Erasmus+ Strategic Partnership for Schools project

EFFECTIVE METHODS FOR STRENGTHENING THE LEARNING PROCESS IN TEACHING SCIENCE

Erasmus+

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Effective Methods for Strengthening the Learning Process in Teaching Science

2018

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INTRODUCTION

Partnership

During 2016-2018, partner schools from Italy, Latvia, Lithuania, Portugal and Turkey implemented the Erasmus+ Strategic Partnership for Schools Project "Effective Methods for Strengthening the Learning Process in Teaching Science". We based this partnership on a need to exchange teaching and learning experiences between European schools and develop new ideas around improving the teaching of Biology, Physics and Mathematics. The project set out to explore the potential of using effective methods and their effectiveness for a more creative learning environment and to enrich everyday educational processes in partner institutions.

There were short-term exchanges of groups of students and joint staff training events for teachers organized in Italy, Lithuania, and Turkey. The teaching, learning events based on participation in Maths Laboratory and CLIL based Biology and Physics activities, exploring effective methods in relation to CLIL based Science and Maths teaching methodology, Biology teaching by using Natural Science Mobile lab, choosing teaching methods and using technology in order to create active learning processes in teaching Mathematics, participating in Science Fair, an activity based on creating a common project.

Based on the training experience, using skills and knowledge from transnational activities schools organized their own lessons and activities using the methods discussed. They also shared lessons plans, co-created lesson plans that support the learning paradigm in the educational process and provided

colleagues with feedback. Their learnings resulted in a collection of lesson plans and material for further application in schools.

Working transnationally gave a broader perspective and meaning for both teachers and students, enhancing the motivation to teach and learn. This was also related to transforming the learning process into something much more engaging with the use of multiple and varied resources, materials and approaches developed during this project. The collection of material in this book also reflects the broader perspective of teachers on teaching methodologies in different countries and an appreciation of belonging to a wider community.

Aim of the book

This book is intended for teachers and provides lesson plans and descriptions of successfully implemented projects.

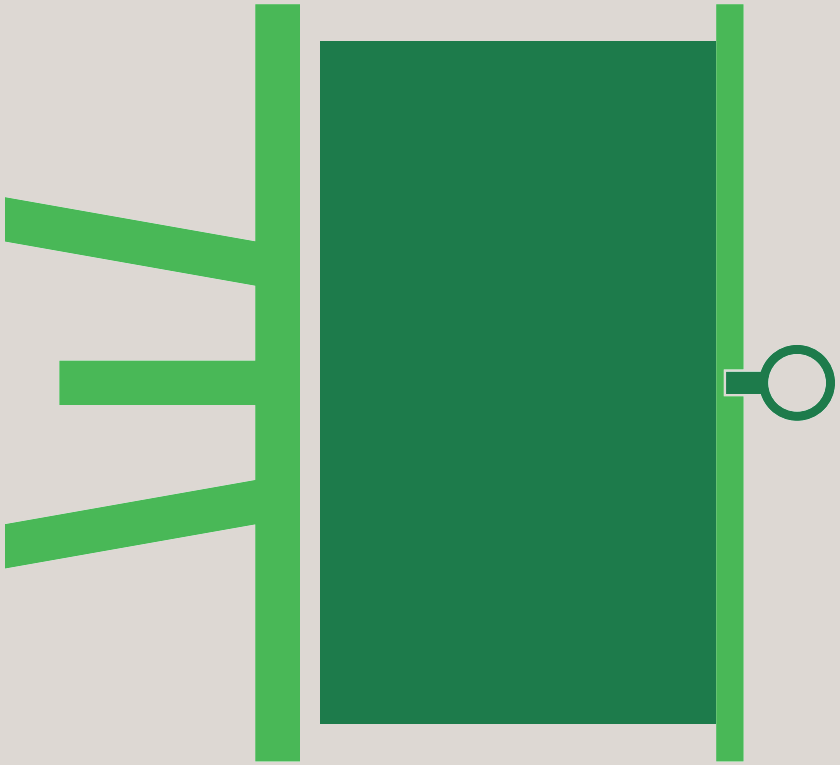
It furthermore emphasizes what effective methods for strengthening the learning process in teaching different subjects can be used. All of the lessons and activities adopt an active approach - active because they engage students in real tasks, instead of giving them the role of passive listeners and watchers. For example; a lesson may address an empirical issue, leading students to either discover the scientific explanation behind the issue or the scientific method to solve it, or even require students to produce an actual outcome of their research and combine science with bilingual writing skills. Being active and engaged is the key to increasing motivation and curiosity in students, so lessons are based on practical work linked to reality in order to improve competence as well as knowledge. Some of the activities also contain interdisciplinary content further proving the fact that knowledge linked to reality (for example the Biology lesson/P.E. lesson regarding breathing and heart beats) often makes comprehension easier.

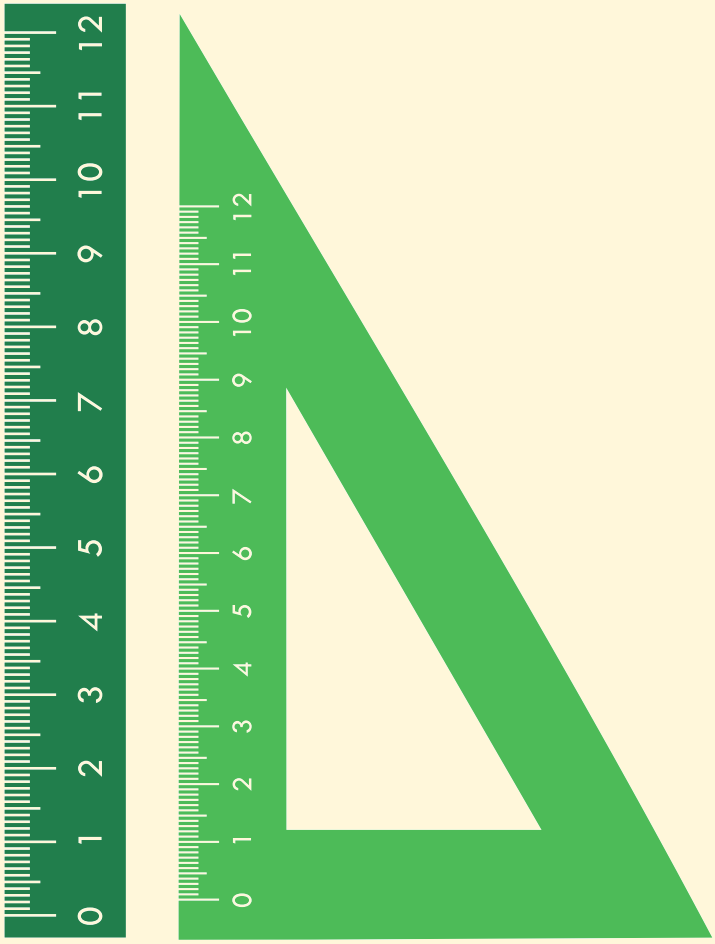
The lessons adopt instructional methods thus the introduction should provide an overview of what is to be covered during the class period. An overview with a clear, concise presentation of the key objectives and ideas serves as a road map for learning. Effective visual aids are helpful at this point as students understand better and retain more when they know what to expect. The purpose of the overview is to prepare students to listen to the body of the lesson. Revising the theoretical knowledge creative methods are used (for instance, mistakes on purpose method).

Group work is a commonly used methodology as well as the use of practical tools involved in projects; presentations, experiments. Learner – centred instructional and active learning methods (problem-based learning and task-based learning) are at the centre of the lessons presented in this book.

We hope this publication will become the source for new ideas and aspirations to organise and develop more engaging activities for students who learn Mathematics, Physics, and Biology.

LESSONS





MATHS LESSONS

Country:	Latvia
School:	Balvi State Gymnasium
Lesson/subject:	Maths
Level:	9th Grade

QUADRATIC FUNCTION

ICT support, equipment needed

Calculators, document camera, projector.

Teaching aims

Students will be able to:

* Graph and interpret a quadratic function from a real life situation.
* Graph a quadratic function from general form and determine the axis of symmetry, the vertex, the maximum or minimum.

Learning outcomes

As a result of studying this topic students will be able to:

* understand that quadratic functions are used to describe real life situations;
* recognize a quadratic function from its algebra;
* recognize the graph of a quadratic function.

Methodology / methods

Questions and discussion; reading information; cooperative learning groups.

Lesson phases and timing

Introduction (20 minutes)

Break students into groups of 2 or 3 for this part of the lesson. Provide the students with the worksheet "introduction to the general form of a quadratic function" (annex 1). The students read through the problem and complete the first two questions. As a whole group, discuss the questions then talk about how they would solve the remaining questions. You will have to teach the students how to find the vertex when the general form of a quadratic function is (x = -b/2a). They should be able to find the answer both graphically and algebraically. Provide the students with the general form of a quadratic function equation: ax2+ bx +c=0, and explain the meaning of the values of a, b and c, and how they affect the behaviour of a quadratic function.

Some additional teacher notes have been provided to assist in the discussion, if needed.

Posing the task (20 minutes)

Ask students break into groups again and do calculations on the other side of the worksheet (annex 2).

Evaluation / evaluation tools

It is done when the tasks have been finished. Have a whole class discussion on the answers to the questions.

Materials / resources, worksheets

* Worksheets (annex 1 and annex 2);
* Answer key (annex 3).

Additional information

Anticipated student responses and teacher support:

How do we set up the graph for this function?

What will the x-axis and y-axis represent?

Teacher will review the dependent variable (x) and the independent variable (y) with the students.

What did you notice about how the graph is shaped?

In the equation y =-16x2 +70x +3, what does the 3 represent? Students might say 3 feet above the ground when the football is punted, which would be the correct answer.

Can the polynomial be factored?

How do we find the maximum/minimum?

What is the y-intercept?

The y-intercept is the constant term in the function. It can be observed by the graph of the function intercepting the y axis.

What values did you use for your chart? Why did you decide to use those values?

What will the vertex of the parabola represent in this situation?

How do I find the maximum height of the golf ball?

What information does the axis of symmetry provide?

What does the c value represent in this situation?

Explain to the students that the axis of symmetry divides the parabola in half and passes through the vertex point.

Annex 1

Worksheet "introduction to the general form of a quadratic function"

Use the scenario below to answer the questions that follow.

Ray guy, the Oakland raiders punter, holds the record for the longest "hang time" (the amount of time the football stays in the air) for a punt in the national football league (NFL) at 8 seconds. It is considered a good punt if the "hang time" lasts longer than 4.5 seconds. If a punter kicks a football with an upward velocity of 70ft/sec. And his foot meets the ball at 3 feet above the ground, the function y= -16x2 + 70x + 3 represents the height of the ball y in feet after x seconds.

1. Graph the function of the height of the ball using an input-output table.
2. What was the height of the football when it was first punted?
3. How high was the football at its maximum height?
4. How high was the football after 4 seconds?

Annex 2

Worksheet

Use the scenario below to answer the questions that follow.

Lexi Thompson was on the 16th hole at a famous golf course with the pin being 175 yards away from the tee. She chose to use her 9 iron for this hole. The equation for Lexi's drive (path of the golf ball) can be modelled by the equation h(d) = - 0.04d2 + 5d, where d is the distance the ball travelled in yards and h(d) represents the height of the ball.

1. What was the height of the golf ball when it was first hit? Explain your reasoning.
2. How high was the golf ball at its maximum height?
3. When the golf ball has reached it's maximum height, how much further does it have to travel before it lands?

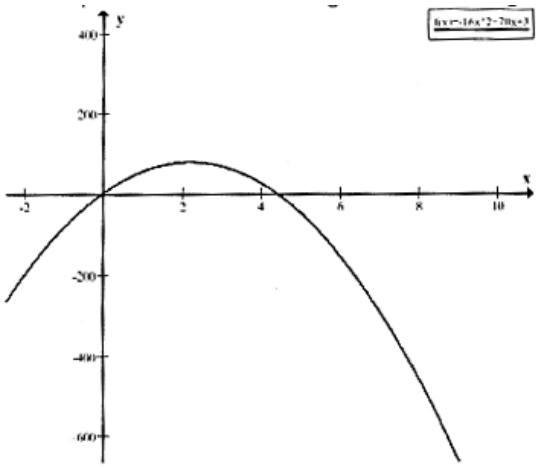
Annex 3

Answer key

Scenario.

Ray guy, the Oakland raiders punter, holds the record for the longest "hang time" (the amount of time the football stays in the air) for a punt in the national football league (NFL) at 8 seconds. It is considered a good punt if the "hang time" lasts longer than 4.5 seconds. If a punter kicks a football with an upward velocity of 70ft/sec. And his foot meets the ball at 3 feet above the ground, the function y= -16x2 + 70x + 3 represents the height of the ball y in feet after x seconds.

1. Graph the function of the height of the ball using an input-output table.



x	y
0	3
1	57
2	79
3	69
4	27
5	−47
6	−153

2. What was the height of the football when it was first punted?

3 feet.

3. How high was the football at its maximum height?

$$x = -\frac{b}{2a}$$

$$x = -\frac{70}{2(-16)} = \frac{70}{32} \approx 2.1875$$

$$y = -16\left(\frac{70}{32}\right)^2 + 70\left(\frac{70}{32}\right) + 3 \approx 79.5625$$

About 79.56 feet.

