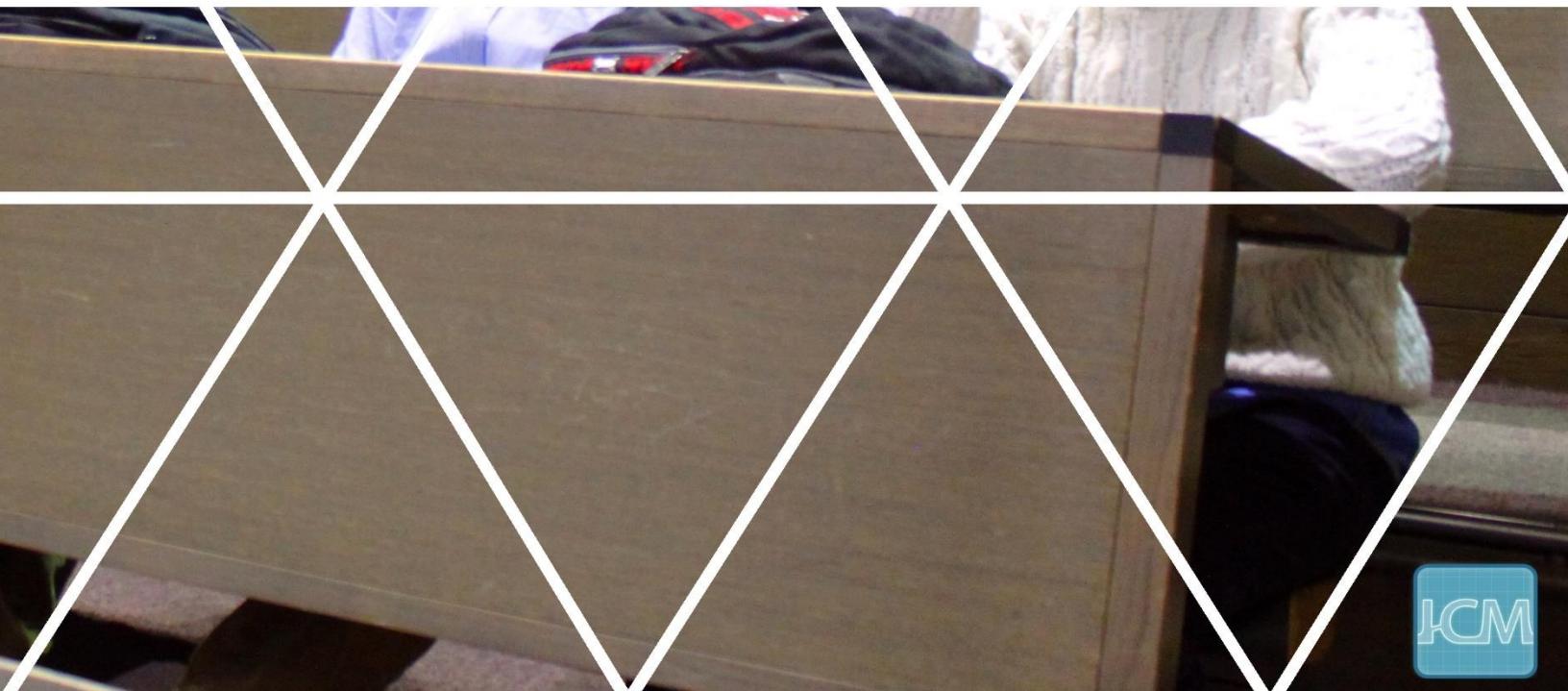
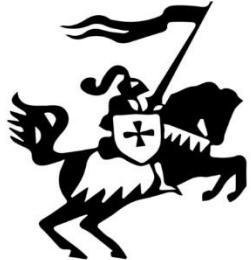
Andrea

„U Kini je bilo super. Čim smo došli bilo mi je malo čudno jer je grad dosta zagađen, a ja sam navikla na prirodu i naš mali grad, a i hrani prvih dana nisam mogla jesti. Nije bilo vremena za upoznavanje ljudi okolo jer smo cijelo vrijeme bili u toj školi. Navečer smo opet pripremali se za sljedeći dan. Imali smo jedan slobodan dan kad smo se kao turisti prošetali po gradu. Dok smo bili u školi, lako smo se sporazumijevali jer je to škola stranih jezika ali, u hotelu i po ulici bilo je teško jer oni ne znaju engleski. „

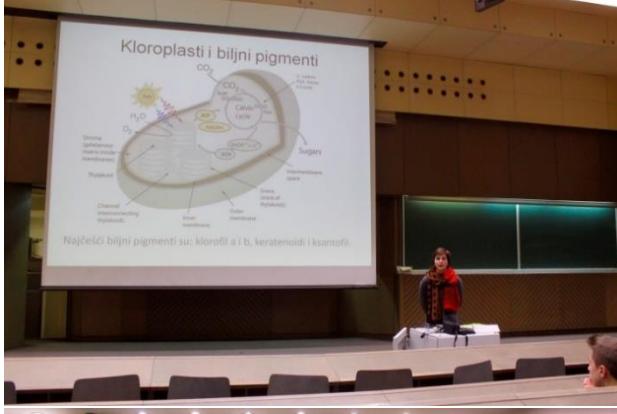
Mateja

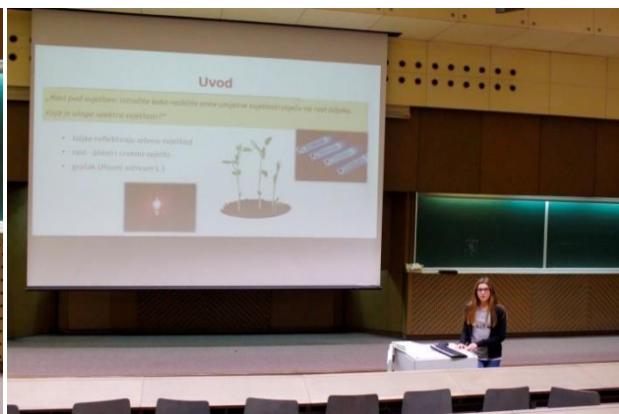


SLIKE S DRŽAVNOG TURNIRA MLADIH PRIRODOSLOVACA









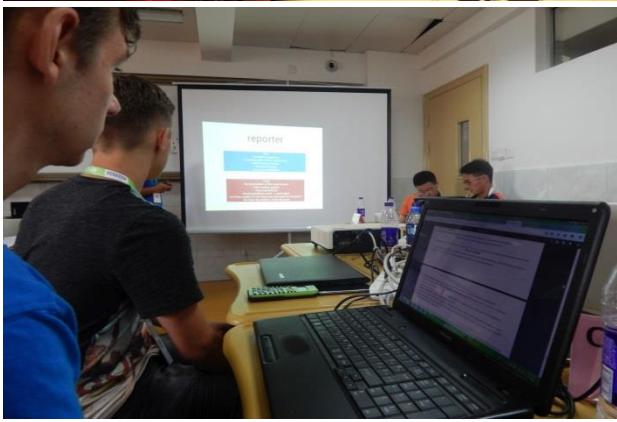


SLIKE S MEĐUNARODNOG NATJECANJA IYNT 2017.

NANJING, KINA

















General Council of the International Young Naturalists` Tournament

Nanjing 5th International Young Naturalists`
Tournament 2017 Organizing Committee

5th International Young Naturalists` Tournament 2017 – Nanjing, China

DIPLOMA

THIRD PLACE

This is to certify that the team
Croatia

Luka Bulić Bračulj (Captain)
Andrea Belamarić
Elena Lukačević
Luka Mikšić
Mateja Ostojić
Mihael Pristav
Danko Marušić (Leader)

has achieved 3rd place and earned Bronze Medals
at the 5th International Young Naturalists' Tournament 2017

Dr. h.c. Evgeny YUNOSOV
Chairman of the General Council

Mr. ZOU Zheng
Principal of NFLS



Dr. Ilya MARTCHENKO
Speaker of the General Council

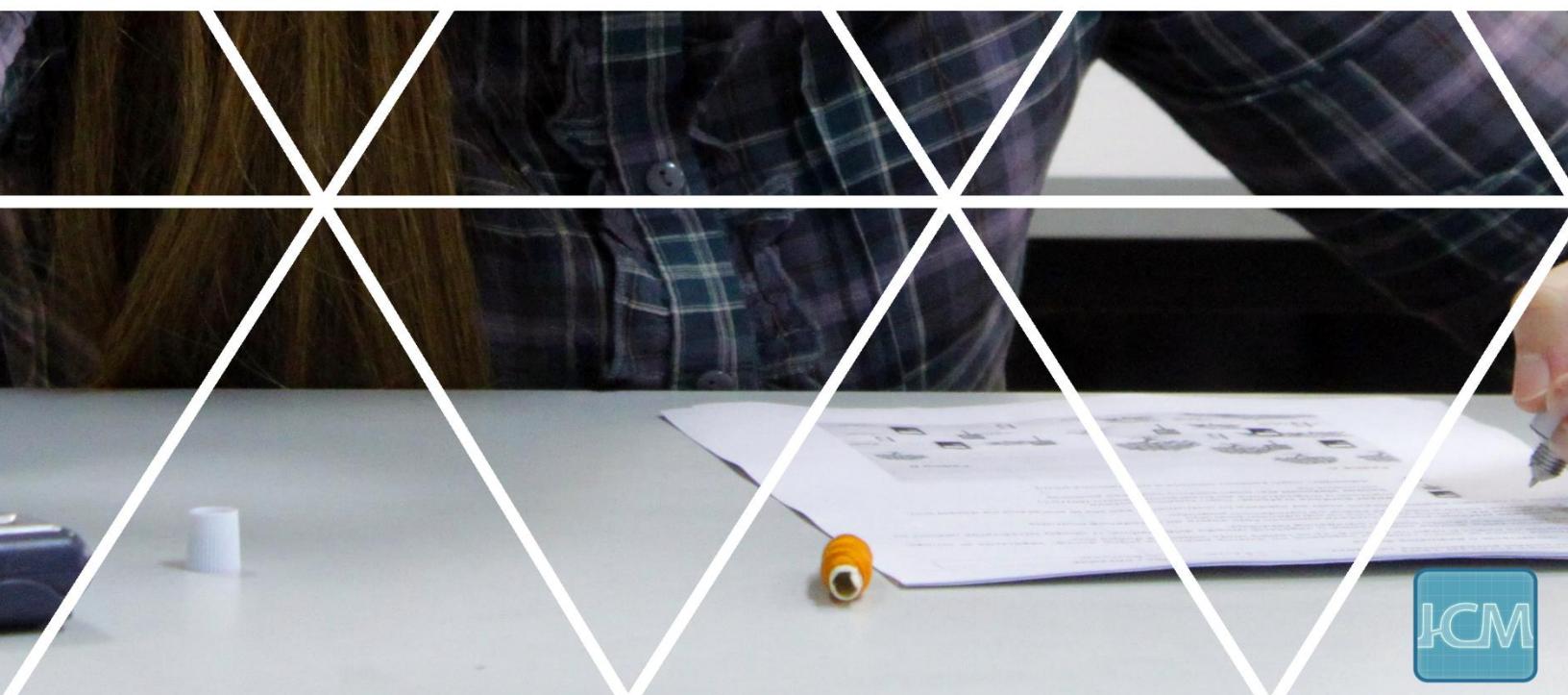
Mr. FENG Shaodong
Vice President, Jiangsu Association
for Science and Technology

Nanjing, July 04, 2017

www.iynt.org



PREZENTACIJE PROBLEMA HRVATSKE EKIPE



Problem 1. Invent yourself: Good guesses



Croatia Team
Reporter: Andrea Belamarić

Problem 1: Invent yourself:
Good guesses



• Problem 1:

"In 1906, Francis Galton observed a contest where 800 farmers guessed an ox's weight. To his surprise, **the median of the guesses was within 0.8% of the true measured weight**. What is the chance of obtaining such a good match by coincidence? Select an interesting and important parameter, measure it and give a group of human observers the task to guess the value of the parameter. Discuss the results of your experiments."



Formulation

- Impact:
 - Parameter
 - Expertise of the examinees
 - Size of the group
- Hypotheses:
 - 1) Some parameters are easier to estimate
 - 2) Greater expertise gives better result
 - 3) Bigger group gives better result



Theory

"Wisdom of the crowd"

- Estimation of the group is more accurate than individual
- Errors do compensate
- Individuals have to be independent, no agreement!



Some statistics...