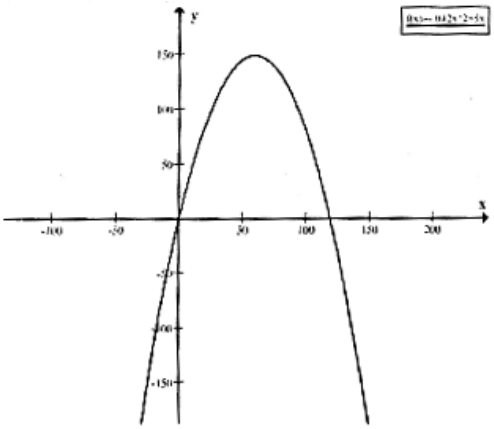
4. How high was the football after 4 seconds?

27 feet.

Scenario.

Lexi Thompson was on the 16th hole at a famous golf course with the pin being 175 yards away from the tee. She chose to use her 9 iron for this hole. The equation for Lexi's drive (path of the golf ball) can be modelled by the equation h(d) = - 0.04d2 + 5d, where d is the distance the ball travelled in yards and h(d) represents the height of the ball.

1. What was the height of the golf ball when it was first hit? Explain your reasoning.



x	y
0	0
20	83.2
40	132.8
60	148.8
80	131.2
100	80
120	−4.8

0 feet. Answers may vary.

2. How high was the golf ball at its maximum height?

About 95.24 yards.

$$x = -\frac{b}{2a}$$

$$x = -\frac{5}{2(-0.042)} = \frac{5}{.21} \approx 59.52$$

$$y = -0.042\left(\frac{5}{.21}\right)^2 + 5\left(\frac{5}{.21}\right) \approx 95.238$$

3. When the golf ball has reached it's maximum height, how much further does it have to travel before it lands?

The ball lands between 119 and 120 yards away from Lexi, so if the golf ball is at it's maximum height at about 60 yards away, then the ball travels another 60 yards.

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Mathematics. Parabolics. Square function.
Country where the lesson came from	Latvia
Country/person who used it	Vasileviciute Lithuania
Level/age of students	9th grade (14 years)
Date	2017-05-23

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The instructions were clear.
Did it fit your curriculum?	Not too much because we learn it in the 10th class.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Lithuanian - English
Was time enough?	Time was enough
Was it easy to pass the information onto students and putting up the task?	It was a little difficult, because of lack of English knowledge.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	It was good, because most of the students were active in the lesson.

In which extent did you reach the predicted aims and outcomes?	We reached the predicted aims.
What was student's reaction/feedback?	Students said they liked the lesson.
Was the methodology and materials suitable for the activity?	The methodology was suitable.
Could the activity plan be improved? If so, how would you improve it?	
Other remarks	

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Maths: Quadratic Function
Country where the lesson came from	Latvia
Country/person who used it	Italy: Capelletti
Level/age of students	12 years
Date	30 October 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes they were
Did it fit your curriculum?	No, I had to adapt this topic to the level of my students
Other remarks	I used a geometry lab to show parabolic function  
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Italian
Was time enough?	Yes

Was it easy to pass the information onto students and putting up the task?	Yes
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	I observed ad check their work in classroom, I made a written test
In which extent did you reach the predicted aims and outcomes?	I think I reach my predicted aims to a certain extent, but probably not entirely because of the complexity of this topic
What was student's reaction/feedback?	They were happy and curios to explore such a kind of topic, but with some difficulty
Was the methodology and materials suitable for the activity?	Yes, but as I said, I had to adapt this topic with the age of my students
Could the activity plan be improved? If so, how would you improve it?	Yes, think about the use in real world of this function (for example in optical lens, in architecture, in long distance communications…)
Other remarks	

Feedback on the lesson/activity (3)

GENERAL INFORMATION	
Subject and topic	Quadratic Function
Country where the lesson came from	Latvia
Country/person who used it	Portugal / Professor of Mathematics: Cristina Santos
Level/age of students	Secondary education, 10th year
Date	October 31, 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The instructions were clear and sufficient to carry out the proposed activity.
Did it fit your curriculum?	The content was part of the curriculum.
Other remarks	Although the quadratic function study was part of the Mathematics curriculum for the 10th grade in Portugal, this was not the best timing for its teaching. The students already had some knowledge in this area, namely regarding the type of chart and how to determine the zeros of the function. Thus, a small change was made to the activity, all of which was performed using the graphing calculator's capabilities.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	In English and Portuguese.
Was time enough?	The time was enough for the activity, 1 lesson of 90 minutes.

Was it easy to pass the information onto students and putting up the task?	It was relatively easy to pass on the information to the students and set the task for them. From the mathematical point of view it was quite easy, however, as it was also necessary to add instructions regarding the use of the graphing calculator it made it much more difficult to use the English language.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Regarding the evaluation of the activity, I asked the students to write a brief text about the activity where the students highlighted the following aspects: * The activity motivated them to learn; * Activities involving work between peers are always stimulating; * The introduction and learning of new content using new technologies was stimulating and attractive; * Was motivating to know what other students learn in other countries; * It was very interesting and different to have a Mathematics class in English. In relation to the evaluation of the skills developed with this activity these will be integrated in the tests in the resolution of problems involving the study of quadratic functions using the graphing calculator.
In which extent did you reach the predicted aims and outcomes?	Although the more thorough study of the quadratic function was taught only around February, this activity was very useful to: * Facilitate the understanding of Mathematics in solving problems in real contexts; * Understand and study some of the features of the quadratic function; * Introduce the functions of the graphing calculator in the study of the quadratic function. Therefore, the objectives were achieved and the results were as expected.

What was student's reaction/feedback?	The reaction of the students was excellent, as the activity encouraged them to work in groups to help each other. They asked for the teacher's help several times in the use of the graphing calculator, however, they did not reveal difficulties in the part of the interpretation and of what was intended from the mathematical point of view. It was equally interesting the spirit of mutual aid between teacher and students because there were many times the students helped and encouraged the teacher in the use of English. The atmosphere in the classroom was of mutual help. We all learn from each other.
Was the methodology and materials suitable for the activity?	Yes. The methodology and materials were adequate to carry out the activity.
Could the activity plan be improved? If so, how would you improve it?	Thinking about the objectives that were intended to achieve I believe that the activity was well thought out.
Other remarks	It would be interesting to add to this activity the use of the graphing calculator as another motivating tool for trapping. Use this resource not as a substitute for analytical processes for solving this type of problem, but as a facilitator of interpretation and verification of results.

Feedback on the lesson/activity (4)

GENERAL INFORMATION	
Subject and topic	Maths - Quadratic Function
Country where the lesson came from	Latvia
Country/person who used it	Liz FIRSATBUL(Maths Teacher)
Level/age of students	10th Grade
Date	01.10.2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes The instructions were clear.
Did it fit your curriculum?	Yes, it fit the curriculum. The only difference is we applied it to the 9th grades.
Other remarks	We nearly have the same topic in our curriculum.
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Turkish
Was time enough?	Yes, it was enough.(40 minutes)
Was it easy to pass the information onto students and putting up the task?	We could pass the information into our students successfully.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	We have applied a pop quiz related with quadratic functions after the class.

In which extent did you reach the predicted aims and outcomes?	It was below average.(80%)
What was student's reaction/feedback?	The subject was interesting for the students because I have exemplified the subject to the real life situations.
Was the methodology and materials suitable for the activity?	Yes, the methodology was suitable for the activity.
Could the activity plan be improved? If so, how would you improve it?	Yes, we can maybe add some more examples and practice the topic more after this class.
Other remarks	Application of this plan was entertaining both for me and students. It made us happy (that the some subject with the same methodology) We have enjoyed doing.

Country:	Portugal
School:	Escola Daniel Sampaio
Lesson/subject:	Mathematics
Level:	9th grade

DETERMINATION OF INACCESSIBLE HEIGHTS

Outdoor activity, similarity of triangles, Thales theorem, trigonometry of the right triangle, trigonometric reasons for an acute angle, operations with approximate values, problems resolution.

Level

The activity aims students between the ages of 13 and 15 who attend the 9th grade. However, the first two experiences can be applied, with changes and/or additions to students between the ages of 12 and 14, who attend 7th or 8th grade.

ICT support, equipment needed

View **MATERIALS/RESOURCES, WORKSHEETS**

Teaching aims

Developing competences:

* To enunciate the Thales Theorem with rational proportional constants.
* To recognize, using the Theorem of Thales, that two triangles are similar when two internal angles of one are equal to two of the inner angles of the other and designate this property by "AA criterion of similarity of triangles".
* To recognize, using the Thales Theorem, that two similar triangles have corresponding angles equal.
* To solve geometric problems involving the use of the Theorem of Thales.
* To solve problems involving the determination of unknown distances using the Thales Theorem.
* To operate approximate values of real numbers.
* To solve problems involving approximations of measures of magnitudes.
* To solve problems involving the determination of distances using given acute angles and the respective trigonometric ratios given by a calculating machine or by a table.
* To analyse and criticize a result in the context of a problem.

Learning outcomes

Students will have the opportunity to recall the following contents: similarity of triangles, Theorem of Thales, operations with approximate values and proceed to rounding.

Students will develop the following mathematical skills: measuring with tape measure, using the scientific calculating machine to determine a trigonometric ratio, determining inaccessible distances, using trigonometric reasons in problem solving, analysing and discussing results.

Methodology / methods

* The methodology adopted was group work.
* All experiments were carried out in small groups of 5 students each, in a total of six groups.
* Throughout each experience, each of the groups worked out schematics, wrote down measurements, answered some questions and made calculations in their notebooks. Subsequently, the results were discussed in a large group.
* Finally they applied the concepts in exercises and problems of the school manual. At the end of the activity students completed a table with their self-assessment.

Lesson phases and timing

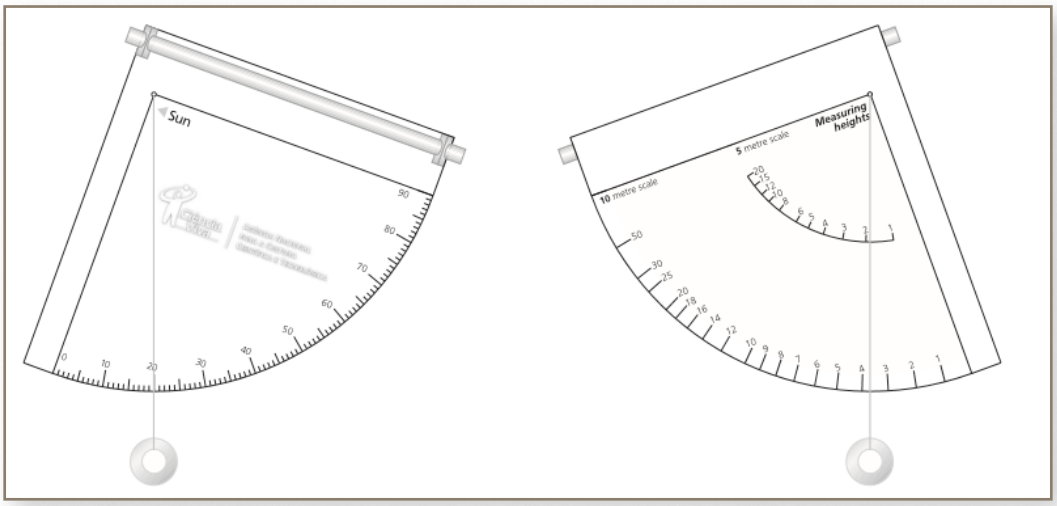
The activity was developed in two 90-minute classes:

* In the first class, students built the quadrant, developed the first two experiments and recorded all the schemes and measures carried out in their notebook.
* In the second class the students developed the third experiment, proceeded to discuss results in a large group and solved exercises in the school manual.

Instructions for Quadrant Construction

* Cut out the two sides of the cardboard quadrant;
* Glue the part that says “Measure Heights” in the part that says “Sun”;
* Cut out the black circles and fold the flaps over to the side that says “Sun”;
* Carefully introduce and on the side that says “Sun” to straw on the flaps of the quadrant;
* With a needle, pass the string through the dot marked in the quadrant;
* Tie a weight on the line so that it is taut and does not get stuck in the quadrant.

Your quadrant should look like this:



Be careful when you are using your quadrant - you should never look at the Sun through the straw because you could damage your eyes.

Now you can use your quadrant to measure the angle of the Sun above the horizon. Hold your quadrant in one hand and turn the

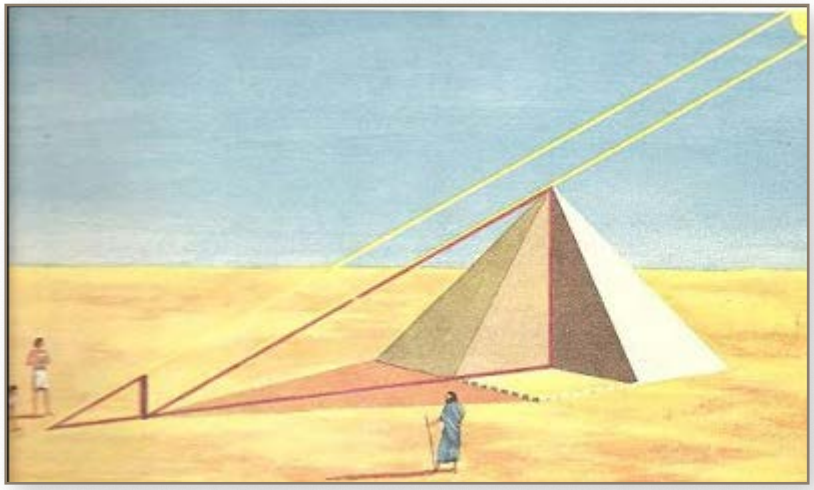

Quadrant

straw towards the Sun. Put your other hand on the outer end of the straw and tilt the quadrant until you can see a bright spot on the palm of your hand. Read the number where the thread lies and you will find out the angle of the Sun above the horizon. Early in the morning this angle is smaller and at midday it is larger.