- Mean

$$\frac{7 + 19 + 22 + 27 + 53}{5} = 25.6$$
- Median – central value of a list
 7 19 22 27 53
- Standard deviation – dispersion of the values

$$\sqrt{\frac{(25.6 - 7)^2 + (25.6 - 19)^2 + (25.6 - 22)^2 + (25.6 - 27)^2 + (25.6 - 53)^2}{5}} = 15.2$$



The experiment

1) School colleagues

Parameters

- mass of a pumpkin
- length of a rope
- number of marbles in a jar

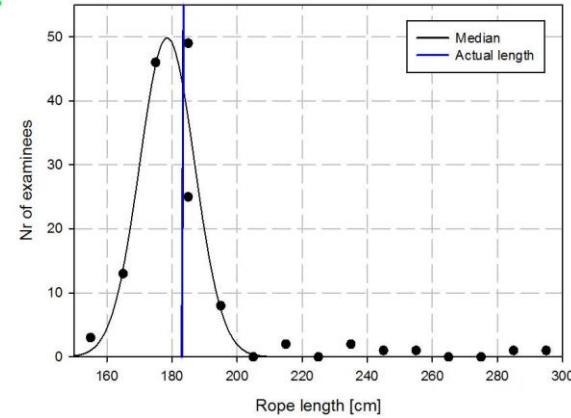


2) Sellers on a marketplace

- mass of a pumpkin



PARAMETER

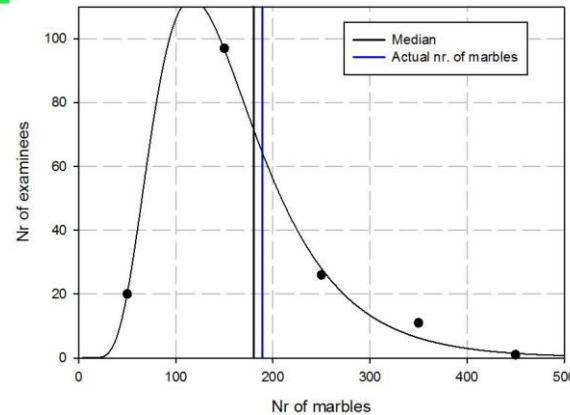




Length of a rope

	students
Number of examinees	152
Real value	183 cm
Median	183 cm
Median error	0 %
Standard deviation	19.2 cm → 11 %
Average individual error	12 cm
Group error	0 cm
Examinees better or equal to the group	4%

EASY TO ESTIMATE



10



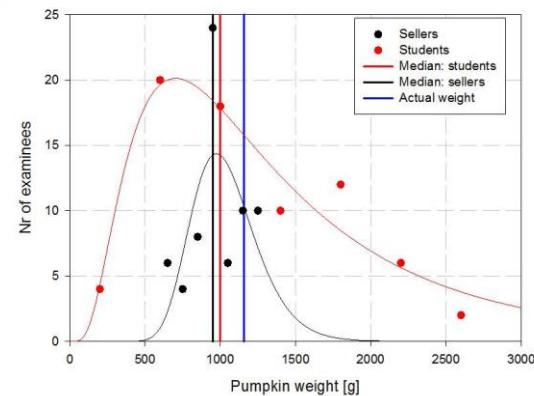
Marbles in a jar

	studnets
Number of examinees	152
Real value	189
Median	180
Median error	5 %
Standard deviation	70 → 37%
Average individual error	51
Group error	9
Individual / group error ratio	5.7
Examinees better than group	16%

DIFFICULT TO ESTIMATE



EXPERTISE



13

Results – pumpkin



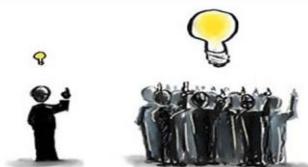
	students	sellers
Number of examinees	70	
Real value		1158 g
Median	1000 g	950 g
Median error	14%	18%
Standard deviation	718 g → 62%	283 g → 24%
Distribution range	100 g - 2600 g	700 g - 1300 g



Results – pumpkin



	students	sellers
Average individual error	663 g	188 g
Group error	158 g	208 g
Individual / group error ratio	4.2	0.9
Percentage of examinees better than group	11.8%	51.4%



GROUP SIZE

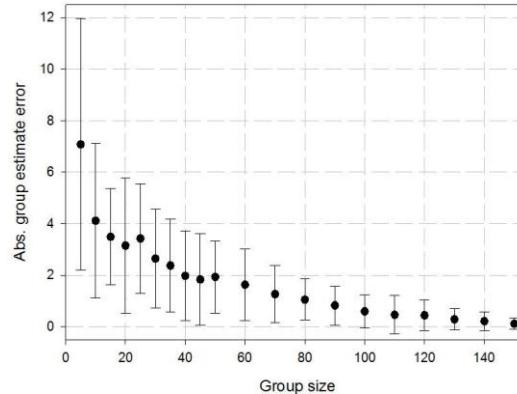


Group size

- Max. 152 examinees
- Subsets of sizes 5-140
→ 50 randomly picked subsets
 - medians and their error
 - median of medians



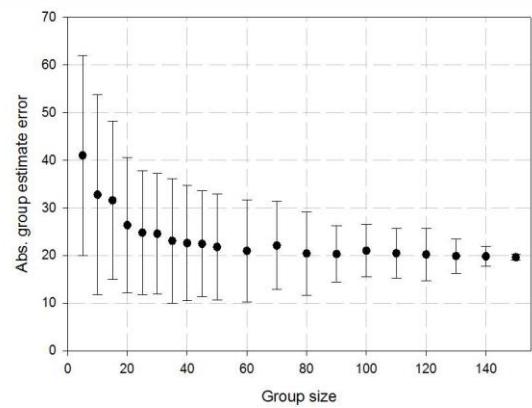
Rope



18



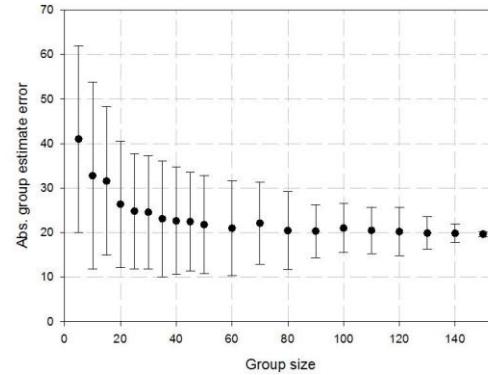
Marbles



19



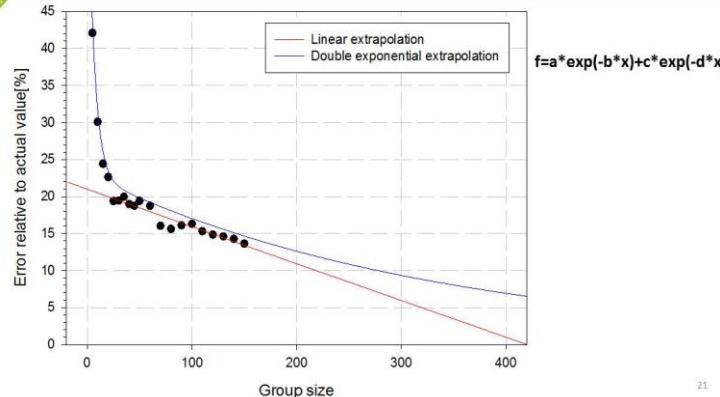
Pumpkin



20



Could Galton achieve such accuracy?



21



Conclusion

Galton's result is not a coincidence: hypotheses of this investigation is approved!

- 1) Some parameters are more difficult to estimate: weight, volume (more dimensions...)
- 2) Expertise does not influence the group estimation median, just standard deviation
- 3) Estimation of a bigger group is better. If group size is bigger it less matters how we choose the group



Literature

- Is "Group Size" the Best Measure of Accuracy?, by John E. Leslie III, 1993.
- <http://galton.org/essays/1900-1911/galton-1907-vox-populi.pdf?page=7>
- <http://sciencing.com/count-jelly-beans-jar-4913844.html>
- Boris Petz: Statistics



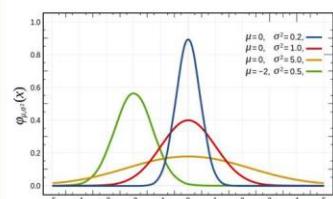
Thank you!



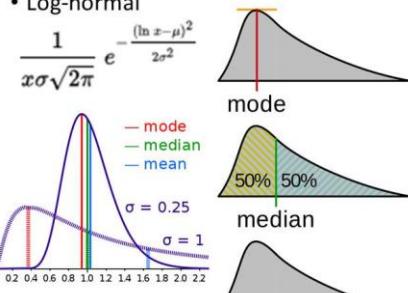
Distribution

- Normal

$$f(x | \mu, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



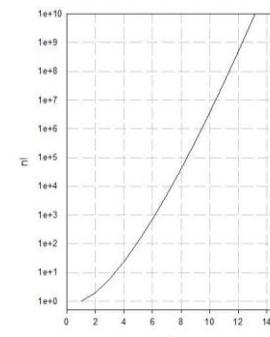
- Log-normal



Choosing random subset

- Subset of k from set of n:

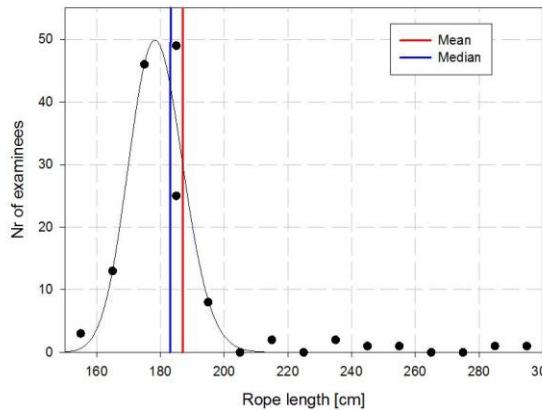
$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$



26



Median and mean



27

Problem 3. Invent yourself: Curved mirrors



Problem 3. Curved mirrors

"Suggest and demonstrate interesting experiments in which large concave mirrors can be used to heat up or cool down various objects.,,"

- heating an object by giving it thermal energy of another object
- thermal radiation
- redirecting the thermal radiation with mirror



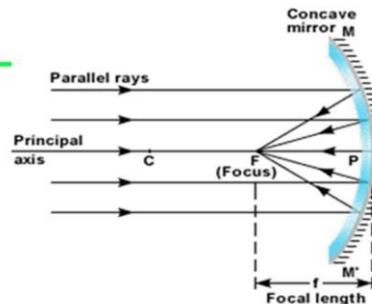
Purpose of investigation

- the goal of this investigation is heating water with concave mirror
- comparison of heating curve of water with and without curved mirror
- research on how temperature change during heating depends on the power of source
- Compare the results of experiment with calculated and predicted data and if there is a difference, explain it



Concave mirror

- redirecting radiation
- focal point-point where parallel rays cross after they hit the surface of mirror
- focal length-length from mirror to focus





Thermal radiation-the process through which energy is emitted from a heated object in all directions in the form of electromagnetic radiation.

$$Q=mc\Delta T$$

2. Law of Thermodynamics-heat can flow spontaneously from a hot object to a cold object.

$$P = \frac{\Delta E}{t} = \frac{Q}{t}$$

Hypothesys

- Water will heat up faster when thermal radiation is focused onto it with concave mirror.



Experimental setup



Light bulbs (ouurce of heating)



Light bulbs of different power
35W, 55W, 70W, 140W, 190W



Mirrors



Focus: 14cm
width:30



Measuring devices



Vernier LabQuest stream device and stainless steel temperature probe



Rest of setup



Light bulb throat



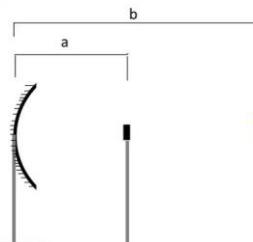
Metal stand



Black plastic box



Measuring and data acquisition



$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

$$\eta = \frac{r^2 \pi}{4b^2 \pi} P_{zrcalo} = \eta P_{uk}$$

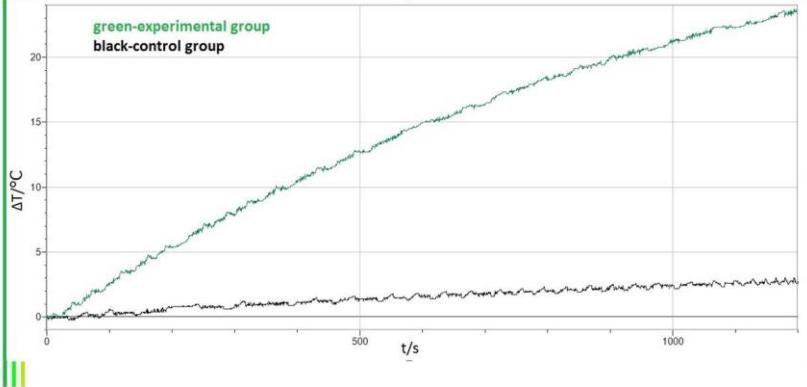
$$\Delta T = \frac{t * P_{zrcalo}}{mc}$$

- t: 20 min(time in which water was heated)
- a=18 cm(distance from mirror to water)
- b=63 cm(distance from mirror to light bulb)
- η=1,42%(percent of energy which mirror redirect to water)
- r=15cm(radius of mirror)
- m: 15 g(mass of water)
- f=14cmP
- P_{uk}(power of light bulb)
- P_{zrcalo}(power of light bulb used for heating water)
- ΔT(change of temperature of water for given time)
- control group
- data processing is performed in the program LoggerPro
- comparison between control and experimental group
- comparison between light bulbs
- comparison between predicted and measured data



Results

- Water heathened using mirror developed higher temperatures then the one heathened without it
- Change of temperature of water grew wenn power of ligh bulb was higher
- In perfect conditions(when wattter does not give its energy to air arround it) heating curve would be a linear funktion
- Predicted results
- Predicted data was higher and grew linearly in time, whenn on the other hand, measured dana did not grew linearly and was lower then expected
- With the rgrowth of power of ligh bulb temperature changes measured:non linear
expected: linear



Conclusion

- sound level is reversaly proportional to the length of the pipe
- sound level is reversaly proportional to the diameter of the pipe

Problem 4. Invent yourself: Language barriers



Team Croatia
Reporter: Luka Bulić Bračulj

Problem 4: Invent yourself: Language barriers

Problem

- Speakers of related but different languages or dialects can sometimes understand each other, without any prior intentional study. Propose an interesting study of such a mutual intelligibility. Investigate it experimentally for the pairs of dialects or languages of your choice. Introduce and determine quantitative parameters.
- Examine mutual intelligibility of South Slavic languages. Does it depend on their relatedness or geographical proximity?