Experiment 1

According to the diagram presented, it makes the following measurements:

* Choose one of the tallest trees and measure the full length of your shade. Write this value;
* Choose a colleague from your group, measure your height and your shadow. Write these values.



Experiment 2

Your quadrant has, on one side, a scale in degrees, equal to that of the protractor, which gives a slope or an angle with the horizontal line. On the

other side, give yourself the height of an object. To determine the height of the tree proceed as follows:

* Move away from the tree 5 meters in a straight line in any direction and turn to the tree (you can achieve it by taking very large steps, in this case it will be 5);
* Take the quadrant and peer through the straw to the top of the chimney. The line indicates a number on the 5-meter scale on one side of the quadrant. Write that number.

Evaluation/evaluation tools

The students made a report where they indicated all the schemes, measurements and calculations made to determine the alura of the tree and answered the following questions:

Experiment 1

1. Make a diagram or a small outline of the situation, involving the tree and your colleague as well as their shadows and their measurements.
2. Why Thales thrust his stick perpendicularly to the floor?
3. Compare the triangles obtained by the different groups. Are they all the same? What differences are there? What are the similarities? Explain.
4. Apply your knowledge on similarity of triangles to determine the height of the tree.
5. Try to compare your results with your colleagues. Did they all find the same result? Why? Explain.

Experiment 2

1. The value you got will be the height of the tree? Explain.
2. Try to compare your results with your colleagues. Did they all find the same result? Why?
3. Compare the values obtained in the two experiments.

In the end, students completed the following self-assessment form:

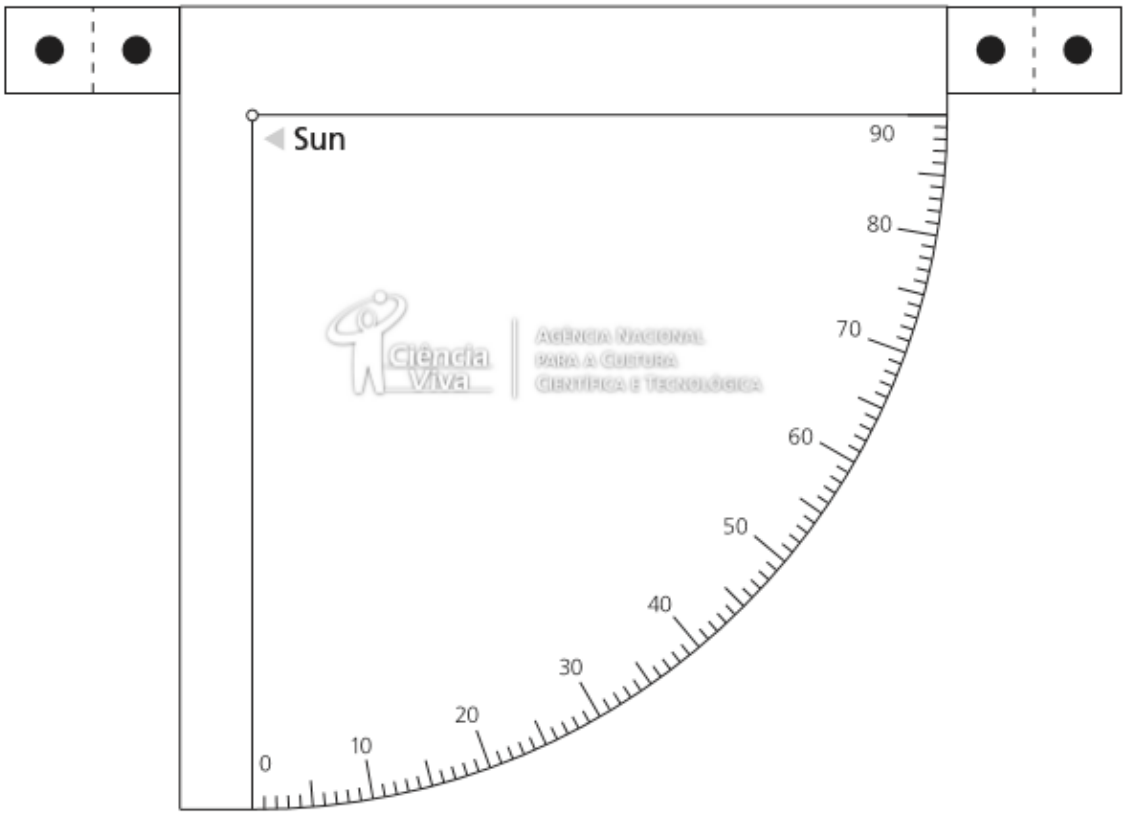
(Fill in by placing X in the desired option)

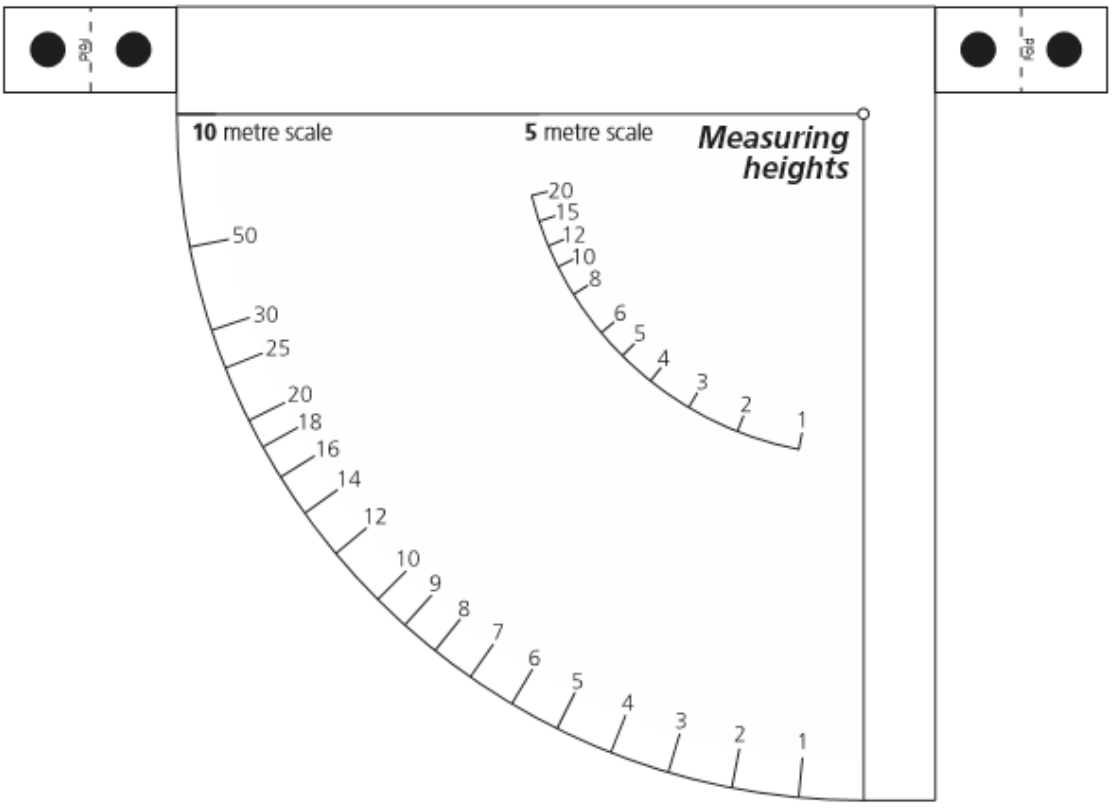
Group elements	For this activity I needed support				After doing this activity I feel that on the similarity of triangles (1) and trigonometric ratios (2)…								Your commitment to the activity was		
	none	little	some	much	I do not understand anything		I understand a little		I understand better		I understand a lot better		poor	satisfactory	very good
					1	2	1	2	1	2	1	2			
In this activity we enjoyed…															

Materials/resources, worksheets

A4 paper, paper-board, scissors, glues, string, straws, needles, measuring tapes of 5 meters or more, copy of the quadrant and model scientific calculating machines.

Copy of the quadrant model (can be extended):


Sun
0
10
20
30
40
50
60
70
80
90


10 metre scale
5 metre scale
Measuring heights
50
30
25
20
18
16
14
12
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9
8
7
6
5
4
3
2
1
20
15
12
10
8
6
5
4
3
2
1

Additional information

Experience 1 of this activity needs to be performed in a sunny day.

Source: http://www.cienciaviva.pt/equinocio

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Maths: Talete
Country where the lesson came from	Portugal
Country/person who used it	Italy: Capelletti
Level/age of students	13 years
Date	30 October 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes they were
Did it fit your curriculum?	Yes, it fits, except the astrolabe.  

Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Italian
Was time enough?	Yes
Was it easy to pass the information onto students and putting up the task?	Yes
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	I observed ad checked their work in classroom, I made a written test
In which extent did you reach the predicted aims and outcomes?	I think I reach my predicted aims to a great extent for most of my students
What was student's reaction/feedback?	They were happy and curios to explore such a kind of topic and instruments
Was the methodology and materials suitable for the activity?	Yes
Could the activity plan be improved? If so, how would you improve it?	Yes, think about the use in past world of these instruments and try to use theme in a lot of situations.
Other remarks	

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Mathematics. Determination of inaccessible height.
Country where the lesson came from	Portugal.
Country/person who used it	Latvia. Klinta Andža.
Level/age of students	15-16 years old. Form 9.
Date	September 12, 2017.

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear enough.
Did it fit your curriculum?	Yes, it fits the curriculum. It was more as repetition because I applied it at the beginning of the school year.
Other remarks	Very well planned lesson.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	Yes, it took two lessons (40 minutes long).
Was it easy to pass the information onto students and putting up the task?	The activities and tasks motivated students for learning. Only some students had difficulties with the tasks.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students did the self-evaluation (Annex 3). Their knowledge was not evaluated.

In which extent did you reach the predicted aims and outcomes?	This activity was useful to review and use geometry in the classroom. The students had the opportunity to review the following contents: similarity of triangles, Theorem of Thales, operate with approximate values and proceed to rounding. Students developed their mathematical skills doing measuring with tape measure, using the scientific calculating machine to determine a trigonometric ratio, determining inaccessible distances, using trigonometric reasons in problem solving and analysing and discussing results.
What was student's reaction/feedback?	Students liked the lesson a lot. They understood the topic better and worked hard. Some students needed the help of the teacher.
Was the methodology and materials suitable for the activity?	Yes, certainly. Very interesting experiments.
Could the activity plan be improved? If so, how would you improve it?	No. I have not got any suggestions.
Other remarks	

Country:	Turkey
School:	Mersin Deniz Ticaret Odasi Mesleki Ve Teknik Anadolu Lisesi
Lesson/subject:	Maths
Level:	9-10 grade 14-16 years old

TRIGONOMETRY FOR SOLVING PROBLEMS

ICT support, equipment needed

Interactive whiteboard, worksheet.

Teaching aims

This lesson offers a pair of puzzles to enforce the skills of identifying equivalent trigonometric expressions. Additional worksheets enhance students' abilities to appreciate and use trigonometry as a tool in problem solving. This lesson is adapted from an article by Mally Moody, which appeared in the March 1992 edition of *Mathematics Teacher*.

Learning outcomes

Students will be able to:

* Analyse situations, check for limitations, and examine appropriate methods of solutions using trigonometry.
* Practice manipulating trigonometric functions and in substituting equivalent expressions.
* Work in small groups encouraging classmates and communicating thoughts.

Methodologies/methods

Presentation, Discussion, Question and Answer, Demonstration.

Lesson phases and timing:

Trigonometry Practice

For the first puzzle, **Trigonometry Square Activity Sheet 1**, students must apply trig values for some common angles. Prepare the activity sheet by cutting up the sheets into squares, and ideally laminating them.

Place the sixteen squares in an envelope. Divide students into groups (groups of three work well). Give each group an envelope of squares, and instruct them to match equivalent expressions to create one large square, lining up equivalent values. Students will review and learn common equivalents and will be better prepared to deal comfortably with trigonometric functions in more advanced studies. If a group seems to be having difficulty, suggest identifying one of the corner squares to get started. (Note that the arrangement on the

original activity sheet represents one possible solution, though students may find others.)

Trigonometry Square Activity Sheet 2

Is the same idea as **Trigonometry Square Activity Sheet 1**, except here the students will be matching equivalent expressions, using trig identities.

These sheets are "answered" by the correct assembly of the puzzle. Some answers will vary on these two activity sheets. Students should be encouraged to present and defend their own answers. They should also be encouraged to reflect on and accept the possibilities suggested by classmates.

During the process students are encouraged to remember the trigonometric values by the facilitator that is teacher.

Evaluation/evaluation tools

Assessment Options

1. Have students complete **Trigonometry Square Activity Sheet 2** independently.
2. Create a mixed set of questions including angle of elevation and angle of declination. Have students identify whether it would be angle of elevation or angle of declination for each question. Then have them solve for a missing variable.

Extensions

1. Have students redo the **Trigonometry Square Activity Sheets** in a different order.
2. Have students create their own **Trigonometry Square Activity Sheet** and exchange and solve with a partner.

3. Ask students to come up with other real world scenarios in which angle of elevation and angle of declination would be applicable.

Materials/resources, worksheets

Worksheet 1, Worksheet 2.