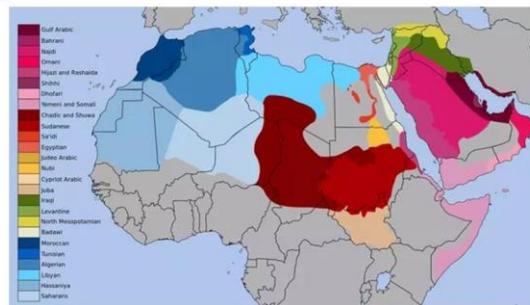
Mutual Intelligibility

- A relationship between languages or dialects in which speakers of different but related varieties can understand each other without prior familiarity
- Sometimes used as a criterion for distinguishing languages from dialects



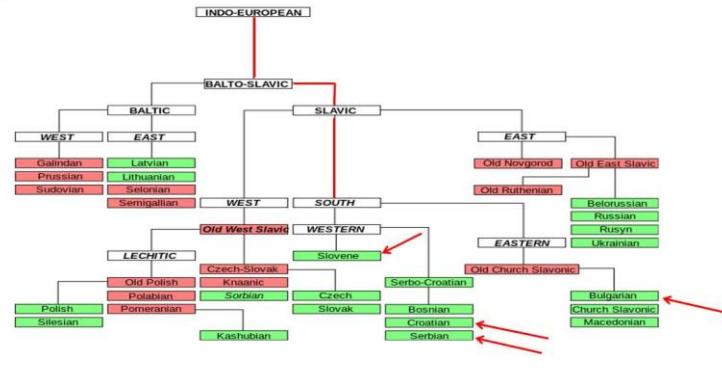
Dialect Continuum

"A spread of language varieties spoken across some geographical area such that each differs only slightly from its neighbors, but the differences accumulate over distance so that widely separated varieties are not mutually intelligible"





Slavic Languages



Slavic languages



Hypotheses

- Croatian and Serbian will be most mutually intelligible
 - Sometimes considered a same language
- Slovenian will be asymmetrically mutually intelligible with Croatian and Serbian
 - From experience
- Bulgarian will be least mutually intelligible with all languages
 - Least related with all other languages
- Slovenian and Bulgarian will be least mutually intelligible
 - Dialect continuum
 - Geographically most distant
- Relatedness and mutual intelligibility will be related

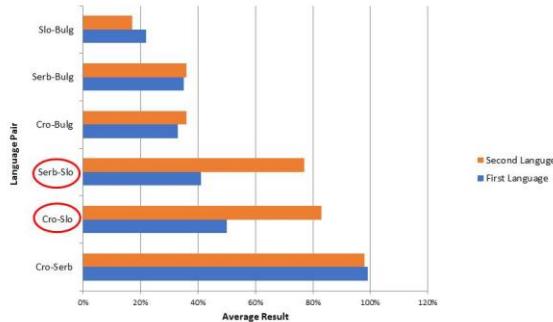


How to Test Mutual Intelligibility?

- | | |
|--|---|
| <ol style="list-style-type: none"> Word Translation Cloze Test Picture Test | <ol style="list-style-type: none"> Written Spoken |
|--|---|



Asymmetrical Intelligibility



Conclusion

- Croatian and Serbian are most mutually intelligible
 - They could be classified as a same language
- Bulgarian is least mutually intelligible for all languages
- **Related languages are more mutually intelligible**
- Least mutually intelligible pair is Slovenian-Bulgarian, which is also most geographically distant pair
- Mutual intelligibility in Croatian-Slovenian and Serbian-Slovenian is asymmetrical



Literature

- Golubović J., Gooskens C. : Mutual intelligibility between West and South Slavic languages, 2015, University of Groningen
- Encyclopaedia Britannica (www.britannica.com) 13:20, 19.04.2017.
- en.m.wikipedia.org/wiki/Slavic_Languages, 13:30, 19.04.2017.
- Eifring, H., Theil, R.: Linguistics for Students of Asian and African Languages, 2005, University of Oslo



Thank you for attention!



p-values

Cro-Serb	0,7384
Cro-Slo	0,0004
Cro-Bulg	0,8349
Serb-Slo	0,0013
Serb-Bulg	0,7592
Slo-Bulg	0,5360

Problem 5. Invent yourself: IYNT grades



Team Croatia
Reporter: Luka Bulić Bračulj

Problem 5: Invent Yourself:
IYNT grades



Problem

- An upwards of four thousand grades that Jurors have given in Science Fights of previous four IYNTs can reveal properties and hidden regularities of the IYNT grading. Suggest an interesting hypothesis that concerns the IYNT grades and test it with real data from previous IYNTs.
- Investigate differences in strictness between grades of different jurors. Examine the possibility of bias in grading.



Bias

- Inclination or prejudice for or against one person or group, especially in a way considered to be unfair.
- A systematic distortion of a statistical result due to a factor not allowed for in its derivation.

Conscious bias

Unconscious bias



Bias in sports

- Bias is present in everything that includes subjective grading

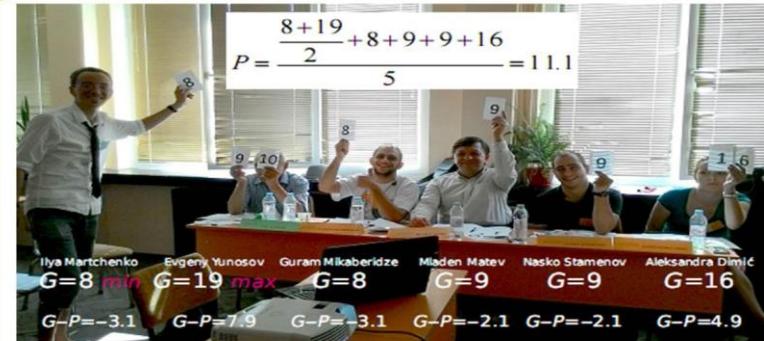




How IYNT decreases bias?

- Increased number of judges
 - Law of large numbers
- Taking average of highest and lowest grade as a single grade
- Tolerance of ± 2 points
- Dividing grading in different parameters

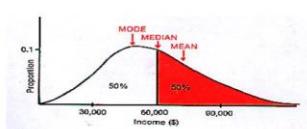
	for Reporter	Range	for Opponent	Range	for Reviewer	Range
a	Essence of the Report, Results, Scientific methods, Vision of scientific context, correctness of justified conclusions, team work , original ideas, depth, originality , team work , resourcefulness.	-8...+6	Objectivity, Relevance, Resource analysis, Relevance, non-intrusive, interesting questions, team work , original ideas, depth, originality , team work , resourcefulness.	-4...+4	Impact of the Report, Analysis, Review, Relevance, interesting questions, team work , original ideas, depth, originality , team work , resourcefulness.	-2...+2
b	Reactions to critique, Answers, team work , team work .	-3...+3	Reactions to critique, active, points arguments, team work .	-2...+2	Reactions to critique, active, wrap up of the Stage.	-1...+1
Y	Structured and persuasive presentation, team work .	-3...+3	Structured and persuasive presentation, team work .	-2...+2	Structured and persuasive presentation, team work .	-1...+1
G	Techniques visualizations, demonstrations, team work .	-2...+3	Techniques visualizations, team work .	-1...+2	Techniques visualizations, team work .	-0...+1



Statistics

- Mean value
- Median
- Mode

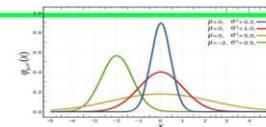
$$\bar{X} = \frac{X_1 + X_2 + X_3 + \dots + X_N}{N}$$



Statistics

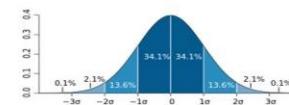
- Gaussian curve

$$f(x) = \frac{1}{\sigma \sqrt{2\pi}} e^{-(x-\mu)^2/(2\sigma^2)},$$



- Standard deviation

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$



- T-test

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

$$d.f. = \frac{\left(\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}\right)^2}{\frac{1}{N-1} \left(\frac{s_1^2}{N_1}\right)^2 + \frac{1}{m-1} \left(\frac{s_2^2}{N_2}\right)^2}$$



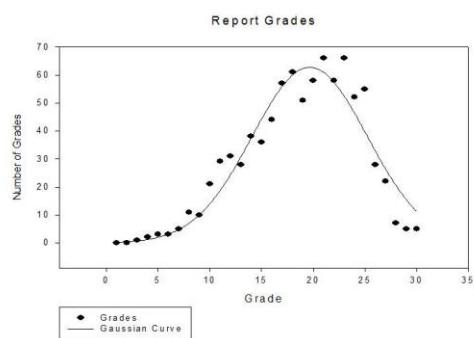
Statistics

- P-value
 - $P>0,05 \Rightarrow$ statistically insignificant
 - $P<0,05 \Rightarrow$ statistically significant



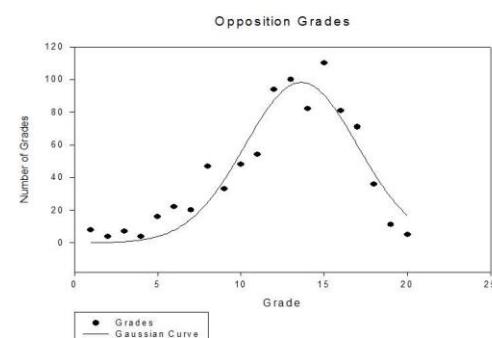
Report

Mean = 18,89
Median = 19
Mode = 21 & 23
 $R^2 = 0,9157$



Opposition

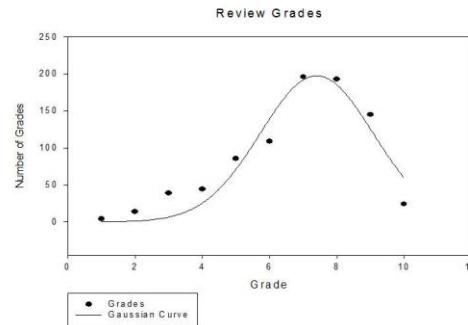
Mean = 12,71
Median = 13
Mode = 15
 $R^2 = 0,8871$





Review

Mean = 6,88
Median = 7
Mode = 7
 $R^2 = 0,9062$

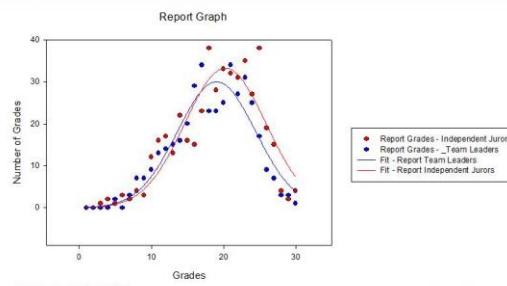


Independent Jurors VS Team Leaders

- Hypothesis:
 - There will be a statistically significant difference
 - Average independent juror's grade will be lower



Independent Jurors VS Team Leaders

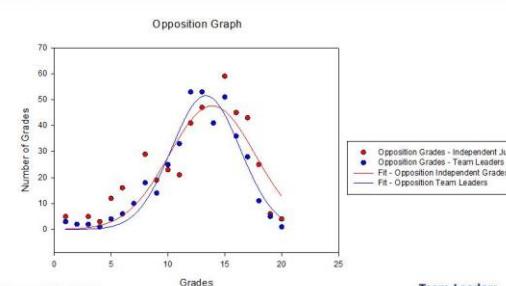


Independent Jurors
Mean = 19,25
Median = 20
Mode = 18
 $R^2 = 0,8372$

Difference: Statistically significant



Independent Jurors VS Team Leaders



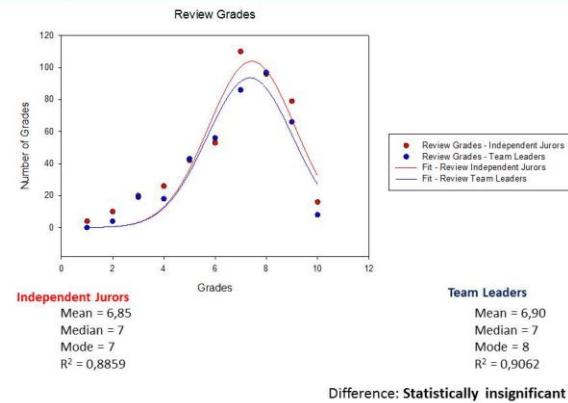
Independent Jurors
Mean = 12,68
Median = 13
Mode = 15
 $R^2 = 0,7848$

Team Leaders
Mean = 12,733
Median = 13
Mode = 12 & 13
 $R^2 = 0,9405$

Difference: Statistically insignificant



Independent Jurors VS Team Leaders

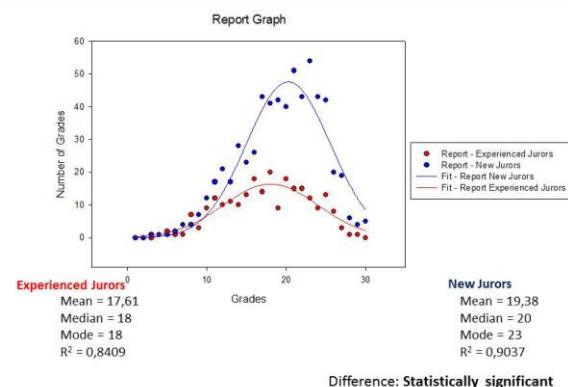


Experienced Jurors VS New Jurors

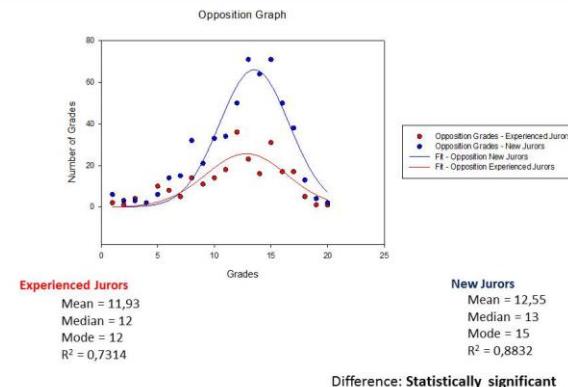
- Hypothesis:
 - There will be a statistically significant difference
 - Average experienced juror's grade will be lower