Annex 1

Trigonometry Square

$\frac{\sqrt{2}}{2}$ $\tan 60°$ $\frac{\sqrt{3}}{2}$ sec 45°	0 $\cos 30°$ $\sqrt{3}$ sin 60°	$\frac{1}{2}$ $\frac{\sqrt{3}}{2}$ 1 csc 30°	1 2 $\cos 0°$ csc 30°
$\sqrt{2}$ $\frac{1}{2}$ 1 sin 45°	$\cos \frac{\pi}{6}$ undefined $\cos 90°$ sin 0°	$\tan 45°$ $\frac{1}{2}$ $\cot 0°$ 2	2 $\frac{\sqrt{3}}{2}$ $\sin 30°$ $\sqrt{2}$
$\frac{\sqrt{2}}{2}$ $\cot 30°$ 1 sin 90°	0 $\sin \frac{\pi}{2}$ $\sqrt{3}$ $\frac{\sqrt{3}}{2}$	$\sec 60°$ 0 1 $\frac{\sqrt{3}}{3}$	$\csc 45°$ 0 $\tan \pi$ 0
1 $\cot \frac{\pi}{4}$ $\frac{\sqrt{2}}{2}$ 0	$\sin 60°$ $\frac{\sqrt{2}}{2}$ 1 $\frac{\sqrt{3}}{2}$	$\tan 30°$ $\cot 45°$ $\cos 45°$ $\frac{\sqrt{3}}{2}$	$\cos 90°$ 1 1 $\frac{\sqrt{2}}{2}$

Annex 2

Trigonometry Properties Square

NAME ____________________

$\cos^2 A$ $\sin A$ $\frac{\cos A}{\cot A}$ $\frac{1}{\sec A}$	$\sec A$ $\sin A$ $\sec^2 A - 1$ $\frac{\sin A}{\tan A}$	$\cot A$ $\tan^2 A$ $\cos^2 A \tan^2 A$ $\sin A \cot A$	$\frac{\tan A}{\sec A}$ $\sin^2 A$ $\sin^2 A$ $1 - \sin A$
$\cos A$ 1 $\sin A$ $\sin^2 A \cot^2 A$	$\cos A$ $\tan A \cos A$ $\sec^2 A$ $\cos A \sec A$	$\frac{1}{\sec A}$ $1 + \tan^2 A$ $\frac{1}{\cot A}$ $\frac{1}{\cos A}$	$\frac{\cos^2 A}{1+\sin A}$ $\tan A$ $\cot A$ $\cos A$
$\cos^2 A$ $\cot^2 A + 1$ $1 - \cos^2 A$ $\frac{1}{\csc A}$	1 $\sin^2 A$ $\tan A \cos A$ $\csc^2 A$	$\sec A$ $\frac{1}{\csc A}$ $\frac{\sin^2 A}{1+\cos A}$ $\frac{\sin A}{\cos A}$	$\cot A \sin A$ $1 - \cos A$ $\cos A$ 1
$\sin A$ 1 $\frac{1}{\cot A}$ $\cos^2 A$	$\cot^2 A + 1$ $\frac{\sin A}{\cos A}$ $\frac{1}{\sin A}$ $\csc A$	$\tan A$ $\csc A$ 1 $\frac{1}{\sec^2 A}$	$\sin^2 A + \cos^2 A$ $\sec^2 A - \tan^2 A$ $\cot^2 A - \csc^2 A$ $\tan A$

Feedback on the lesson/activity

GENERAL INFORMATION	
Subject and topic	Trigonometry, formulas and trigonometric ratios
Country where the lesson came from	Turkey
Country/person who used it	Portugal / Professor of Mathematics: Cristina Santos
Level/age of students	Secondary education, 11th year
Date	May 8, 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The instructions were clear and sufficient to carry out the proposed activity.
Did it fit your curriculum?	Most of the content was part of the curriculum with the exception of the secant, co-secant and cotangent functions.
Other remarks	At first I thought I would apply Lithuania's activity because it was completely in line with my students' curriculum, but I had a problem: the sites and instructions of the sites to use were in Lithuanian.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	In English
Was time enough?	The time was enough for the activity, 1 lesson of 90 minutes.
Was it easy to pass the information onto students and putting up the task?	Yes, it was easy. Although I never gave any classes in English I think it went well.

AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	I asked the students to write a short text about the activity where the students highlighted the following aspects: * The activity motivated them for learning; * Activities involving peer work, self-employment and / or competition are always stimulating; * The introduction and learning of new contents in the field of trigonometry was easy and appealing; * It was stimulating and motivating to know what other students learn in other countries; * It was super interesting and different to have a Mathematics class in English.
In which extent did you reach the predicted aims and outcomes?	Although the trigonometry unit was already taught in December, this activity was useful for reviewing certain content for the overall assessment test. Therefore, the objectives were achieved and the results were as expected.
What was student's reaction/feedback?	The reaction of the students was great in that the activity stimulated them to work in pairs autonomously. Practically they did not want the help of the teacher because they were determined to find several solutions for the construction of the Puzzle. After finding a solution they went immediately to search for the 4X4 Puzzle. Most groups resolved an expression and then went looking for an expression that was equivalent, however, there was a group that first simplified all expressions and then linked them to get the 4X4 Puzzle.
Was the methodology and materials suitable for the activity?	Yes. The methodology and materials were adequate to carry out the activity.
Could the activity plan be improved? If so, how would you improve it?	I do not have any suggestions.

Country:	Lithuania
School:	Pakruojis "Atzalynas" Gymnasium
Lesson/subject:	Mathematics
Level:	3A (students of 17-18 years old)

SINE FUNCTION

ICT support, equipment needed

* Internet
* Computer
* Multimedia.

Teaching aims

Seek that students would gain mathematics knowledge, which would help them to create graphs. Also that students would apply sine function features while solving tasks.

Learning outcomes

Know how to create function graphs and investigate function features while doing tasks.

Methodology/methods:

* Explanation of new material
* Demonstration
* Learning together

Lesson phases and timing:

Phase 1 (3 min.)

Teacher reminds angle measuring in radians, sine feature sin(-x)=-sin(x), arcsine definition and formula, angles 30°, 45°, 60° sine meaning.

Phase 2 (20 min.)

New material explanation: discussing together with students how based on unique circle the graph of sine is obtained, defining what kind of function is periodic and with the help of graph function features are being analysed.

Phase 3 (7 min.)

The examples of sine vibrations (waves, oscillations/fluctuation) are presented, the term 'sinusoid' is being heard, the transformations of 'concertina' and 'spring' are given.

Phase 4 (7 min.)

Practice. Based on given graphs students describe corresponding functions.

Phase 5 (6 min.)

Reflection. Analyzing what they found out and learned.

Phase 6 (1 min.)

Evaluation. Activity is finished with self-evaluation about and what has been learned, how it went.

Phase 7 (1 min.)

Giving homework.

Evaluation/evaluation tools

Filling in the table, where they point out what they had already known about sine function, what new they found out and what they did not understand during this class. (Annex 1)

Materials/resources, worksheets

Student's Book. - Deveikyte, J.; Gedminiene, J.; Vanagas, V. 'Mathematics for You. 11th class expanded course 1st part.'

https://smp2014ma.ugdome.lt/MO/Matematika/index.html?path=r041

http://mkp.emokykla.lt/imo/lt/mo/271/

Annex 1

Table for self-evaluation

What I know about…	What new I have learned about…	What I do not understand yet? What will I do in order to be more successful?

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Mathematics. Sine Function.
Country where the lesson came from	Lithuania.
Country/person who used it	Latvia. Anita Kamendere.
Level/age of students	17 years old. Form 10.
Date	May 12, 2017.

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were understandable.
Did it fit your curriculum?	This topic was taught in January, so I used it as repetition.
Other remarks	Interesting examples of using the sine function are provided.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	The time was enough because the students were familiar with this topic.
Was it easy to pass the information onto students and putting up the task?	The tasks were understandable because in schools in Latvia they are similar in this topic/subject.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students' knowledge was not assessed. Students did self-evaluation.

In which extent did you reach the predicted aims and outcomes?	The aim of the lesson is fulfilled – graphic design of sine function, sine function and real examples. The objectives were achieved.
What was student's reaction/feedback?	Students liked the lesson. They were motivated and willingly participated. The table of feedback was used.
Was the methodology and materials suitable for the activity?	Yes. The only problem was that the provided sites were in Lithuanian.
Could the activity plan be improved? If so, how would you improve it?	The lesson plan is good. It is tailored to the students in the classroom.
Other remarks	Thank you for the lesson!

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Maths - Sine Function
Country where the lesson came from	Lithuania
Country/person who used it	Turkey / Taylan ÇİFTÇİ(Maths Teacher)
Level/age of students	11th Grade (16-17 years old)
Date	10.11.2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes The instructions were clear.
Did it fit your curriculum?	No, we have it in our academic high school curriculum. At our school we have a more vocational based curriculum.
Other remarks	In the curriculum of the 11th grades we have optional maths classes so we could apply this activity plan to the ones who has this optional maths class.
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Turkish
Was time enough?	Yes, it was enough.(40 minutes)
Was it easy to pass the information onto students and putting up the task?	Putting the abstract knowledge of maths into graphics is first difficult for the learners.
AFTER THE LESSON/ACTIVITY	

How did you do the evaluation?	I applied the same table from the annex 1.
In which extent did you reach the predicted aims and outcomes?	While applying the lesson plan, we had a difficulty in the background knowledge of the students in sine function. For example we had a difficulty in explaining the concept of arcsine.
What was student's reaction/feedback?	They had enjoyed learning to drawing the graphics of sine function.
Was the methodology and materials suitable for the activity?	Yes, it was suitable.
Could the activity plan be improved? If so, how would you improve it?	We have derived from this topic that trigonometry and music is closely related. Using this links http://muthisbilim.org/Bilim/trigonometri-ve-muzik, http://www.malinc.se/math/trigonometry/musicen.php we can see some interesting examples.
Other remarks	In Turkey, the topic about the features of sine function includes in the academic high school curriculum. But we at least tried to explain an applied this lesson plan on the simple basis. According our vocational school curriculum.

Country:	Latvia
School:	Balvi State Gymnasium
Lesson/subject:	Maths
Level:	9th Grade

PERIMETER AND AREA CALCULATION

ICT support, equipment needed

Calculators, projector.

Teaching aims

Students will be able to use perimeter and area calculation in real life.

Learning outcomes

As a result of studying this topic the students will be able to:

* Calculate the perimeter of non-conventional areas;
* Calculate arc length;
* Calculate the area in true to life situations.

Methodology/methods

Questions and discussion; Reading information; Cooperative Learning Groups.

Lesson phases and timing:

Introduction (3 minutes)

Break students into groups of 2 or 3 for this part of the lesson. Some additional teacher notes have been provided to assist in the discussion, if needed.

Posing The Task (35 minutes)

Repeat:

1. The perimeter of the circle,
   the length of the line;
   arc length;
2. Rectangle area, doughnut ring area.

Task:

A football field needs to be set up according to the given size.

Calculate:

1. How many square metres of the artificial cover(-ing) are necessary to cover the area?
2. How many metres (altogether) will all the selected lines have?
3. How many square metres (altogether) will have to be painted white, if the line width is 12 cm?

4. How many litres of colour are necessary if 5 square metres can be painted with one litre of paint? (Look up the size of the area in the Annex 1)

Evaluation/evaluation tools

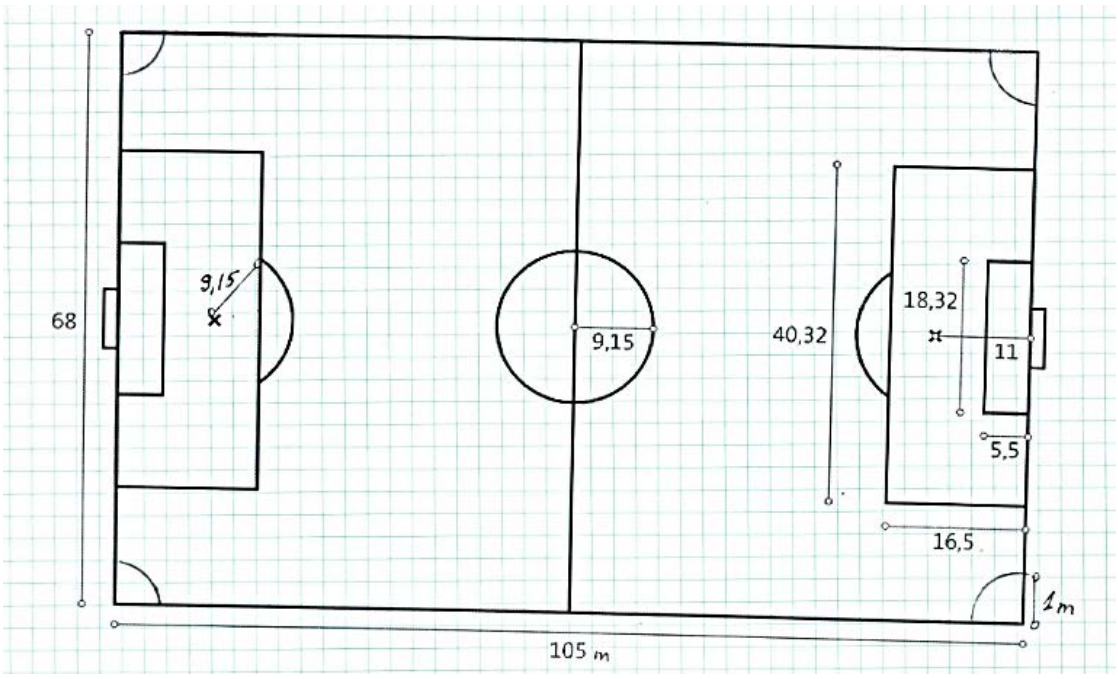
When the students have finished their work, have a whole class discussion on the answers to the questions.

Materials/resources, worksheets

Worksheet.

Annex 1

Worksheet



Country:	Lithuania
School:	Pakruojis "Atzalynas" Gymnasium
Lesson/subject:	Mathematics
Level:	1 a (14-15 years old)

SQUARE ROOTS

ICT support, equipment needed

Multimedia, smartphones, coloured pencils, A3 paper sheets.

Teaching aims

Repeat formulas of fast multiplication and other learned topics as well as consolidate actions with square roots.

Learning outcomes

Will learn to perform various tasks with square roots.

Methodology/methods

Group work, discussion, project preparation.

Lesson phases and timing:

Phase 1 (7-15 min.)

Teachers announce the topic of the class and explain the problem, which will help students to deepen their knowledge by finding a solution to it. Teachers also repeat the most important rules and formulas. Afterwards, students are divided into smaller groups, with the help of computer program, and they receive an explanation which methods to use for their group works (students download the necessary app for the QR code, which will help them to scan the codes put up on the walls of the classroom and this way to solve the coded tasks).

Phase 2 (30-45 min.)

After receiving the first task, distributing the work in their groups and scanning the code, where the hint to the next task is hidden, students try to resolve the assignment with no mistakes and as fast as possible. The goal is to decode the hidden word and find out its meaning. Later on, pupils summarize everything and prepare a small presentation for their classmates.

Evaluation/evaluation tools

10-20 min.

Students present their accomplished tasks and point out the most difficult and the easiest things while doing the job.

5-10 min.

Teachers summarize everything and thank students for their precise, responsible and creative work.

Materials/resources, worksheets

Coded tasks (example)

Additional information

Teachers - Ausra Vasileviciute and Alma Petrulaitiene.

Country:	Latvia
School:	Balvi State Gymnasium
Lesson/subject:	Maths
Level:	Form 7 (13-14 years old).

SOLVING PERCENTAGE TASKS IN EVERYDAY LIFE

ICT support, equipment needed

Projector, mobile phone or computer, Internet connection.

Teaching aims

Repeat and strengthen knowledge solving percentage tasks, linking them with real life.

Learning outcomes

As a result of studying this topic students will be able to:

* Understand how percentage is often used in real-life situations;
* Repeat the ways of solving per cent tasks.

Methodology/methods

Mind maps. Questions and discussion. Task solving. Work in pairs. Working with technology.

Lesson phases and timing

Introduction (5 min.)

In the beginning of the lesson, the teacher asks students the question "Where do we see percentage every day?" Students need to fill in a mind map where they daily see/use percentage. When it is done, students say their variants. Then the teacher asks the next question: "Is it important to calculate percentage tasks?" Students answer and justify the answer. After that, the teacher asks: "What is the aim of the lesson? Pupils say their variants, and then the teacher tells them the aim of the lesson (reads from the screen).

Power Point presentation (15 min.)

Teacher uses Power Point presentation (Annex 2). Slide show on the screen, showing how percentage can be expressed in part and in decimal. Having discussion. The next slide contains 3 examples where students themselves need to convert parts or decimal to percentage. Once the majority has been done, the answers are turned on so the students can compare and ask if something is unclear.

Examples of two percentage tasks are given. For example, how much would you pay for Nike bots with 20% discount, or checking uniforms at school- how many students in percentage are wearing the uniform.

Use and feedback (20 min.)

Each student is given a worksheet with parts, decimal or percentage. They have to find the pair and put an equal sign between two worksheets.

Students work in pairs. For each pair the worksheet with different percentages is given. Students can use their mobile phones or computers to find the information they need, for example prices. The teacher can help if needed.

At the end of the lesson each pair should explain the solution of one task. The rest of the class will find out what the dream car of these pupils is, how much it costs and what is the price with discount.

Evaluation/evaluation tools

Students complete three short tasks. Answers are discussed with the teacher, students correct mistakes (if needed) and do self-evaluation.

Materials/resources, worksheets

Power Point presentation (Annex 2) and worksheet (Annex 1).

Additional information

The last three tasks can be done individually and checked/evaluated by the teacher.

Annex 1

Worksheet

Task 1

Write in percentage.

a) $\frac{1}{5}$ = b) $\frac{1}{8}$ = c) $\frac{3}{5}$ =

d) $\frac{17}{25}$ = e) 0,06 = f) 0,17 =

Task 2

Draw a rectangle in the notebook which edges are 5 cm and 4 cm long! Colour 30% of this rectangle! Draw a rectangle which edges are 3 cm and 5 cm long! Colour 60% of this rectangle!

Task 3

Imagine and write what kind of car would you like to have?

_____

Surf on the Internet and write how much does it cost?

_____

Imagine that the seller will give you a 30% discount. Calculate how much will this car cost?

_____

How much money will you save?

_____

Task 4

In March school uniform check was done 4 times.

Calculate how much % of students in Form 7a were wearing the uniform?

Check 1 – 12 students of 16 were wearing school uniforms.

Check 2 – 17 students of 20 were wearing school uniforms.

Check 3 – 8 students of 16 were wearing school uniforms.

Check 4 – 9 students of 15 were wearing school uniforms.

Annex 2

Power Point presentation

1 slide. "SOLVING PERCENTAGE TASKS IN EVERYDAY LIFE"

2 slide. Where do we see percentage in everyday life?

3 slide. Is it important to calculate percentage tasks?

4 slide. The aim of the lesson

Repeat and strengthen knowledge solving percentage tasks, linking them with real life.

5 slide. Percentage

If the whole is divided into 100 parts and 17 pieces have been taken, then it can be said that $\frac{17}{100}$ have been taken, or 0,17, or 17%.

1. With a normal part $\frac{17}{100}$
2. With decimals 0,17

3. Percentage 17%

6 slide. Convert to Percentage!

a) $\frac{3}{10}$

b) $\frac{2}{5}$

c) $\frac{1}{3}$

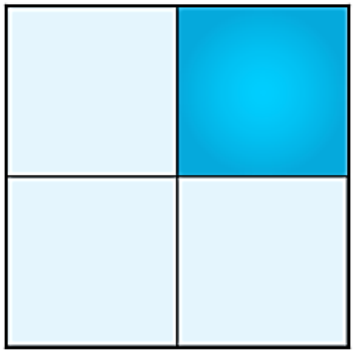
Answers

a) $\frac{3}{10} = \frac{30}{100} = 30\%$

b) $\frac{2}{5} = \frac{4}{10} = \frac{40}{100} = 40\%$

c) $\frac{1}{3} = 1 : 3 = 0{,}3333 = 33\%$

7 slide. As you can see one part of square is coloured. How much % is it ?



8 slide. Tasks.

1 way. Percentage from the number.

Task. "Nike" shoes costs 70 Euros, but now they have a 20% discount.

How much does shoes cost now?

9 slide. Answers.

20% no 70 Euro

$$20\% = \frac{20}{100} = \frac{1}{5}$$

1) $\frac{20}{100} \cdot 70 = \frac{20 \cdot 70}{100} = \frac{1 \cdot 70}{5} = 14$

2) a) $70 : 100 = 0{,}7$ b) $0{,}7 \cdot 20 = 14$

10 slide. Task.

Imagine and write what phone would you like to buy?!

Look on the Internet and write how much does it cost?!

Imagine that the seller will give you a 30% discount. Calculate how much will the phone cost?

How much money will you save?

Tell the rest of the students about it!

11 slide. 2 way. One number as the second number percent.

12 slide. Answer.

Whole class = 100%

$$\frac{number\ of\ boys}{all\ students}$$

$$\frac{7}{28} = \frac{1}{4} = \frac{25}{100} = 25\ \%$$

13 slide. Task. In form 11 today at school are 20 students. 14 of them have got uniform. How many students (%) have a uniform today?

14 slide. Answer.

$$\frac{students\ whose\ got\ the\ uniform}{all\ students}$$

$$\frac{14}{20} = \frac{7}{10} = 0{,}7 = 70\ \%$$

15 slide. Solving tasks. Check yourself!

1. Say in percentage!

$$0{,}03 \quad un \quad \frac{15}{25}$$

2. Calculate!

30% no 200

25% no 64

3. A quarter of the class did not go to the excursion. 20 students are studying in the classroom. How much students went on an excursion?

16 slide. Thank you for the lesson!

Country:	Lithuania
School:	Pakruojis 'Atzalynas' Gymnasium
Lesson/subject:	Mathematics
Level:	2 c (16-17 years old)

FRACTIONAL ALPHANUMERIC PHENOMENA AND THEIR SIMPLIFICATION

ICT support, equipment needed

Projector, lamp, board, textbook.

Teaching aims

Pupils will prepare for the test and develop these competences:

* Learning how to study – individually by solving the tasks and doing the knowledge map.
* Communication – while conducting group work.
* Recognition – by systematizing gained knowledge while doing the personal knowledge map.

* Initiative and creativity – by doing, analysing, evaluating and presenting own knowledge map.
* Personal – while using their individual knowledge and gained experience.
* Self-assessment– by evaluating personal level of understanding during the class and performing the wisdom evaluation snowflake by the end of the it.

Learning outcomes

After systematizing and repeating the prior knowledge about fractional alphanumeric phenomena, individually or with the help from colleagues and teachers, working in pairs or in groups, students will create knowledge map and be able to solve at least 5 fractional alphanumeric phenomena tasks

Methodology/methods

* Question method – to find out everyone's expectations about the class.
* Talk, discussion – raising a problem and setting goals.
* 'Board attack' – to awaken the knowledge.
* Mistakes on purpose method with the repetition of theory.
* Group work – while creating knowledge map and doing the exercises.
* Individual work – while presenting a personal knowledge map in the group setting as well as evaluating personal knowledge and work during the class.
* 'Little hand' – to evaluate the level of understanding during the class and receive feedback.

* ‘Skills snowflake’ – evaluation of your personal activities and competences by the end of the class and receiving feedback.

Lesson phases and timing:

Initial activities (10 min.):

* Finding every student’s personal problem.
* Homework check.

Main activities (30 min.):

* Repetition of theory and meaning.
* Creation of general knowledge map in groups and its presentation.
* Solving given tasks individually, in groups or in consultation with ‘teachers- consultants’.

End of the class (5 min.):

* Discussion of implementation of the set goal and tasks.
* Individual tasks during the class, preparation to write the test individually and self-evaluation marked in ‘Skills snowflake’.

Evaluation/evaluation tools

‘Skills snowflake’ – for personal development and self-evaluation at the end of the class (Annex 1).

Materials/resources, worksheets

Textbook 'Skills snowflake', knowledge map.

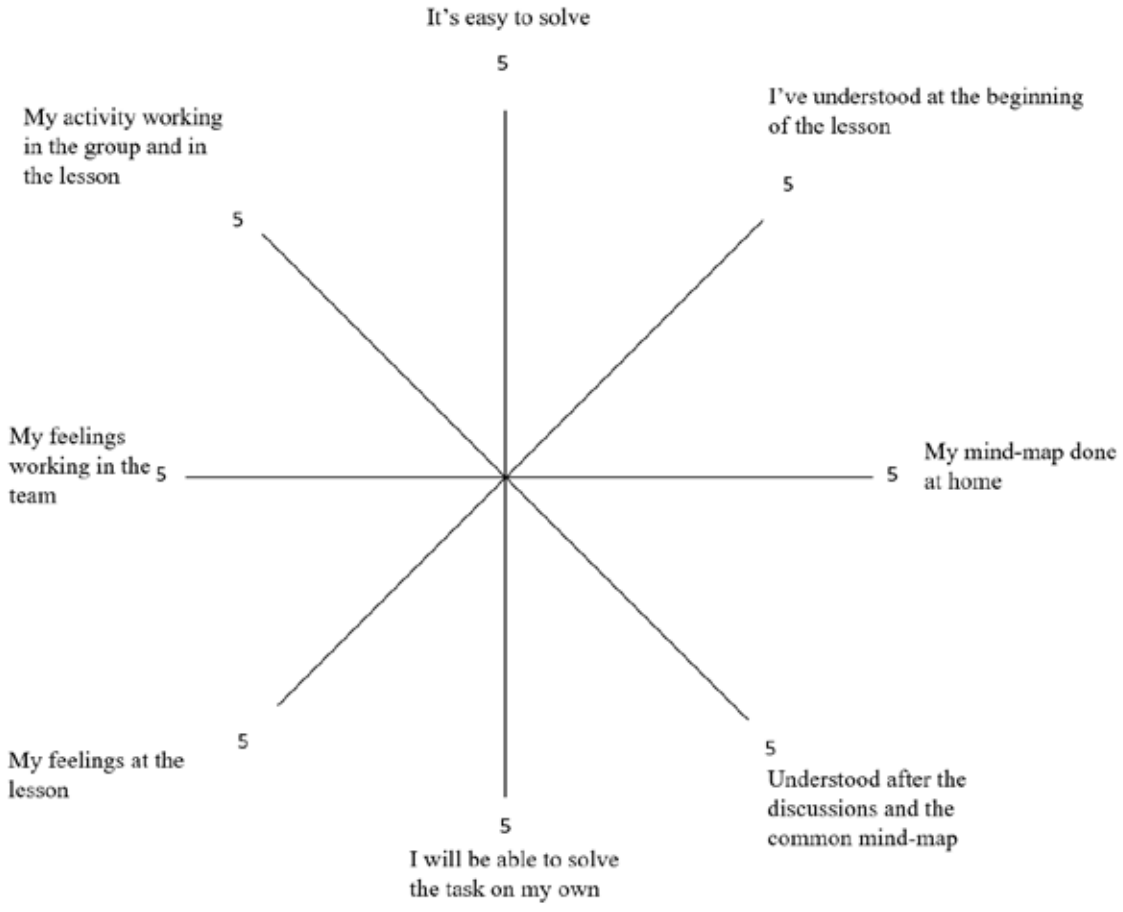
Additional information

Self-evaluation 'Skills snowflake' is added , teacher – Rita Vinskunaite.