Experienced Jurors VS New Jurors

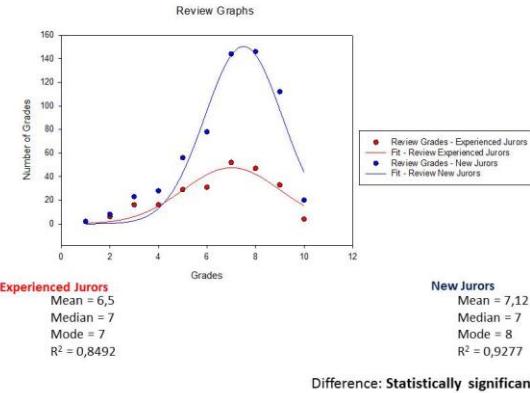


Experienced Jurors VS New Jurors





Experienced Jurors VS New Jurors

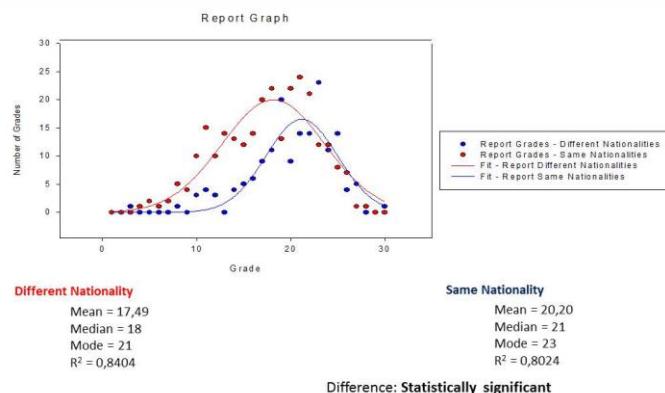


National Bias

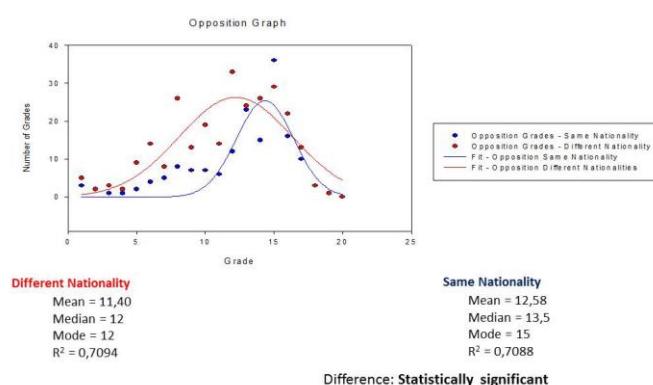
- Hypothesis:
- There will be a statistically significant difference
- Average grade will be higher when given by the juror from the same country as the reporter/opponent/reviewer



National Bias

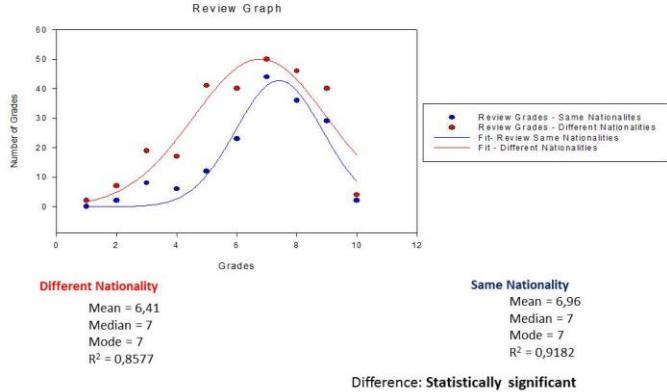


National Bias





National Bias



Conclusion

- There's a statistically significant difference between independent juror's grades and team leader's grades, but only for reporter
 - Team leaders gave lower average grade fo report
 - Worked more on problem solutions
- There's a statistically significant difference between experienced and new juror's grades
 - Experienced jurors gave lower average grade
- It's possible there was national bias in the IYNT 2016

International Young Naturalists' Tournament
IYNT 2017 NANJING

Luka Bulić Bračulj

Thank you for your attention!



P-value results

- Independent VS Team Leader
 - Rep: p= 0.0277
 - Opp p= 0.8397
 - Rev: p= 0.7005
- Experienced VS New
 - Rep: p< 0.0001
 - Opp: p= 0.0357
 - Rev: p= 0.0005
- National Bias
 - Rep: p< 0.0001
 - Opp: p= 0.0023
 - Rev: p= 0.0026

Problem 7. Growing through asphalt



Team Croatia
Reporter: Mateja Ostojić

Problem 7: Growing through asphalt

Problem

- Can a little plant grow straight up through concrete or asphalt?
- In everyday life we can see how different plants grow straight up through asphalt or concrete.
- Causes: → Asphalt has little gaps, and plants try to occupy the entire environment so they push the asphalt (with hydrostatic pressure). All plants will grow if they have optimum pH conditions and sufficient moisture.



Experiment

- 10 seeds of plants wheat covered with asphalt/concrete for every parameter.
- Average temperature: 21, 3°C
- **Different parameters tested**
 - Concrete vs. Asphalt
 - Percentage of cement in concrete
 - Thickness of asphalt layer
 - Type of substrate in which seed is sown



Growth





Hypothesis

Concrete vs. Asphalt

- Plants will grow better through asphalt than through concrete.

Percentage of cement in concrete

- Plants will grow better through concrete which has less cement.

Thickness of asphalt layer

- Plants will grow better through thinner layer of asphalt.
- Plants will continue their growth through asphalt, although they shoted up from humus.

Type of substrate in which seed is sown

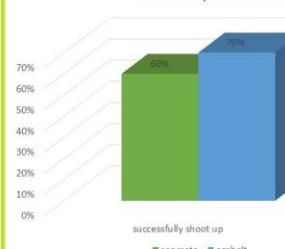
- Plants sown in humus will grow better than ones sown in sand.
- Plants sown in asphalt won't shoot up.



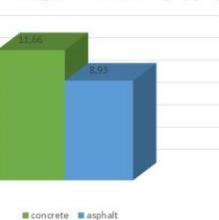
1st hypothesis:

- Plants will grow better through asphalt than through concrete.

How many of them shoted up?



Average time of shooting up(days)



WHY?



- Particles of concrete are mutually well connected , while there are gaps between particules of asphalt.
- I couldn't constrict asphalt.



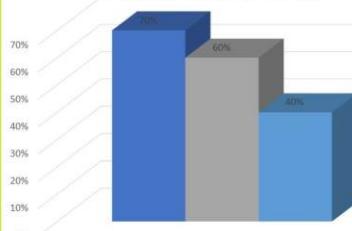
2nd hypothesis:



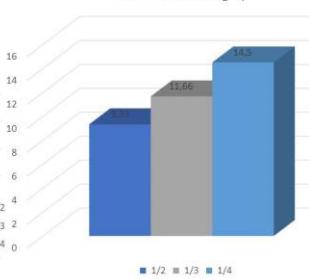
- Plants will grow better through concrete which has less cement.
- I covered just sown seeds with different types of concrete.
- The ratios of sand and cement were 1:2, 1:3 and 1:4.
- Layers of concrete were 2 cm thick.



How many of them shoted up?



Time of shooting up



3rd hypothesis:

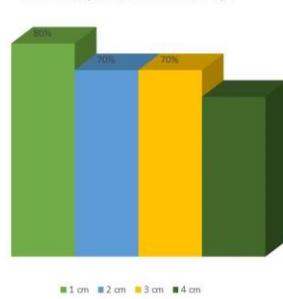
- Plants will grow better through thinner layer of asphalt.



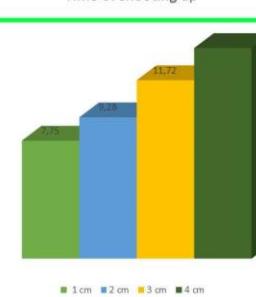
I covered plants with 1, 2, 3 and 4 cm os asphalt.



How many of them shoted up?



Time of shooting up



4th hypothesis:

- Plants will continue their growth through asphalt, although they shoted up from humus.



- I sown seeds of wheat in humus
- They shoted up after 6 and 7 days.
- I covered them with liquid asphalt after 11 days
- 70 % of wheat continued it's growth.



5th hypothesis:

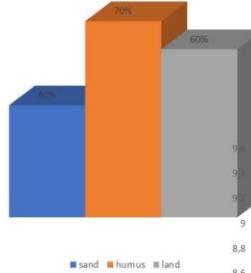


- Plants sown in humus will grow better than ones sown in sand.

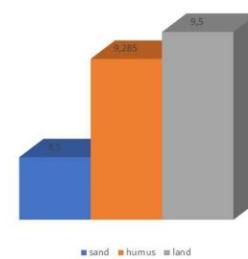
• Since plants shoot up from ground, not from asphalt, i assumed that they will grow fastest in bowls with most fertile land.



How many of them shoted up?



Time of shooting up



6th hypothesis

- Plants sown in asphalt will not shoot up.
- I sown 10 seeds in asphalt and watered them regulary
- None of them shoted up.



Conclusion

- 1) Plants will grow better through asphalt then through concrete.✓
- 2) Plants will grow better through concrete which has less cement.✓
- 3) Plants will grow better through thinner layer of asphalt.✓
- 4) Plants will continue their growth through asphalt, although they shoted up from humus.✓
- 5) Plants sown in humus will grow better than ones sown in sand✓
- 6) Plants sown in asphalt won't shoot up.✓



Problem 9. Salt production



Team Croatia
Reporter: Mateja Ostojić

Problem 9: Salt production

Formulation of the problem

➤ Solar evaporation of seawater or salt mining are common methods to produce common salt (NaCl). Propose a method to extract salt from a natural source and determine both productive capacity of your method and purity of the product. Demonstrate an amount of salt produced by your method.



Methods



CRYSTALLIZATION



EVAPORATION UNDER INFRARED LIGHT



EVAPORATION IN THE OVEN



EVAPORATION IN THE MICROWAVE



1) Crystallization





Hypothesis

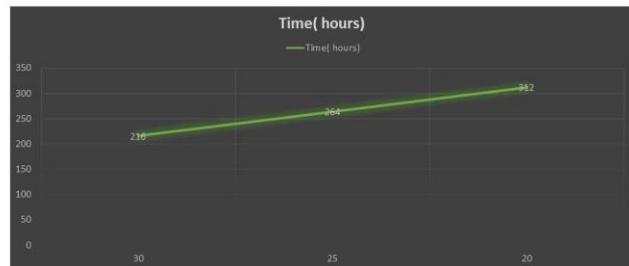
- 1) I will get the biggest amount of salt from the bowl with the biggest diameter.
- 2) Crystallization will be the fastest in the bowl with the biggest diameter.
- 3) Crystallization will be faster on higher temperature.
- 4) I will get bigger amount of salt in crystallization in which I used nylon thread than in crystallization in which I used cotton thread.
- 5) Crystallization will be faster when I use nylon thread.



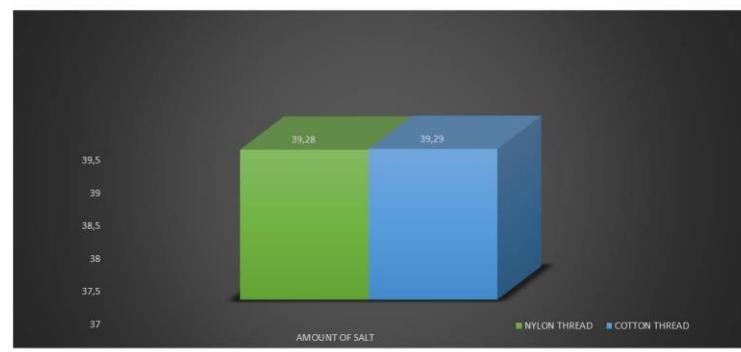
1) Does amount of salt depend on diameter of bowl?



2) How does radius of the bowl influence on time of crystallization?

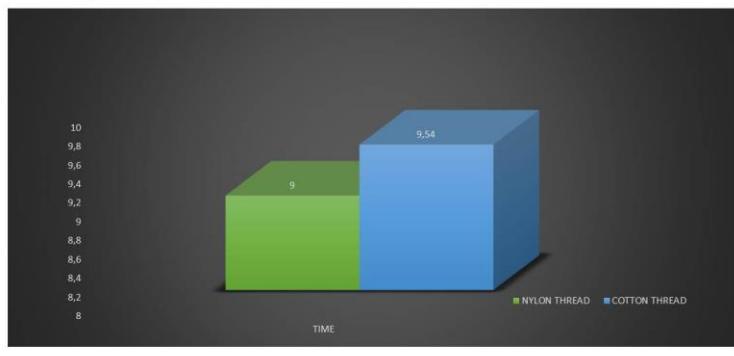


4) How does amount of salt depend on material of thread?





5) How does time of crystallization depend on material of thread?



CONCLUSION

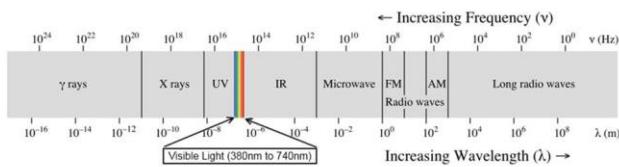
- 1) I will get the biggest amount of salt from the bowl with the biggest diameter. ✗
- 2) Crystallization will be the fastest in the bowl with the biggest diameter ✓
- 3) Crystallization will be faster on higher temperature. ✓
- 4) I will get bigger amount of salt in crystallization in which I used nylon thread than in crystallization in which I used cotton thread. ✗
- 5) Crystallization will be faster when I use nylon thread. ✓



2) Evaporation under different lights

I evaporated seawater under

- 1) visible light
- 2) infrared light
- 3) microwave light

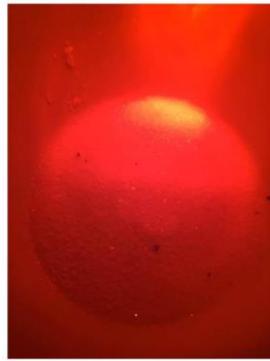


Hypothesis

- 1) I will get the same amount of salt from all three methods.
- 2) Evaporation will be fastest in the microwave.