Annex 1

'Skills snowflake' – for personal development and self-evaluation:

Theme: _____ Date: _____



Country:	Portugal
School:	Daniel Sampaio Secondary School
Lesson/subject:	Maths
Level:	12th year. 17-18years

GEOMETRIC TRANSFORMATIONS OF THE GRAPH OF A FUNCTION

ICT support, equipment needed

Graphic calculator or computer.

Teaching aims

Students will be able to:

* Recognize, given a real function of real variable f , a real number c and a cartesian referential, that the cartesian graph of a function g defined in $D_g = D_f$ by $g(x) = f(x) + c$ is the cartesian graph image of f by the vector translation $\vec{u}(0,c)$.

* Recognize, given a real function of real variable f, a real number c and a cartesian referential, that the cartesian graph of a function g defined

by $g(x) = f(x-c)$ the set $D_g = \{ x + c : x \in D_f\}$ is the cartesian graph f image by the vector translation $\vec{u}(0,c)$.

* Designate, given a plane provided with an orthogonal reference and a number $0 < a < 1$ (respectively $a > 1$), by "vertical contraction (respectively vertical expansion) of coefficient a" to the transformation of the plane ϕ which at the point P(x,y) associates $\phi(P)$ the coordinate point (x,ay).
* Recognize, given a real function of a real variable f, a number $0<a<1$ (respectively $a > 1$) and an orthogonal reference, that the cartesian graph of a function g defined by $g(x) = af(x)$ is the cartesian graph f image of the vertical contraction (by vertical dilation) of coefficient a.
* Designate, given an orthogonal reference and a number $0<a<1$ (respectively $a > 1$), by horizontal contraction (respectively horizontal dilation) of coefficient a the transformation of the plane ϕ which to the point $\phi(P)$ associates the coordinate point (ax, y).
* Recognize, given a real function of a real variable f, a number $0<a<1$ (respectively $a > 1$) and a cartesian referential, which the cartesian graph of a function g defined in $D_g = \{x/a : x \in D_f\}$ by $g(x) = f(ax)$ is the f cartesian graph image of the horizontal (respectively contraction) of coefficient 1/a.
* Recognize, given a real function of real variable f and a cartesian referential, that the cartesian graph of a function g defined in $D_g = D_f$ per $g(x) = -f(x)$ is the f cartesian graph image by the axis reflection Ox.
* Recognize, given a real function of real variable f and an cartesian referential, that the cartesian graph of a function g defined in $D_g = \{ -x : x \in D_f\}$ by $g(x) = f(-x)$ $g(x) = f(-x)$ is the cartesian graph image by the axis reflection Oy.

Learning outcomes

As a result of studying this topic students will be able to:

* Recognize a geometric transformation of the graph of a function.
* Describe the geometric transformations occurring in a graph.
* Indicate some characteristics of the functions after geometric transformation of your graph, namely: domain, range and coordinates of the vertex.
* Explain how you can get the graph of a function from the graph of another through the geometric transformations.

Methodology/methods

* Group work of 4 students (1 week)
* Presentation of results and conclusions obtained in a large group through exposure in Powerpoint (1 lesson of 90 minutes)

Lesson phases and timing

Student activities:

In the presentation class of the Powerpoints the students present all their conclusions to the class (90 minutes). The presentation is followed by discussion of results.

Throughout the discussion the teacher should help clarify the concepts and procedures used.

Teacher guidelines:

With this activity we intend to recall the graphical transformations of functions, for this was used a quadratic function.

The role of the teacher in this task should be, fundamentally, to support the work of each group, laying clues or making some clarifications that help overcome obstacles.

In the next class the teacher should propose the resolution of exercises that involve graphical transformations of more complex functions, such as: other polynomial functions, functions defined by branches, rational functions, irrational functions and trigonometric functions.

Later concepts should be applied to exponential and logarithmic functions.

Evaluation/evaluation tools

Presentation of the worksheet resolved.

Presentation of the Powerpoint with the conjectures and conclusions reached.

Participation in the discussion of the results obtained.

Relevance of the questions presented in the course of the work.

Materials/resources, worksheets

Work sheet, instructions for the graphing calculator.

Additional information

This activity was used to review the geometric transformations in the function graph and to select the students who would participate in the meeting in Lithuania in the 12th grade class with students aged 17 to 18 years.

Annex 1

Worksheet

Functions of type: f(x)+d, d ∈ ℝ

1. Consider the function defined by $f(x) = x^2 + 2x$ and the function defined by $g(x) = f(x) + d$.

   1.1 Gets the function g graph when d = -2, d = -1, d = 2.

   1.2 What can you say about the domain of the function g ?

   1.3 Consider the following tables for different values of the parameter d and complete them for different values of $x \in D_g$.

$d = -2$		
x	$f(x)$	$g(x)$

$d = -1$		
x	$f(x)$	$g(x)$

$d = 2$		
x	$f(x)$	$g(x)$

   1.4 The cartesian graph of the function g can be obtained by a _____ associated with the vector $\vec{u}$(___ , ___), from the cartesian graph of the function f.

Then we have: P (x, y) ∈ G_f ⇔ P'(___ , ___) ∈ G_g.

To obtain the graph of g when d = -2, d = -1, d = 2:

* TI 84 Plus

Putting the expression of f on Y1 and on Y2 put Y1+{-2, -1, 2}

To get Y1 do: VARS, Y VARIABLES, 1: Function, ENTER, 1: Y1

* CASIO fx-CG20

Put the expression of f on Y1 and on Y2 put Y1+{-2, -1, 2}

To get Y1 do: VARS, F4 (GRAPH), F1(Y), 1

* TI-Nspire™ CX

Putting the expression of f on f1(x) and on f2(x) put f1(x) + {-2, -1, 2}

Functions of type: f(x-c), c ∈ ℝ

2. Now consider the function h defined by h(x) = f(x-c), c ∈ ℝ

   2.1 Gets the function h graph when c = -2, c = -1, c = 2.

   2.2 What can you say about the domain of the function h?

   2.3 Consider the following tables for different values of the parameter c and complete them for different values of x ∈ D_h.

$c = -1$		
x	$f(x)$	$h(x)$

$c = 1$		
x	$f(x)$	$h(x)$

$c = 2$		
x	$f(x)$	$h(x)$

How can we get the image of x ∈ D_h by the function h knowing the image of x by the function f?

2.4 The cartesian graph of the function h can be obtained by a _____ associated with the vector $\vec{u}$ (___ , ___), from the cartesian graph of the function f.

Then we have: P (x, y) $\in G_f \Leftrightarrow$ P'(___ , ___) $\in G_h$.

Functions of type: af(x), a $\in \mathbb{R}^+$

3. Now consider the function defined by i(x) = af(x), a $\in \mathbb{R}^+$

3.1 Gets the function i graph when a = 0.25, a = 0.5, a = 1.5, a = 2.

3.2 What you can say about the domain of the function i ?

$a = 0{,}25$		
x	$f(x)$	$i(x)$

$a = 0{,}5$		
x	$f(x)$	$i(x)$

$a = 1{,}5$		
x	$f(x)$	$i(x)$

$a = 2$		
x	$f(x)$	$i(x)$

3.3 Consider the following tables for different values of the parameter a and complete them for different values of x $\in D_i$.

3.4 If the point P with coordinates (x, y) belongs to the cartesian graph of f, then the point P' with coordinates (___ , ___) belongs to the cartesian graph of i .

Definition of vertical dilatation (vertical contraction)

The geometric transformation of the plane that transforms any point P(x,y) of the plane into the point P' (x, ay), with $a > 1$ is called vertical dilatation if $0 < a < 1$ is called vertical contraction, both with coefficient a.

3.5

* For a certain real number $a > 1$ the cartesian graph of a function i defined by $i(x) = af(x)$ with domain $D_i =$ __, is the image of cartesian graph of f by the _____ with coefficient _____.
* For a zero real number $0 < a < 1$ the cartesian graph of a function i defined by $i(x) = af(x)$ with domain $D_i =$ __, is the image of cartesian graph of f by the _____ with coefficient _____.

Therefore, given a point with coordinates $(x, y) \in G_f$ its image, as a result of one of these transformations, has coordinates (___ , ___) and belongs to the graph of the function defined by i(x) = ___.

4. Now consider the function j defined by $j = f(bx)$, $b \in \mathbb{R}^+$

4.1 Gets the graph of the j function when $b = 0.5$, $b = 0.75$, $b = 1.2$, $b = 2.5$.

4.2 What can you say about the domain of function j ?

4.3 Consider the following tables for different values of parameter b and complete them for different values of $x \in D_j$.

$b = 0,5$

x	bx	$f(x)$	$j(x)$

$b = -0,25$

x	bx	$f(x)$	$j(x)$

$b = 0,5$

x	bx	$f(x)$	$j(x)$

$b = 1,5$

x	bx	$f(x)$	$j(x)$

4.4 If the point P with coordinates (x, y) belongs to the cartesian graph of f, then the point P' with coordinates (___ , ___) belongs to the cartesian graph of j .

Definition of horizontal dilatation (horizontal contraction)

The geometric transformation of the plane that transforms any point P(x,y) of the plane into the point P' (x/b, y), with $b > 1$ is called horizontal contraction if $0 < b < 1$ is called horizontal dilatation, both with coefficient 1/b.

4.5

* For a certain real number $b > 1$ the cartesian graph of a function j defined by $j(x) = f(bx)$ with domain $D_j = \{\_\_\_\_ : x \in D_f\}$, is the image of cartesian graph of f by the _____ with coefficient _____.

* For a certain real number $0 < b < 1$ the cartesian graph of a function j defined by $j(x) = f(bx)$ with domain $D_j = \{\_\_\_\_ : x \in D_f\}$, is the

image of cartesian graph of f by the _____ with coefficient _____.

Therefore, given a point with coordinates (x, y) ∈ G_f its image as, a result of one of these transformations, has coordinates (___ , ___) and belongs to the graph of the function defined by j(x) = ___ .

5. Do the same study for the following functions:

$$m(x) = - f(x),$$

$$n(x) = f(-x),$$

$$p(x) = |f(x)| \text{ e } q(x) = f(x-c) + d.$$

Adapted from "Transformações em Funções" by Cristina Negra; Emanuel Martinho; Helder Martins.

Country:	Portugal
School:	Daniel Sampaio Secondary School
Lesson/Subject:	Maths
Level:	12th year. 17-18 years

NUMBER OF NEPER AND THE LIMIT OF THE GENERAL TERM SUCCESSION

ICT support, equipment needed

Graphic calculator.

Teaching aims

Students will be able to:

* Conjecture the limit of succession defined by $u_n = \left(1 + \frac{1}{n}\right)^n$
* Get an approximate value for the number of Neper

Learning outcomes

As a result of studying this topic students will be able to:

* Prove that the succession of the general term is increasing, has major and minor, justify that is convergent, denote by "Neper number" ("and") the respective limit and know that e is an irrational number.

* Know that the function defined in $\mathbb{R}\setminus[-1,0]$ by $f(y)=\left(1+\frac{1}{y}\right)^{y}$ has limit e and justify that for $\pm\infty$ the $\lim\left(1+\frac{x}{n}\right)^{n}=e^{x}$.

Methodology/methods

* Individual work in a 90 minute class.
* Presentation of results and conclusions obtained in class.

Lesson phases and timing

Student activities

The 90 minutes of class will be distributed as follows:

* The first 10 minutes for the teacher to explain the activity.
* The following 40 minutes for the students to solve the activity.
* The last 40 minutes for discussion of results and presentation of conjectures and conclusions.

Throughout the discussion the teacher should help clarify the concepts and procedures used.

Teacher guidelines:

It is intend with this activity that the students conjecture the limit of the succession defined by and that have an approximate value of the number of Neper.

After the activity is completed the teacher can encourage students to search the Neper number on the Internet.

Evaluation/evaluation tools

- Presentation of the worksheet resolved.
- Presentation of the conjectures and conclusions reached.
- Participation in the discussion of the results obtained.
- Relevance of the questions presented in the course of the work.

Materials/resources, worksheets

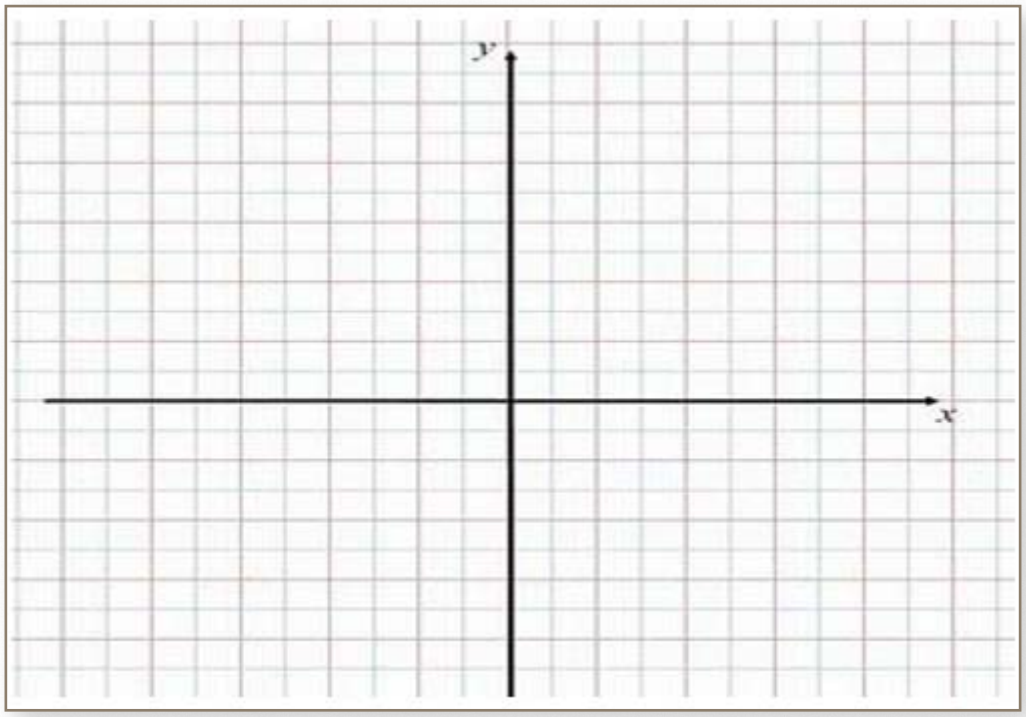
Worksheet.

Annex 1

Worksheet

1. Consider the following succession defined by: $a_n = \left(1 + \frac{1}{n}\right)^n$

1.1 With the help of the graphing calculator, graphically represent the first 30 terms of the sequence.



1.2 Analyze the graph and conjetures if:

* The sucession is monotone

_____

* The succession is limited

_____

1.3 Complete the following table with the help of the graphing calculator:

n	1	2	3	4	5	6	7	8	9	10	...	500	...	1000		10 000
a_n																

As n increases, the terms of this sequence appear to approximate _____

Country:	Italy
School:	Istituto Comprensivo di Uggiate Trevano - Primary school
Lesson/subject:	Maths
Level:	9-10 years old

MATHS AND COOKING

Abstract: the activity was realized with an initial teacher's presentation about fractions. After students' preparation (hands washing, apron wearing, …) the classroom was divided in 5 work teams (each group is involved in one activity – see annex) to use fractions to calculate portions, to use capacity measures to make some cocktails, to calculate proportions. Finally all pupils was involving to welcome greeting for guests and presentation of prepared food and drinks.

ICT support, equipment needed

* Computer
* Internet

Teaching aims

Pupils will be able to:

* know fractions
* use fractions to calculate portions
* know capacity measures
* use capacity measures to make some cocktails
* read and follow instructions
* calculate the right amount

- measure polygons and to break them up
- calculate proportions
- follow a rhythm of colours

Learning outcomes

Students are able to prepare an aperitif for thirty persons

Methodology/methods

- Work teams
- Reading informations
- Explanation
- Questions and discussions

Lesson phases and timing

1. Teacher's presentation - **15 minutes**
2. Students' preparation (hands washing, apron wearing, …) - **10 minutes**
3. 5 work teams (each group is involved in one activity – see annex) - **1 hour**
4. Welcome greeting for guests and presentation of prepared food and drinks - **30 minutes**
5. Time for enjoying the aperitif - **30 minutes**

Evaluation/evaluation tools

- To taste food and drinks

* To complete the worksheet about the activity

Materials/resources, worksheets

Food, drinks, blender, knives, spoons, bowls, glasses, plates, trays, pictures, aprons, napkins, soap.

Annex 1

PROBLEM N 1 (fractions)

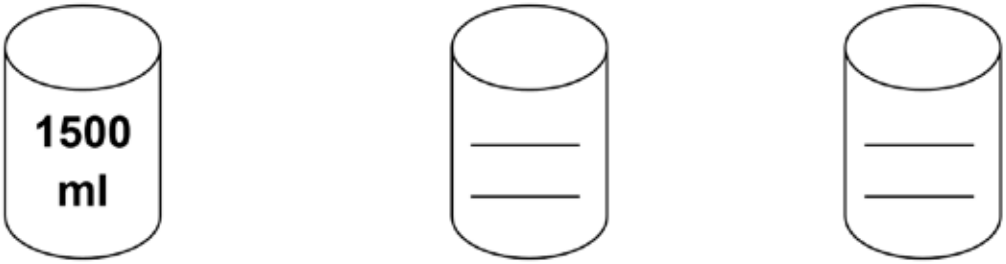
Class 4 B from primary school of Uggiate Trevano, has to prepare two welcome cocktails for the group of representatives from Erasmus+. Help us to calculate the correct amounts of ingredients.

To prepare the "MAGIC COCKTAIL", you need:

* ½ of grapefruit juice
* ¼ of peach juice
* ¼ of strawberry juice

If 1500 ml of juice is enough for 10 people, how much juice do you need for 30 people?

10 people _____ _____



When you have worked out the correct amounts, find:

½ of grapefruit juice, ½ of _____ =

_____ : 2 =___ _____ X1=

¼ of peach juice, ¼ of _____ =

_____ : ____ = ____ _____X___ =

¼ of strawberry juice, ¼ of _____ =

_____ : ____ = ____ _____X___ =

To prepare strawberry juice, you have to divide the strawberries in 4 parts and blend them in the blender with about 500 gr of water.

Then combine the three juice and mix well.

ENJOY YOUR COCKTAIL !

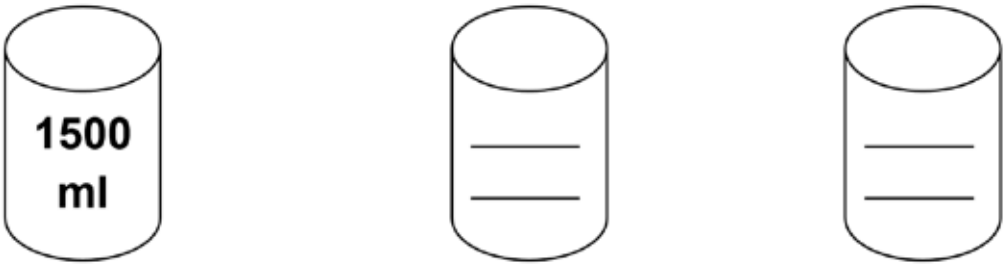
PROBLEM N 2

To prepare the "FRUIT COCKTAIL", you need:

* ½ of orange juice
* ¼ of blueberry juice
* ¼ of pineapple juice
* ¼ of sparkling water

If 1500 ml of juice is enough for 10 people, how much juice do you need for 30 people?

10 people _____ _____



When you have worked out the correct amounts, find:

½ of orange juice, ½ of _____ =

_____ : 2 =___ _____ X1=

¼ of blueberry juice, ¼ of _____ =

_____ : ____ = ____ _____X___ =

¼ of pineapple juice, ¼ of _____ =

_____ : ____ = ____ _____X___ =

¼ of sparkling water, ¼ of _____ =

_____ : ____ = ____ _____X___ =

Then combine the four liquids and mix well.

ENJOY YOUR COCKTAIL !

International Sandwiches (geometric shapes)

Ingredients: white bread, ham, mayonnaise, white bread, salami (italian sausage), philadelphia.

1. **Ham and mayonnaise**

Class 4 B from primary school of Uggiate Trevano, has to prepare two welcome International sandwiches for the group of representatives from Erasmus+.

To prepare this sandwiches they have to divide white bread in 2 parts and again in 4 parts, making 8 triangles. Then they put on bread ham and mayonnaise.

2. **Salami and philadelphia**

Class 4 B from primary school of Uggiate Trevano, has to prepare two welcome International sandwiches for the group of representatives from Erasmus+.

To prepare this sandwiches they have to divide white bread in 2 parts and again in 4 parts, making 8 squares. Then they put on bread salami and philadelphia.

Magic Cocktail

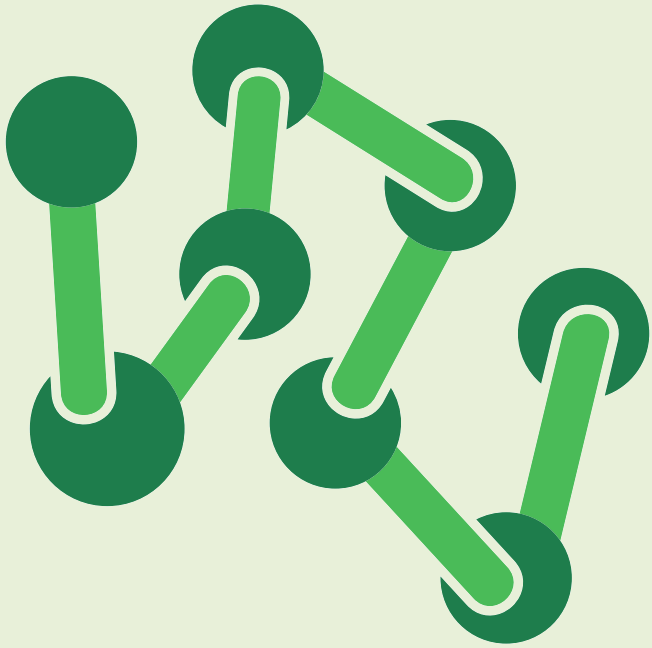
Ingredients: grapefruit juice, peach juice, strawberry juice, orange juice, blueberry juice, pineapple juice, sparkling water.

Italian Flag Stick

Ingredients: olives, mozzarella (fresh Italian cheese), tomatoes.

Twins Biscuits

Ingredients: Pavesini (Italian biscuits: sugar, eggs, wheat flour), Nutella (hazelnut cream), coconut flour, milk, granulated colours sugar.



BIOLOGY LESSONS

Country:	Lithuania
School:	Pakruojis 'Atzalynas' Gymnasium
Lesson/subject:	Biology / Physical education
Level:	1 a (14-15 years old)

RESEARCH ON HEART CONTRACTIONS & RESPIRATORY RATE DEPENDENCE ON PHYSICAL ACTIVITY

ICT support, equipment needed

Clock, ruler, calculator, practical work description sheet.

Teaching aims

Developing competences:

- **Learning to learn** – students raise hypothesis themselves,
- **Communication** – discussing the work in the classroom,
- **Cognition** – while analysing the findings and results through the theoretical material,

* **Personal** – using personal experience and knowledge,
* **Initiative and creativity** – doing practical work, analysing and evaluating results and reaching conclusions.

Learning outcomes

Based on gained knowledge about circulatory and respiratory system activities and using practical work description sheets together with teacher's instructions you will be able to examine heart shrinkage and breathing rate in tranquillity mode as well as after physical exertion. Moreover, you will construct graphs and learn to defend your statements on how and why physical activity influences heart and respiratory rates in 2-3 sentences.

Methodology/methods

Integrated lesson – Biology and Physical education (PE),

Discussion – raising the problem, announcing topic, learning goals & tasks,

Practical work – physical exercise, relay-race,

Individual work – data collection, practical work description sheet, formulating conclusions, evaluation.

Lesson phases and timing

Initial activity (2-3 min.)

In the classroom – raising the problem – performing physical activity increases heart and respiratory rate, what can it be related with? Announcement of topic and lesson's goals and tasks, introducing to practical work, description sheets share-out – talk, discussion, individual work.

Main activity (30-35 min.) :

* **In the classroom** – formulating hypothesis in practical work description sheets; reminding how to measure pulse; counting pulse and respiratory rate in tranquility mode, writing down information – individual work (3-5 min.);

* **In the gym** – (guided by physical education teacher) while listening to teacher's directions, warm-up exercises are being done for 2-3 minutes, pulse and respiratory rate are being measured right after and results are written down; for 7 minutes high physical activity tasks are performed and pulse with respiratory rate are being measured once again with writing down the results; 2-3 minutes relaxation exercises are done with the same sequence of measuring vital signals and writing them down;

* **In the classroom** – with the information collected, the practical work description sheets are being filled in, graphs are being constructed, conclusions are made and work is evaluated (15 min.).

End of lesson (5 min.)

Coming back to learning tasks and discussing what impact does physical exertion has on heart and respiratory rates; finalizing filling in practical work description sheets and leave them for the teacher.

Evaluation/evaluation tools

Evaluation of the practical work.

Materials/resources, worksheets

The sequence of practical work, investigation and analysis of results is being presented to students in great detail in their practical work description sheets "Research about heart and respiratory rate dependence on physical exertion". (Annex 1)

Additional information

Relevance of the research: When an adult is in tranquillity mode, the heart rate is about 60-70 times per minute. Women's', unlike men's heart, beats 6 times faster, children's heart always beats more densely. This rhythm for kids is normal. Increased heart rate (90 times per minute and more) is called tachycardia and reduced one (less than 60 times per minute) – bradycardia. The heart rate is influenced by autonomic nervous system, some hormones that can either increase or decrease the heart rate, e.g.: adrenaline. After physical exertion, e.g.: exercising, heart starts beating faster, the breathing increases. Also, different levels of physical exertion has different effect on heart rhythm and respiratory rate. For a healthy person, after physical activity the heart and breathing rate return to normal in 1-3 minutes. Why doing the manual work increases those vital signs and what can it be associated with?

Annex 1

Research about heart and respiratory rate dependence on physical exertion

Practical work made by .....

Aims

1. To examine heart rate in tranquillity mode as well as after physical exertion.
2. To find out what is physical activity's influence on respiratory rate.
3. To improve observation, counting and constructing graphs skills.

Tasks

1. Measure pulse in tranquillity mode and after exercising.
2. Count how many times we breathe in during time unit in tranquillity mode and after exercising.
3. Construct graphs according to guidelines.
4. Calculate the amount of blood that heart displaces.
5. Explain why pulse and breathing rate changes while performing physical tasks.