Evaporation under infrared light



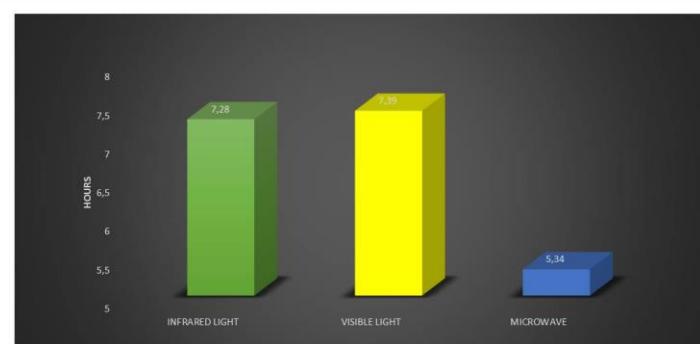
Evaporation under visible light



Evaporation in the microwave

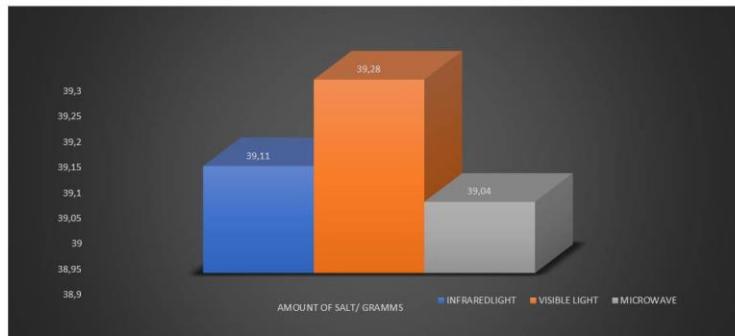


Time of evaporation





Amount of salt



Conclusion

- 1) I will get the same amount of salt from all three methods. ✓
- 2) Evaporation will be fastest in the microwave. ✓



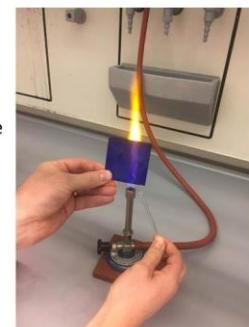
Testing purity of the product

- pH of NaCl solution is 7 neutral.
- I tested it's pH meter and it was 8.05, so I concluded there are some anions of low acid or cations of high alkali.
- I assumed there are: Fe³⁺, K⁺, Mg²⁺ and (SO₄)²⁻



Are there any other cations?

- Potassium's wavelength is 760 nm, so it burns in pink/violet colour and it is visible only under cobalt glass.
- Sodium wavelength is 589 nm, so it burns yellow/orange and it is visible to our eyes.
- I burned an example of salt and watched flame with cobalt glass.
- I concluded there is some potassium in my salt.



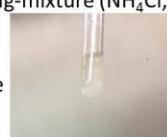


Are there any other kations?

- I tested iron with his reagent NH_4SCN .



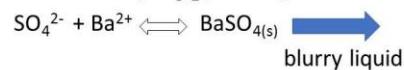
- I tested if there is any magnesium with his reagent Mg-mixture (NH_4Cl , MgCl_2 , $(\text{NH}_4)_2\text{CO}_3$)



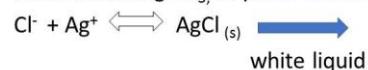
Are there any other anions?

- Firstly, I checked if there are any sulfates.

I added $\text{Ba}(\text{NO}_3)_2$, it's reagent.

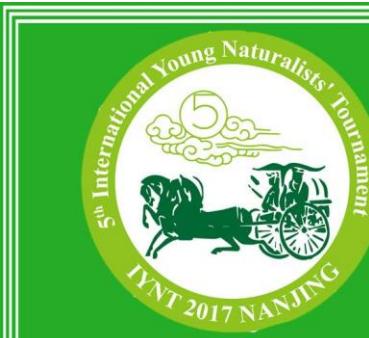


I also added AgNO_3 to prove there is a lot of Cl^-



Can we consume this salt?

SALT	FROM STORE	GOTTEN BY MY METHODS
pH	7,0	8,05
Tested by microbiologist	yes	No
Other elements	yes	yes
Iodinated	yes	no



Team Croatia

Thank you for your attention!

Problem 10. Rijke's tube

Team Croatia
Reporter: Mihail Pristav

Problem 10: Rijke's tube

Problem

"If air inside a vertical cylindrical tube open at both ends is heated, the tube produces sound. Study this effect."

- Pieter Rijke
- getting the sound by changing the temperature of air in tube



P. L. Rijke

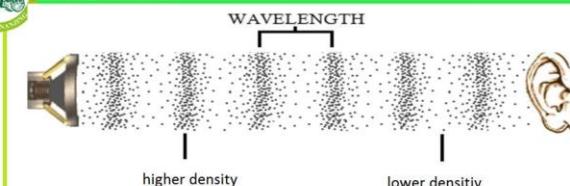


Purpose of investigation

- Determining the parameters on which the sound frequency in the tube depends
- Parameters: l , d



Sound



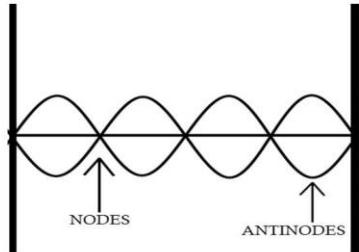
Longitudinal mechanical wave spreading in form of higher and lower densities

$$\Delta p(t) = \Delta p_{\max} \sin(\omega t)$$

$$f = v/\lambda$$

$$\omega = 2\pi f$$

label	meaning
Δp	Change of air pressure
t	Time from beginning to the end of the wave
f	Frequency of wave
v	Speed of wave spreading
λ	wavelength
ω	Circular frequency



- stationary wave
- A collision of a reflected harmonic wave with an original harmonic wave in the same medium

$$f = (2n + 1) \frac{v}{4L}$$

$$v = \sqrt{\gamma p V / m}$$

Hipothesys

- sound level is inversely proportional to the length of the pipe
- sound level is inversely proportional to the diameter of the pipe



Different lengths



Different diameters



Different materials



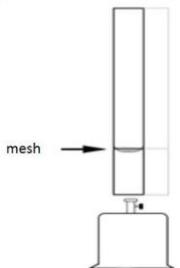
Measuring devices



Vernier LabQuest 2 device and sensor for measuring pressure differences



Measuring and data acquisition



$$y = A \sin (Bx + C) + D$$

- Warming the air in the tube
- Data aquisition was preformed in logerPro
- Reading the period and amplitude, frequency and circular frequency calculation

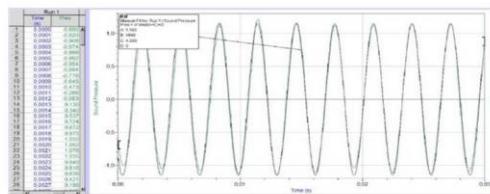


Figure 1. An example of the graph of the dependence of the air pressure on the time obtained by measuring (green color) and the function curve (black) that matches with it.

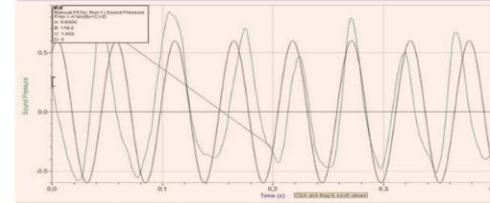


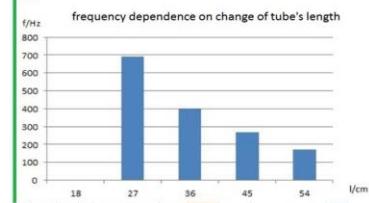
Figure 2. An example of the graph of the dependence of air pressure on the time obtained by measuring (green color) and the curve of the function (black color) that matches with it.



Results

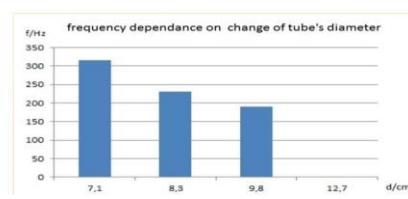
Broj cijevi	f/Hz	ω/s^{-1}
5	170	1068
6	270	1696
7	400	2513
8	690	4335
9	-	-

Frequency and circular frequency data for tubes of different lengths



Broj cijevi	f/Hz	ω/s^{-1}
1	-	-
2	190	1194
3	230	1445
4	316	1985

Frequency and circular frequency data for tubes of different diameters



Conclusion

- sound level is inversely proportional to the length of the pipe
- sound level is inversely proportional to the diameter of the pipe

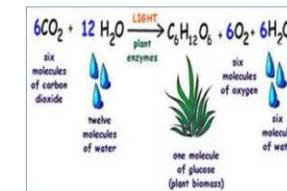
Problem 11. Grow light

Team Croatia
Reporter: Luka Mikšić

Problem 11: Grow light

Formulation of the problem

Investigate how different types of artificial lights affect plant growth. What is the role of light spectrum?



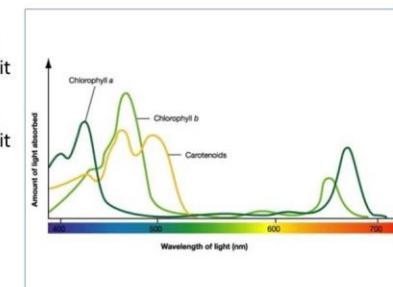
Explanation

- Herbal pigments- chlorophyll a, b
 - chemical compounds of a ring porphyrin structure at the center of which is a magnesium atom
 - in chloroplasts which are oriented towards the light
 - absorb mostly red and blue part of the spectrum of visible light
 - reflect the green part of the spectrum which we see as green colour of the plant



Explanation

- Spectrum of absorption of herbal pigments
 - chlorophyll a maximally absorbs the light wavelength of 430 & 662 nm & it is blue-green colour
 - chlorophyll b maximally absorbs the light wavelength of 453 & 642 nm & it is yellow-green colour
 - for carotenoids the maximum of absorption is between 380 & 550 nm





Parameters

- Types of light:
 - UV lamp
 - fluorescent lamp (yellow and white)
 - LED lamp (yellow and white)
 - Yellow lamp with a fiery thread
 - infrared lamp
 - on the daylight and in dark
- all lights have the same intensity of 2000 lx



Hypotheses

- the kinds of light and the lack of it will affect the germination, growth and development of plants
- the optimum of intensity, duration of light and the light spectrum improve:
 - Growth of plants
 - Synthesis of chlorophyll
 - Photosynthetic activity
- LED, day, lamp with with a fiery thread and UV light should improve the growth of plants -the best emmitting spectar
- FLU and infrared light have slightly worse spectar and should be worse
- Plants in the dark should grow the worst



Methods and measurements

- Experiment 1
 - time of germination
 - average height of 5 tested plants every day
 - average number and surface of leaves every day
 - chlorophyll concentracions in the leaves 8., 15., 20. & 38. day
 - morphological changes



Methods and measurements-Experiment 1





Methods and measurements

- mentioned parameters measured after germination (day 4)
- The bulbs raised as plants were growing
- Measurement od chlorophil concentration
 - 8., 15., 20. & 38. day of experiment
 - leaves picked from plant
 - absorption of spectre recorded with spectrophotometer
 - concentration of pigments calculated by using Holm- Wetstein equation
 - mass fraction of pigments of fresh leaves calculated

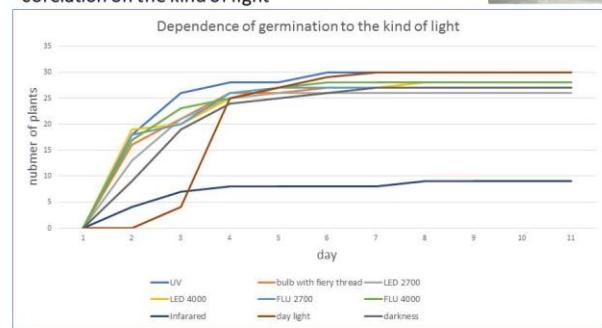


Experiment 2



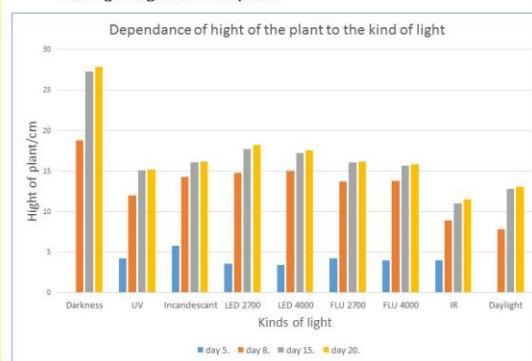
Results

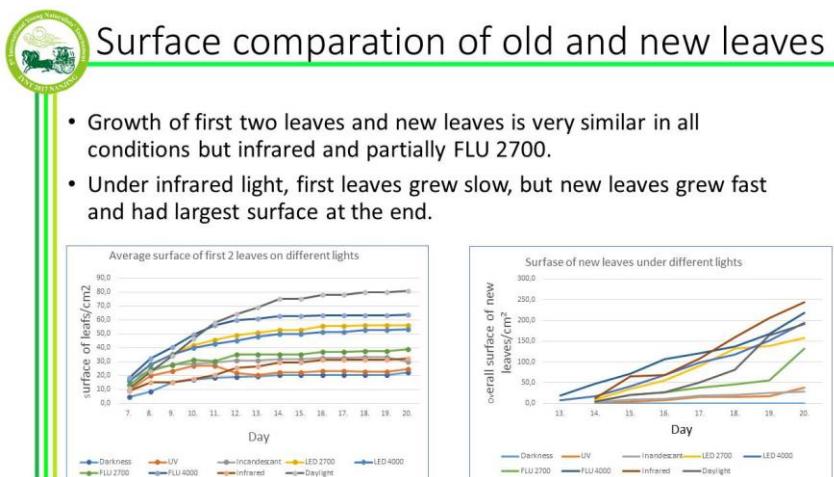
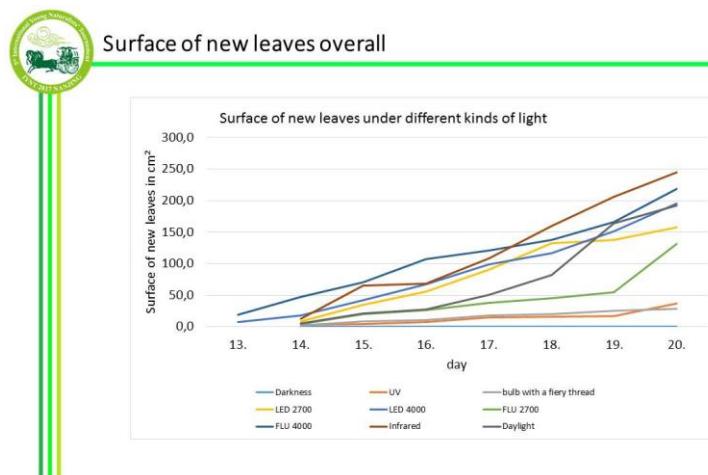
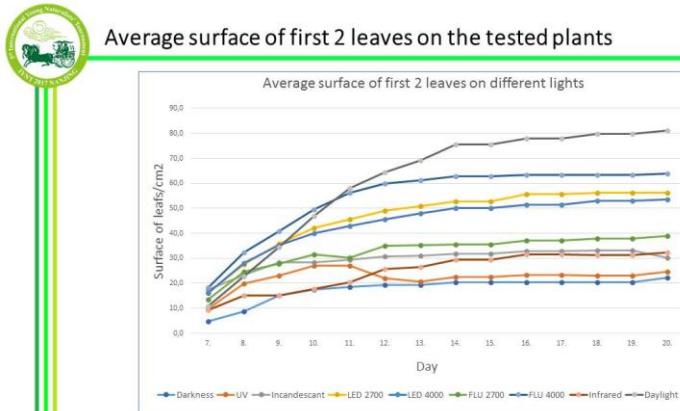
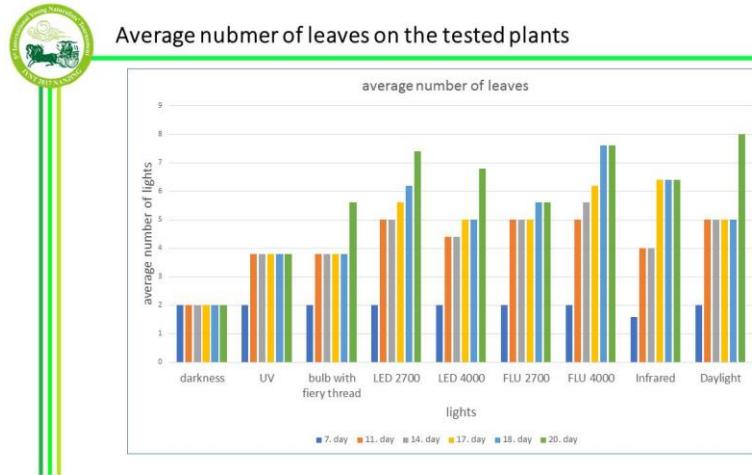
Number of germinated beans
- corelation on the kind of light



Results

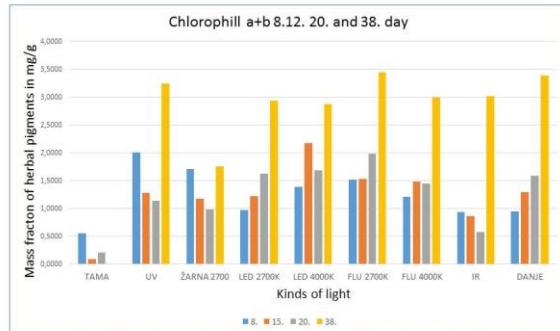
Average height of tested plants



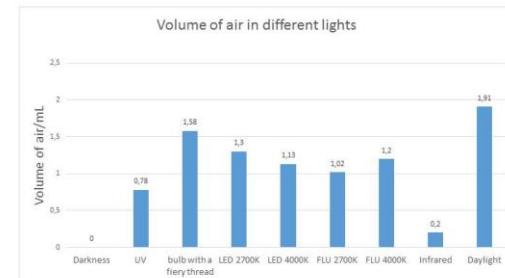




Herbal pigments 8.,15., 20. & 38. day



Experiment 2(pondweed)–Air volume



Morphological characteristics of pondweed



- All plants were the same green colour but:
- in darkness which was half faded
- & plant under infrared light completely lost green colour on the 2. day



Conclusion

- Type of light influence on the germination of plants
- All of tested types of light but infrared affected germination, growth of stems and leaves
- LED,FLU and day light were the best because of their emitting spectar and they did not produce heat
- Infrared and light with fiery thread produced heat energy and burned some of the plants
- UV light was weak so it had to be close to the plants and potentiate UV and light stress (creating reactive forms of oxygen and degradation of proteins)
- Plants in the darkness did not get enough of energy and had herbal paleness symptoms



Recommendation for further work:

- Growth of fresh and dry mass of water plants (pondweed)
- Introduction of red and blue LED 4000 lights in experiment 1



Literature

1. Branka Pevalek-Kozlina, Fiziologija bilja,profil, Zagreb, 2003.
- 2.Katarina-Daniela Dubravec, Ivan Regula,Fiziologija bilja, školska knjiga, Zagreb,1995
- 3.http://www.medp.unist.hr/moduli/zprostori/kolokvij_2/primjena_dopunskego_osvjetljenja_2010.pdf
- 4.Vjera Lopac, Petar Kulišić, Fizika 4 Udžbenik za tehničke škole, Školska knjiga, Zagreb,1999.
- 5.[https://www.fer.hr/_download/repository/Predavanje2\[1\].pdf](https://www.fer.hr/_download/repository/Predavanje2[1].pdf)
6. http://www.pfos.unios.hr/upload/documents/02_AKsOF%20-%20Svjetlost.pdf
- 7.https://www.fer.unizg.hr/_download/repository/EleRas_predavanje_1%5B2%5D.pdf
- 8.Dubravko Horvat, Fizika II, udžbenik fizike za studente Fakulteta elektrotehnike i računarstva, Zagreb, 2006.
9. Ana – Maria – Beatrice Šikić, Rast i fotosinteza vodene leće (*Lemna minor L.*) pri različitim izvorima svjetlosti, Diplomski rad, PMF, Zagreb,2016.
10. Stella Vješnica i Dora Knezović, Utjecaj fluorescentnih lampi na rast pšenice i graha, Istraživački rad za natjecanje iz biologije, III. Gimnazija Split, 2014.
11. Peter Karlson, Biokemija za studente kemije i medicine, Školska knjiga, Zagreb, 1993.
12. Miroslav Lisjak, Marija Špoljarević,Dejan Agić, Luka Andrić, PRAKTIKUM IZ FIZIOLOGIJE BILJA ,Poljoprivredni fakultet u Osijeku ., 2009. preuzeto s http://asd2007.pfos.hr/~dsego/ispltna_literatura/praktikum_fiziologije_bilja.pdf13
- 13.Marija Kristić, UTJECAJ SVIJETLOTI NA POKAZATELJE RASTA paprike ,Diplomski rad, Poljoprivredni fakultet Osijek, Osijek, 2016. preuzeto sa <https://zir.nsk.hr/islandora/object/pfos%3A928>

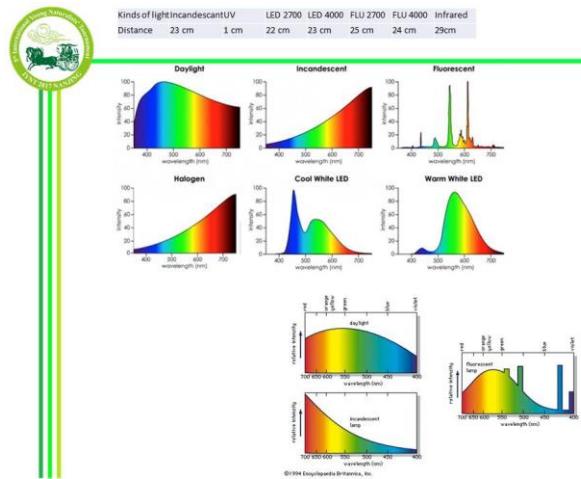


I would like to thank to:



- Chemical department of Veleučilište Karlovac & prof.dr.sc.Davoru Kovačeviću from PMF Zagreb on their favoures of measuring concentration of herbal pigments
- Aquatika Karlovac on their donation of pondweed (*Elodea canadensis*)

Thank you for your attention



Concentration of herbal pigments UV-VIS spektralphotometer

• Holm-Wettstein equations:

- chlorophyll a = $9,784 \times A_{662} - 0,990 \times A_{644}$ [mg/dm³]
- chlorophyll b = $21,426 \times A_{644} - 4,65 \times A_{662}$ [mg/dm³]
- chlorophyll a+b = $5,134 \times A_{662} + 20,436 \times A_{644}$ [mg/dm³]
- carotenoid = $4,695 \times A_{440} - 0,268 \times (\text{chlorophyll a+b})$ [mg/dm³]

$$C = \frac{C_2 \cdot v \cdot r}{m}$$

C(mg/g)-mass concentration of pigments

C₂

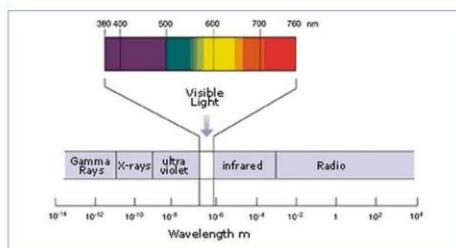
V(mL)-volume of filtrate

r-dilution of the filtrate

M(mg)-mass of the sample



Light



Problem 12. Milk



Team Croatia, IYNT 2017
Reporter: Luka Bulić Bračulj

Problem 12: Milk

The Problem

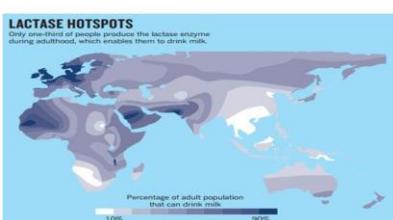
- The problem:
 - "Develop simple methods allowing determination of some of the important properties of milk. Suggest an investigation requiring comparison of various milk samples."
- Plan:
 - Create a method to determine saccharide concentration in milk
 - Determine if milk is regular or lactose-free



Milk and Lactose

- Milk
 - An opaque white fluid rich in fat and protein, secreted by female mammals for the nourishment of their young
- Lactose ($C_{12}H_{22}O_{11}$)
 - Disaccharide (glucose+galactose)
 - Lactose intolerance
 - Lactose-free milk
- Other saccharides in milk
 - Glucose
 - Galactose
 - Complex saccharides

LACTASE HOTSPOTS
Only one-third of people produce the lactase enzyme during adulthood, which enables them to drink milk.

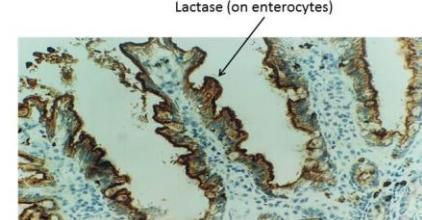


Lactase

- Enzyme
 - Lactose hydrolysis
 - Glucose
 - Galactose
 - Similar enzymes
 - Amylase
 - Maltase
 - Saccharase/invertase

O[C@H]1OC(O)[C@H](O)[C@@H](O)[C@H](O)[C@H](O)[C@H]1O Lactose O[C@H]1OC(O)C(O)C(O)C(O)C(O)C1O D-Galactose O=C1OC(O)C(O)C(O)C(O)C1O D-Glucose

Lactase (on enterocytes)





Saccharide Concentration Determination

- Saccharide concentration in:
 - Regular milk
 - Lactose-free milk



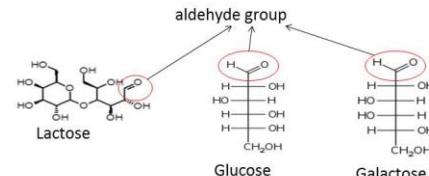
Milk	Regular	Lactose-free
Fats	2.8g/100mL	1.5g/100mL
Proteins	3.3g/100mL	3.3g/100mL
Carbohydrates/Sugars	4.6g/100mL	4.6g/100mL
Lactose	/	<0.1g/100mL

Reactions

1. $\text{R}-\text{COH} + \text{I}_2 + 3\text{NaOH} \rightarrow \text{R}-\text{COONa} + 2\text{NaI} + 2\text{H}_2\text{O}$
2. $2\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 \rightarrow 2\text{NaI} + \text{Na}_2\text{S}_4\text{O}_6$

Reducing saccharides:

- lactose
 - glucose
 - galactose
-] aldoses

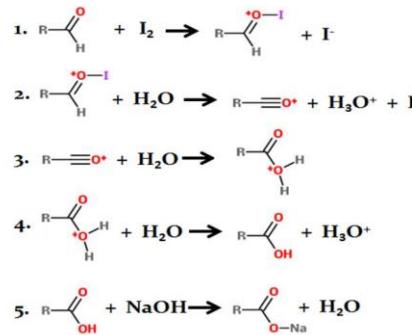


$$n(\text{Saccharides}) = n(\text{I}_2 \text{ added}) - \frac{n(\text{Na}_2\text{S}_2\text{O}_3)}{2}$$



Reaction explanation

- Lactose, glucose and galactose are represented by R-COH



Hypothesis

- Saccharide concentration will be **lower** in regular milk
 - Lactose in lactose-free milk is removed using lactase
 - Lactose is hydrolysed in glucose and galactose
 - For every 1 disaccharide molecule, 2 monosaccharide molecules are created
 - Saccharide concentration increases



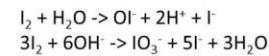
Experiment

- Chemicals:
 - Regular and lactose-free milk
 - 0.2 M CuSO_4 solution
 - 0.5 M NaOH solution
 - 1 M HCl solution
 - 0.05 M I_2 solution
 - 0.1 M $\text{Na}_2\text{S}_2\text{O}_3$ solution
 - starch solution
- Procedures
 - filtration
 - pipetting
 - titration

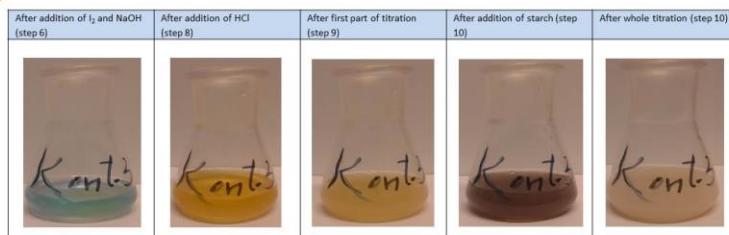


Experiment

- Precipitation of proteins – CuSO_4 and NaOH
- I_2 in surplus and NaOH \rightarrow redox
- Neutralisation of NaOH with HCl
- Titration of I_2 in surplus with $\text{Na}_2\text{S}_2\text{O}_3$ solution
- Starch – indicator for I_2
- Control group - water



Titration



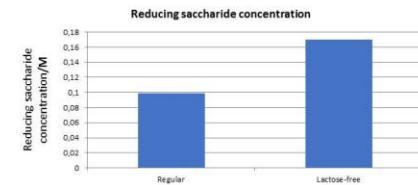
Results

Milk	Regular	Lactose-free	Control (water)
1. titration ($\text{Na}_2\text{S}_2\text{O}_3$ volume)	0.90 mL	0.20 mL	1.90 mL
2. titration	0.95 mL	0.25 mL	1.95 mL
3. titration	0.95 mL	0.20 mL	1.90 mL
Titration average	0.93 mL	0.22 mL	1.92 mL
Reducing saccharide concentration	0.099 M	0.17 M	/

$$n(\text{saccharides}) = n(\text{I}_2, \text{ added}) - \frac{n(\text{Na}_2\text{S}_2\text{O}_3)}{2}$$

↓

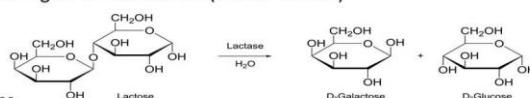
Calculated from control group





Conclusion

- Reducing saccharide concentration
 - Regular milk – 0,099 M
 - Lactose-free milk – 0,17 M
 - Lactose-free milk has higher concentration (almost double)
- Method effectiveness
 - Can't determine concentration of only lactose
 - Can determine concentration of all reducing saccharides



Literature

- Vujić, A. : Opća i nacionalna enciklopedija u 20 knjiga, 2006., Pro Leksis d.o.o.
- Curry, A. : The Milk Revolution, 2013., Nature Vol 500, Macmillan Publishers Limited
- Test Euso 2016 Milk
- Srinivasan U., Jones E., Weir D., Feighery C. : Lactase enzyme, detected immunohistochemically, is lost in active celiac disease, but unaffected by oats challenge, 1999., American Journal of Gastroenterology Vol 94
- Fuquay, J. W. : Encyclopedia of Dairy Sciences, 2011, Academic Press

The slide features the official logo of the International Young Naturalists' Tournament (IYNT) from 2017, which includes a circular emblem with a horse-drawn carriage and the text "5th International Young Naturalists' Tournament IYNT 2017 NANJING". To the right of the logo is the flag of Croatia, which consists of three horizontal stripes of equal width in red, white, and blue colors, with a coat of arms in the center.

Thank you for your attention



Experiment

1. 10 mL of milk added in a 100 mL volumetric flask and filled with water by a half
2. 5 mL of CuSO₄ and 4 mL of NaOH solutions added and mixed
3. Volumetric flask filled with water, mixed and left for 20 minutes
4. Content filtered
5. 10 mL of filtrate measured in Erlenmeyer flask



Experiment

6. 4 mL of iodine and 3 ml of NaOH solution were added and mixed
7. Flask wasprotected from light and left for 20 minutes
8. Added 1.5 mL of HCl
9. Iodine surplus titrated with $\text{Na}_2\text{S}_2\text{O}_3$ solution of concentration 0.1 M until light yellow colouring
10. Added starch until blue colouring and continued titration until colouring dissapeared
11. Titration repeated 2 more times

Problem 16. Paper wrinkles



Team Croatia
Reporter: Luka Mikšić

Problem 16: Paper shrinkage

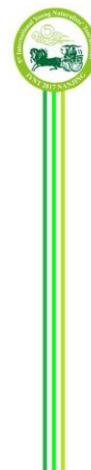


Research question

- „When a piece of paper dries after being wet, it can get wrinkled. Investigate and explain this phenomenon.”
 - cellulose fibers in composition of paper are hygroscopic
 - molecules of water fit in between celluloses fibers bonded with hydrogen bonds
 - evaporation of water creates direct hydrogen bonds between cellulose fibers while paper shrivels and wrinkles



2



Paper

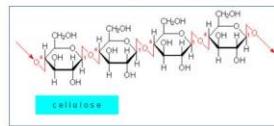
- we get paper from water suspension of herbal fibers on a machine with delicate sifter
- the basic material are celluloses fibers
 - celluloses fibers comes most often from threes (40-50%)
- for improving characteristics of paper different substances (fillers and binders) are added
- hydrogen bonds form between celluloses fibers covered with polymolecular layer of water([Picture 1. c](#))



3



Celluloses

- celluloses is a structural herbal polysaccharides (8-12 thousand molecules of glucose)
- in celluloses the molecules of glucose are bonded with each other with $\beta(1-4)$ glycosidic bonds
- the chains are bonded with each other with hydrogen bonds-fibrillar structure
- it can be easily separated from the rest of ingredients in the wood because it is not soluble in water, organic solvents, acids or lyes

4



Fillers

- The most types of paper contain fillers-mineral substances which:
 - reduce tear resistance - move apart celluloses fibers
 - weaken the forces of hydrogen bonds which connect the fibers in the paper
 - enlarge non-transparency and better shininess, smoothness, whiteness of the paper and better griping of printing paint
 - lower the cost of paper



5

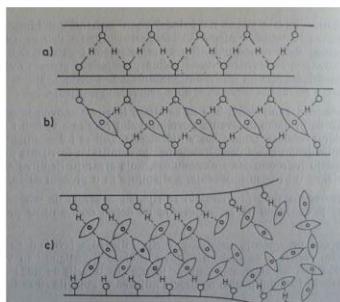


Binders

- With binding we achieve:
 - hydrophobicity of the paper
 - better grip of the fibres which approves the stability of paper
- Binders are
 - rosin, starch, paraffin, protein binders
 - most often used and cheapest is starch
 - it improves the bonding of cellulose fibers in the paper



6



7



Manufacturing of paper

- On the paper machine:
- the greater number of cellulose fibres are oriented in the direction of rotation of sieve (longitudinal direction)
 - the paper tape goes through strained hot steel cylinder (60-100°C)
 - formed more transverse (width) of hydrogen bonds between neighbouring chains that create fibrils (Picture 1a)
 - fibrils stretch 20 times more by length than by width
 - when the fibrils are not enough interlaced in all directions, it stretches by width 5-10%, and by length 3% in the relationship with the wet dimension (2)



8



Hypotheses and parameters

- the both kinds of paper (photocopy and filter paper) will wrinkle and shrink with different intensity under different conditions
- Parameters:
 - temperature of water**
 - paper soaked in hot water (100 °C) will shrink more than the paper soaked in cold water (~20°C) because it absorbs more water and/or loses more binders and fillers
 - type of paper**
 - filter paper will shrink and wrinkle more than the photocopy paper because it does not contain binders and fillers, so it absorbs more water
 - dimensions**
 - paper will shrink more by width than length
 - the size of the paper will not affect on the intensity of shrinkage and wrinkling
 - mass**
 - paper that is not soaked and is dried on 50°C won't change mass, shrink and wrinkle
 - the mass of soaked paper will change in all conditions

9



Methods and measurements

- Two kinds of paper
 - photocopy paper (contains fillers and binders)
 - filter paper (does not contain fillers and binders)
- Measurements
 - measured length and mass of paper
 - quantitatively tested the amount of fillers in the paper
 - amount of ash in the paper measured by annealing paper in the furnace (900°C)
 - qualitatively tested liquid for the presence of starch
 - microscopied the samples of paper with the fluorescent microscope
- Time instances of measurements (mass and length)
 - before soaking (in cold and hot water)
 - after soaking
 - during drying (on 50°C in dryer)
 - intervals of 15min



10



Methods and measures

- Procedure steps
 - cut to the dimensions 100x100mm & 150x100mm
 - digital caliper accuracy of 0.005 mm
 - weight with the analytical digital scale
 - accuracy of 0.1mg and measured
 - soaked in 100 mL of distilled cold water (~20°C) and hot water (100°C) for one minute
 - put on the paper towel and then dry in the dryer (50°C) for 15 minutes
 - cooled down in the desiccator
 - weighed and measured
- Procedure repeated in the intervals of 15 min
- Repeatability
 - measurements were repeated 10 times and average value was calculated



11



Results-microscopic measurements



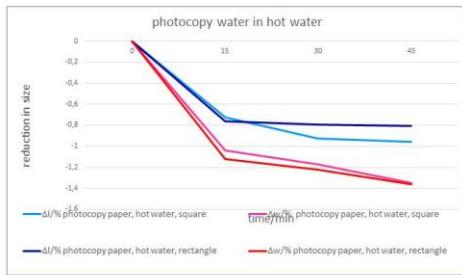
Filter paper before soaking



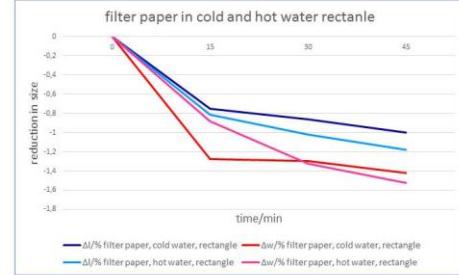
Filter paper after soaking and drying



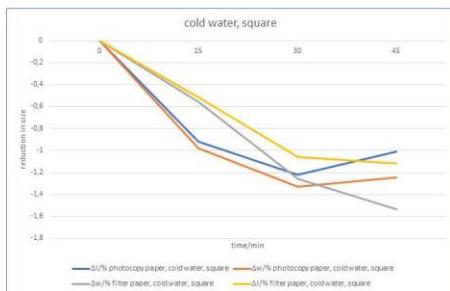
Comparing square and rectangle



Comparing hot and cold water



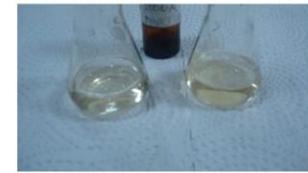
Comparing filter and photocopy paper



Results and discussion

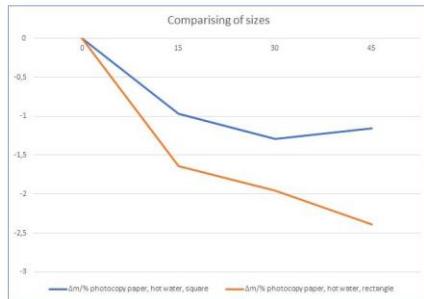
Composition of paper

- Fillers - mineral substances
 - photocopy paper - the mass fraction of ash is ~11,48%
 - filter paper - mass fraction of ash is ~0.1325%
- Binders
 - photocopy paper - starch found in liquid
 - filter paper – no starch

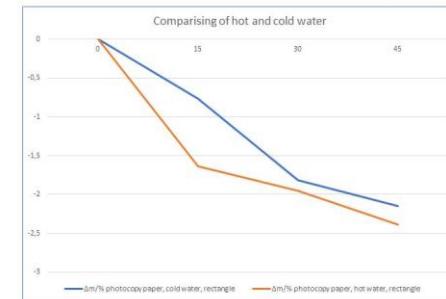




Mass - comparing square and rectangle



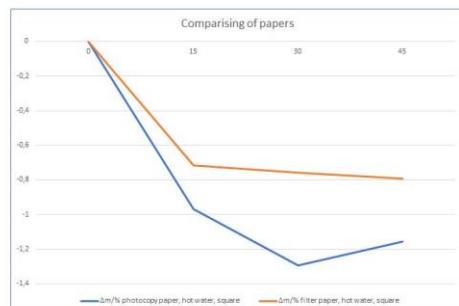
Comparing hot and cold water



18



Comparing filter and photocopy paper



19



Conclusion

- Temperature of water
 - wrinkle is more intense after soaking in hot water - as expected (wavy edge across the width)
 - relation of filter and photocopy paper could not be evaluated
- Dimensions of paper
 - width of both kinds of papers and conditions shrinks more than the length - as expected
- Type of paper
 - filter paper shrinks more by both dimensions and both conditions than the photocopy paper - as expected
- Mass of paper
 - Rectangle decreased more
 - Hot water decreased more
 - Photocopy

20



Conclusion

- There is more supplements that washed out in hot water in the photocopy paper
- Stronger transversely bonding of celluloses fibers
- Rectangle paper
 - there is a bigger difference in shrinking and wrinckling in all kinds of paper and in all conditions which I did not expect
- Longer dimension means longer parallel celluloses fibres means more –OH groups means more hydrogen bonds
- When paper is not soaked but is dried
 - it does not wrinkle
 - slightly looses mass and shrinks (10 times less then soaked) – depending on the air humidity

21



Ideas for further work

- Microscope the samples of paper with an electronic microscope
- Increase the soaking time
- Soak in cyclohexan (hydrophobic) before soaking in water



fluorescent microscope

22



Thanks

Thanks to:

- my mentor
 - the principal and the employees of the „Prirodoslovna škola Karlovac“
 - „Tiskara Žalac Karlovac“
 - „Biološki odsjek PMF Zagreb“
- on their favour in use of space, equipment and help during measurements

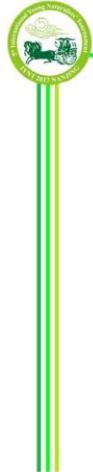
23



Literature

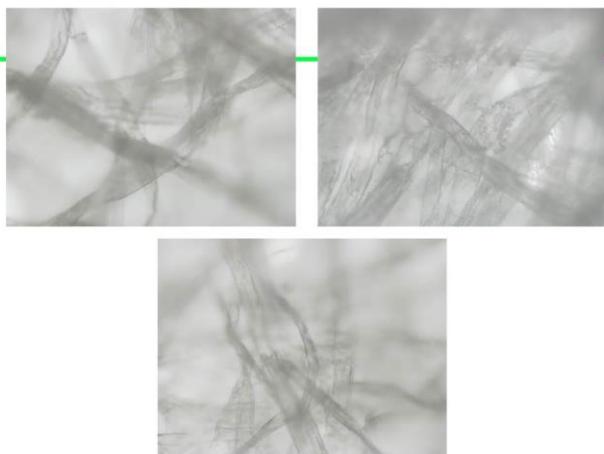
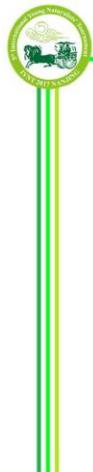
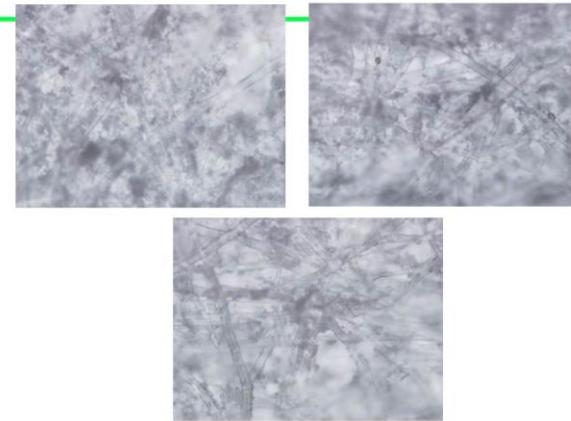
- 1. <http://www.enciklopedia.hr>
- 2.Branka Lozo, Papir, Sveučilište u Zagrebu, Grafički fakultet, Preddiplomski studij grafičke tehnologije, Nastavni tekstovi, Zagreb, 2014. preuzeto sa
- <http://materijali.grf.unizg.hr/media/Nastavni%20materijali%20kolegiji%20Papir.pdf>
- 3. Filip Čorlukić, Tehnologija papira, prvo izdanje, Školska knjiga Zagreb, 1987.
- 4. Milan Sikirica, Branka Korpar-Čolig Organska kemija za IV razred gimnazije , Školsla knjiga, Zagreb, 1998.
- 5. Alan Antonović, Skripta predmeta Kemija drva, Šumarski fakultet Zagreb,
- Drvotehnološki odsjek, Zagreb, 2010. preuzeto s
- studentski.hr/system/materials/v/866df29f88529fba9fcc76d4eaba51ca9df646f0.zip?...
- 6. Peter Karlson, Biokemija za studente kemije i medicine, Školska knjiga, Zagreb, 1993.
- 7. Martina Vukomanović, Prirodni polimeri, Završni rad, Sveučilište J.J. Strossmayera u Osijeku ,Odjel za kemiju ,Preddiplomski studij kemije , Osijek 2015. preuzeto s <https://repozitorij.kemija.unios.hr/islandora/object/kemos%3A70/datarstream/PDF/view>
- 8. Skupina studenata, Tehnologija proizvodnje celuloze i papira, Seminarski rad, Univerzitet u Sarajevu, PMF, Odsjek za kemiju ,Sarajevo, studeni 2010. preuzeto s Tehnologija%20Provodnje%20Celuloze%20%20Papira.html
- 9. I. Kozjak, Spašavanje arhivskoga gradiva nakon katastrofe: nove mogućnosti Središnjeg laboratorija za konzervaciju i restauraciju Hrvatskog državnog arhiva, Arh. vjesn., god. 53 (2010), str. 85-100
- 10. <http://materijali.grf.unizg.hr/media/uvodna%20vezba%20-%20SOVJETVA%20%20ISPITIVANJA%20PAPIRA.pdf>
- 11. A. Golubović-Tehnologija izrade i svojstva papira; Grafički fakultet, Zagreb, 1984 god.

24



Thank you for your attention

25



Measure results of the dry paper

Photocopy dry square			
$\Delta m\%$	$\Delta l\%$	$\Delta w\%$	$\Delta w i l\%$
-0,2341	-0,0201	-0,0601	1,9967
-0,5052	-0,0602	-0,0952	0,5816

Photocopy dry rectangle			
$\Delta m\%$	$\Delta l\%$	$\Delta w\%$	$\Delta w i l\%$
-0,3883	-0,0234	-0,0200	-0,1436
-0,3883	-0,0234	-0,0200	-0,1436

Filter dry square			
$\Delta m\%$	$\Delta l\%$	$\Delta w\%$	$\Delta w i l\%$
-0,1847	-0,0506	-0,0152	2,3225
-0,2956	-0,0557	-0,0203	1,7411
-0,3325	-0,0809	-0,0406	0,9535

Filter dry rectangle			
$\Delta m\%$	$\Delta l\%$	$\Delta w\%$	$\Delta w i l\%$
-0,4842	-0,0134	-0,0050	1,6688
-0,7386	-0,0267	-0,1202	3,4964
-0,8371	-0,0301	-0,1362	3,3299

- Paper without soaking, dried in the same conditions does not wrinkle, slightly loses mass and shrinks (10 times less than soaked).
- The mass fraction of ash is 11,92% (mineral substances)

Problem 17. Tornado machine



Team Croatia
Reporter: Mihael Pristav

Problem 17: Tornado machine

Problem

"Build a machine that produce an indoor air tornado. Investigate properties and stability of the tornado. Is the machine portative enough to be demonstrated at a Science Fight room of the 5th IYNT?"

Purpose of the investigation

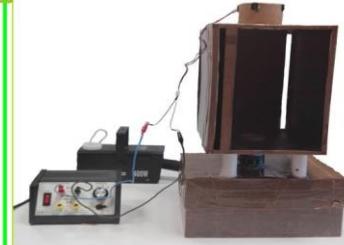
- Making the tornado machine
- Explaining the creation of tornado
- Changing the properties of tornado by changing the fan speed, air supply and smoke drain.
- Determining which tornadoes are stable

Tornado

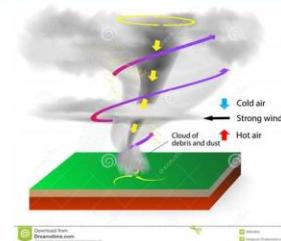
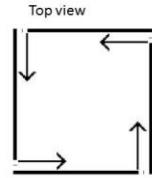
- rapidly rotating column of air that spins
- Iujita scalle (damage caused by tornado)
- Torro scalle (wind speed)
- Shapes: Wedge, V-shaped, cylinder, hourglass...
- Vortex (A rotating column of a fluid)
- Tornadoes in nature form when cold air in clouds goes vertically down and hotter air from below goes up in a circular pattern around the cold air
- Tornado in box forms because the traction between the particles that are further from the center of the box is higher than traction of ones that are in middle of the box



Experimental setup and methods



Full experimental setup



Fog machine



Focus OK-040 fog machine
Visibility of tornado



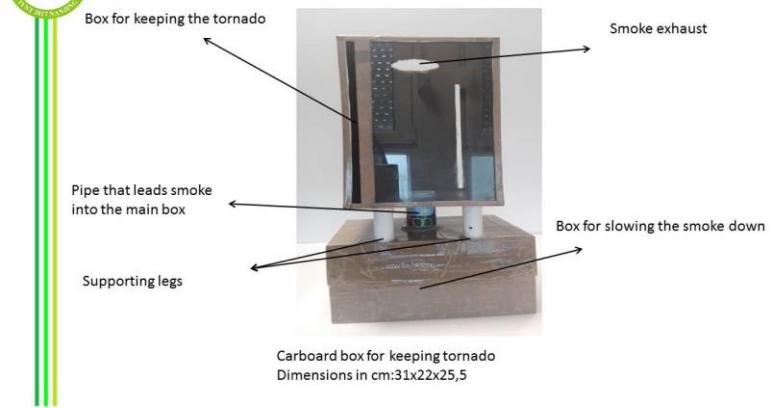
The fan



SLEEVE BEARING S8025M fan
VOLTAGE: 4, 6, 8, 10, 12 V



Box





Rest of setup



Laminar flow device
Stoping the fan to rotate air



Voltage source



Box for slowing the fog down



Canon S100 camera

Hypotheses

- Diameter of tornado will grow when the speed of fan is reduced.
- Diameter of tornado will grow when the surface of the hole between the fan and laminar flow device is increased.

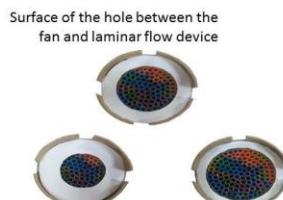


Changing parameters



Angular Speed of fan
(determined by voltage)

ω/s^{-1}	30,70	36,84	42,98	49,12	55,26
U/V	4	6	8	10	12



Surface of the hole between the
fan and laminar flow device

r/cm	2,93	4,29	4,71
------	------	------	------



Data Acquisition and procesing

- Tornadoes were filmed for 3.5 min with a camera
- For each set of parameters 10 films were filmed
- Tornado is stable if he existed and did not fall apart for 3.5 min in minimal 50% and only those were procesed
- Video was procesed in windows media player and paint.net
- Reading the maximum diameter of tornado out of every video ten times and getting the average

Results

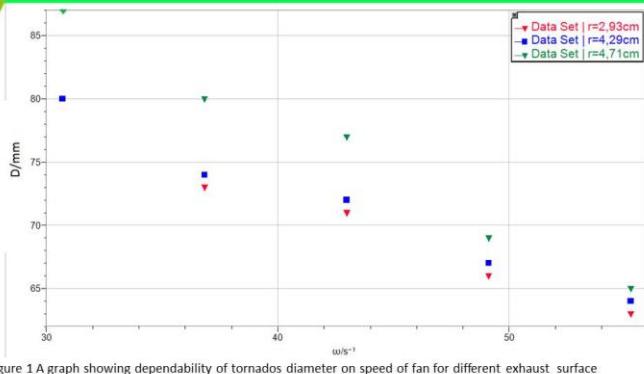
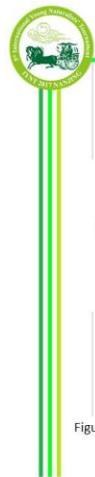


Figure 1 A graph showing dependability of tornados diameter on speed of fan for different exhaust surface

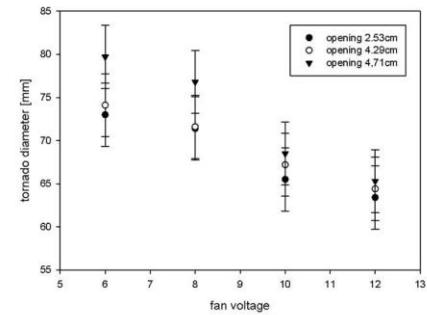
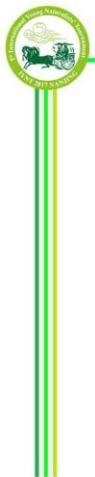
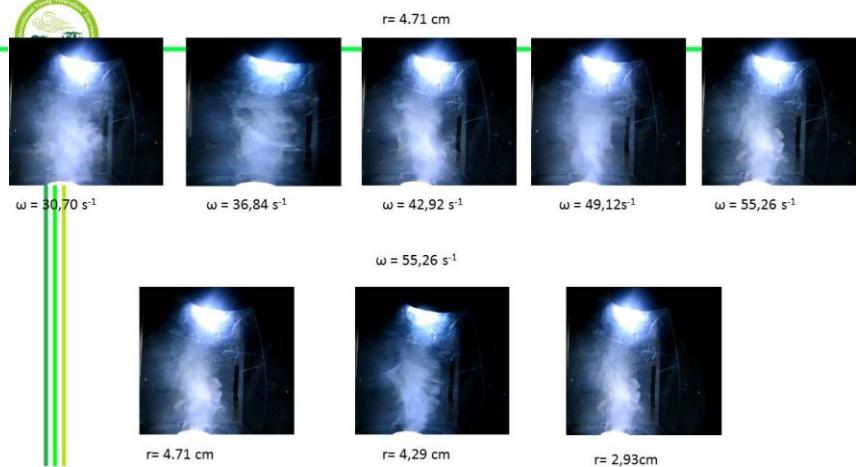
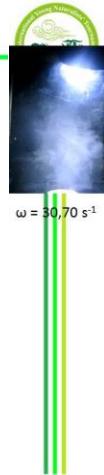
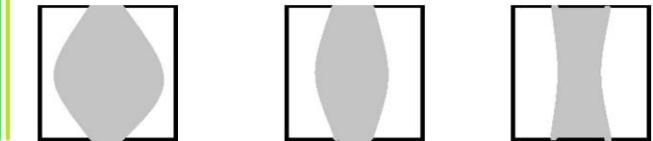


Figure 1 a graph showing maximum difrence from average and conection with other measuring

Conclusion



- Diameter of tornado grew when the speed of fan was reduced.
- Diameter of hole did not affect the diameter of tornado.
- Shown to be a mistake
- Tornado did not form when angular speed was $30,70 \text{ s}^{-1}$ and surface of hole between the fan and laminar flow device was $8,6 \text{ cm}^2$ -Instable
- Shape of tornado was changing from romb a like shape to an hourglass shape





Istraživački centar mladih