Means

Clock, ruler, calculator.

Hypothesis

.....

Sequence

I. Calculate how many times your heart beats in a minute; in 24 hours. Every time your heart shrinks, it expels about 0,1 litre of blood to your aorta.

Count how much blood heart expels in a minute and in 24 hours.

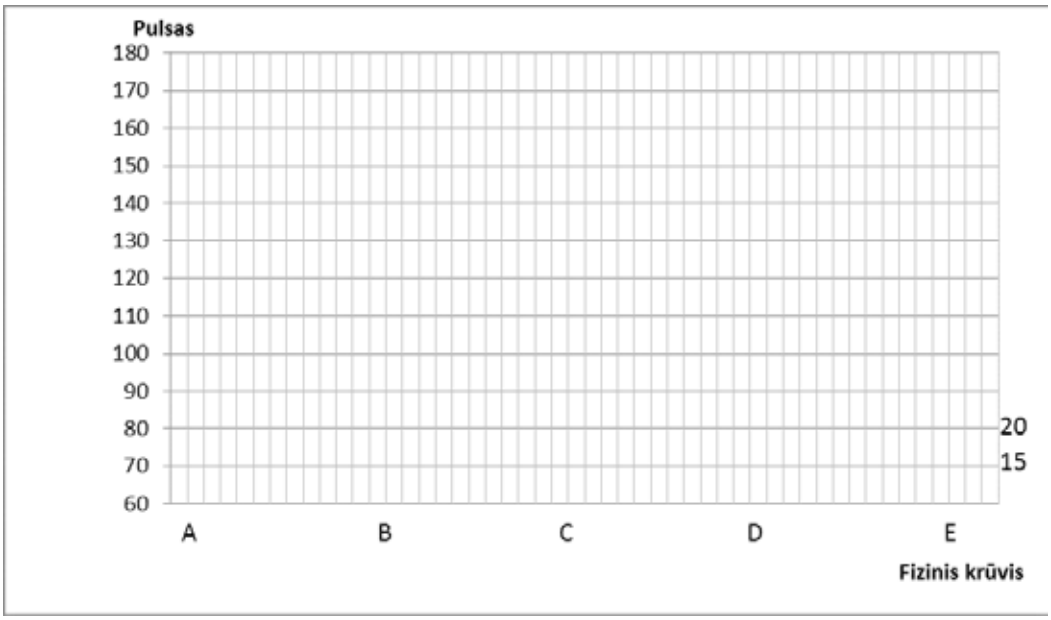
Time	Shrinkage rate	Amount of expelled blood
Minute		
24 hours		

II. Count how much oxygen is necessary for a student during one class……..

III.

* Find a place in your neck or in the inside of your wrist, where you can clearly detect pulse. Calculate how many times in a minute your heart shrinks, how many times you breathe-in in a **tranquillity (A)** mode.
* Do a **warm-up (B)** for about 2-3 minutes. Right after count your pulse and the number of times you breath-in in one minute.
* Do a **highly active tasks (C)** for 7-10 minutes. Right after count your pulse and the number of times you breath-in in one minute.
* Do **relax (D)** exercises for 2-3 minutes and right after that count your pulse and the number of times you breath-in in one minute.
* At the end of the lesson in a **tranquillity (E)** mode once again count your pulse and the number of times you breath-in in one minute.

* With the help of information you collected create two graphs: pulse and respiratory rate.



Conclusions

1. Heart shrinkage rate is affected by .....
   .....
2. Respiratory rate increases after physical activity, because .....
3. Explain what kind of influence physical preparation has on pulse and respiratory rate changes while exercising .....
   .....
4. In 24 hours heart shrinks ..... times and excels ..... litre of blood.
5. During one class one student needs ..... oxygen.

Evaluation

1. What was the easiest part in this work? Why? .....
   .....
2. What new did you learn after completing tasks?
   .....
3. What would you do differently the next time for this work?
   .....

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Biology/Physical education - Research on heart contractions and respiratory rate dependence on physical activity
Country where the lesson came from	Lithuania
Country/person who used it	Portugal / Telma Rodrigues
Level/age of students	10th grade / (14-15 years old)
Date	19 – 25 of May

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes. The only task that we had difficulties to do was the 2nd question: "Count how much oxygen is necessary for a student during one class" because we don't know how to calculate this value, we think we need more data.
Did it fit your curriculum?	Yes, despite we usually explore this topic in 9th grade
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	English and Portuguese
Was time enough?	It had been done in different days. The initial activity and the first part of the main activity was made in the biology class than the part guided by the physical education teacher was made in his class. The students filled the sheets and constructed the graphs at home and the conclusions were taken in another biology class.

Was it easy to pass the information onto students and putting up the task?	Yes.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	I asked the students what they thought about the activity and they filled the evaluation form at the end of the activity.
In which extent did you reach the predicted aims and outcomes?	I think they were accomplished.
What was student's reaction/feedback?	They enjoyed the activity and its multidisciplinarity. It was easy for them to construct the graphs. They had difficulties to do exercise 2 and some of them have some troubles using the English during the lesson. Some students referred that they shouldn't count the respiratory rate because it can be controlled as we want.
Was the methodology and materials suitable for the activity?	Yes, but students couldn't do exercise 2 and I didn't know how to help them.
Could the activity plan be improved? If so, how would you improve it?	Yes, giving the data to calculate the amount of oxygen that is necessary for a student during one class.
Other remarks	I think that when a work sheet is presented it should have its correction for the teacher who is using it knowing how it is supposed to be done.

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Research on heart contractions and respiratory rate dependence on physical activity
Country where the lesson came from	Lithuania
Country/person who used it	Italy
Level/age of students	12 years old
Date	November 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes
Did it fit your curriculum?	Yes, it did
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	In Italian
Was time enough?	Yes, it was
Was it easy to pass the information onto students and putting up the task?	Yes, it was
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	

In which extent did you reach the predicted aims and outcomes?	
What was student's reaction/feedback?	Students were very happy to take part in this activity
Was the methodology and materials suitable for the activity?	
Could the activity plan be improved? If so, how would you improve it?	
Other remarks	

Feedback on the lesson/activity (3)

GENERAL INFORMATION	
Subject and topic	Biology. Research on heart contractions and respiratory rate dependence on physical activity.
Country where the lesson came from	Lithuania.
Country/person who used it	Latvia. Valentīna Pužule.
Level/age of students	14 -16 years old. Form 9.
Date	8 May, 2017.

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear and understandable.
Did it fit your curriculum?	Yes, this topic is included in the curriculum for Grade 9.
Other remarks	Our program includes such work, but it is not usually done in the gym, but the hallway/corridor.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	The time was enough.
Was it easy to pass the information onto students and putting up the task?	Yes, it was easy because students have studied this topic and it was a repetition for them.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students worked in small groups and their group work was evaluated. Data from similar work performed in January were compared.

In which extent did you reach the predicted aims and outcomes?	The role of physical activity in maintenance of cardiovascular and respiratory systems was updated.
What was student's reaction/feedback?	Students happily participated in the lesson and compared their previous results, participated in the discussion of the results.
Was the methodology and materials suitable for the activity?	Yes.
Could the activity plan be improved? If so, how would you improve it?	This topic can be provided in English, teaching English language to older students.
Other remarks	

Country:	Latvia
School:	Balvi State Gymnasium
Lesson/subject:	Biology
Level:	Form 8 (14-15 years old).

THE EXTERNAL CONSTITUTION OF A FISH

Ict support, equipment needed

Computer, projector, screen.

Teaching aims

To form understanding about the peculiarities of the external constitution of a fish.

Learning outcomes

Students can describe the peculiarities of the external constitution of a fish (fins, scales, shape, side line). Students observe the movements of a fish in the aquarium or on a video and come to a conclusion about the importance of different kinds of fins to secure its movements and the balance. Looking at the scale of a fish students can judge its age. Students analyse the adaptation of the external constitution of a fish for living in the water.

Methodology/methods

Frontal work, individual work, group work.

Lesson phases and timing

Brain Storm (3 minutes)

The word "fish" is written on the board. To stimulate the students to work, the teacher asks the students to mention different words in connection with the word "fish". The words are written on the board not explaining anything. When it is done, the teacher says that during the lesson the students will come to the conclusion if these words are connected with the external constitution of a fish.

Work with the text (7 minutes)

A sheet of paper (Annex 1) with a question containing numbers 1-5 is distributed among the students about the external constitution of a fish. There are 5 different questions altogether. The students read the text and answer the questions in their workbook.

Doing tasks/demonstrations (25 minutes)

The students are divided into groups according to the question numbers. The teacher distributes the worksheets and asks the students to do the task they have previously prepared. Each group is asked to introduce to the fulfilled task. Power Point presentations are shown and videos are demonstrated, for example, the importance of fish when a fish moves.

The students work is a group discussing and coming to a conclusion. The group decides who does the presentation. All the groups gradually fill up all

the tasks in their worksheets about the external constitution of a fish. A self – estimated chart is filled in after the fulfilment and analyses of the tasks.

The conclusion task of the lesson (5 minutes)

The external constitution of a fish is shown. The teacher returns to the words written on the board at the beginning of the lesson and explains which of them corresponds to the theme of the lesson.

The component parts of the external constitution of a fish and their importance for living in the water are mentioned. The students mention the correct indications of the external constitution of a fish.

Evaluation/evaluation tools

The teacher estimates how the pupils have understood the new theme. The students estimate their activities during the lesson and how they have understood the new theme. **The teacher's self-estimation**: Has the aim of the lesson been achieved? Have the methods used during the lesson helped to achieve the aim? What has been a success and what hasn't and what needs more attention planning the study process?

Materials/resources, worksheets

A textbook (pages 120 – 122) (Annex 3), a collection of videos, sheets of paper for questions (Annex 1), a worksheet (Annex 2), MS Office Power Point presentation.

Annex 1

1.	**Body sections.** What sections can a fish body be divided into? What formations are there in each section? (p. 120)
2.	**Fins.** What are the types of even and odd fins and what is the importance of these fins? (p.121)
3.	**Body cover.** What are the types of scales and their importance? What necessary information can one get looking at the scales of a fish? What covers the scales from the outside and what does it mean? (p.120 – 121)
4.	**Body shape and body colour.** What are the types of the shape of a fish body? What are the peculiarities of the colour of a fish and the importance of its colour? (p. 120 – 121)
5.	**Organs of sense.** Mention the fish organs of sense and describe in detail the one which other vertebrates do not have.

Annex 2

Worksheet

Name Surname _____

The external constitution of a fish

Task 1

Insert the missing words about the sections (parts) of the fish body.

The fish body consists of _____ sections (parts) _____ and _____ .

The head ends with _____ . The waist ends with _____ . There is/are _____ and _____ on the head.

There is/are _____ . In the waist and there is/are _____ in the tail.

Use the drawing to show the sections (parts) of the fish body.

Task 2

The fish organs of movement are fins. Fill in the chart about the types and importance of fins.

Even fins	Odd fins
1. 2.	1. 2. 3.

Show the types of fins in the drawing.

Task 3

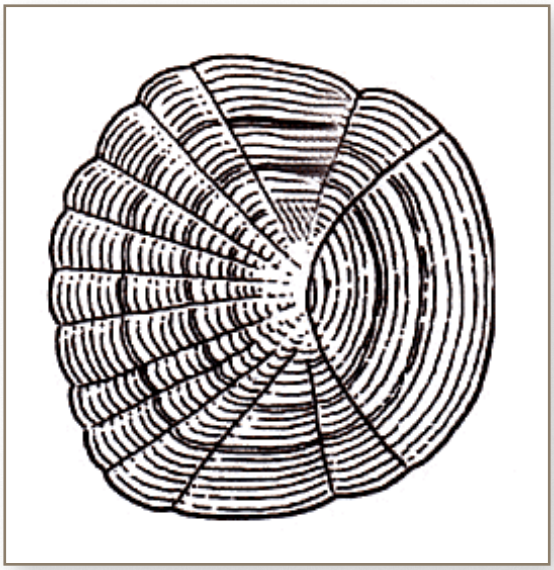
A) Scales cover the fish body. The fish living in Latvia have 2 types of scales with _____ or _____ sides. The main meaning of scales is _____ the fish body from _____ . It is possible to determine the fish _____ according to the scales. The scales are covered by _____ from the outside.

B) Read the text and fill in the chart.

Small scales appear on the fish body when the fish is 1-2 cm tall. Growing up, the number of scales does not change, their size changes. According to the scales it is possible to determine the age of a fish, the speed of its growth, the conditions of its growth, the time when a fish starts to spawn.

Statements	Yes	No
Fish babies hatch scaly.		
The number of scales does not change during the lifetime.		
It is possible to determine the age of a fish according to the scales.		
Different fish species have the same shape of scales.		

C) Peter with his dad went fishing. They caught a pike. Peter look in at the pike scale said "_____ 3 years". His dad also looked at the scale and announced "_____ 4 years". Look at the scale in the picture and decide with the quarrel.



Task 4

Fill in the missing words about the shape of the fish body.

A) The shape of the fish body depends on _____. The larger part of fishes has _____ shape because when they move they lessen _____ of water. For fishes which are less moveable,

the shape can be _____ or _____ to be able to _____ better.

B) Characterize the colour of the fish back, sides, and its belly and why it is so.

_____
_____
_____
_____
_____
_____

Task 5

Mention fish organs of sense and characterize the organs which other vertebrates do not have.

_____
_____
_____
_____
_____

Task 6

Mention the peculiarities of the external constitution of a fish that helps it to live in water.

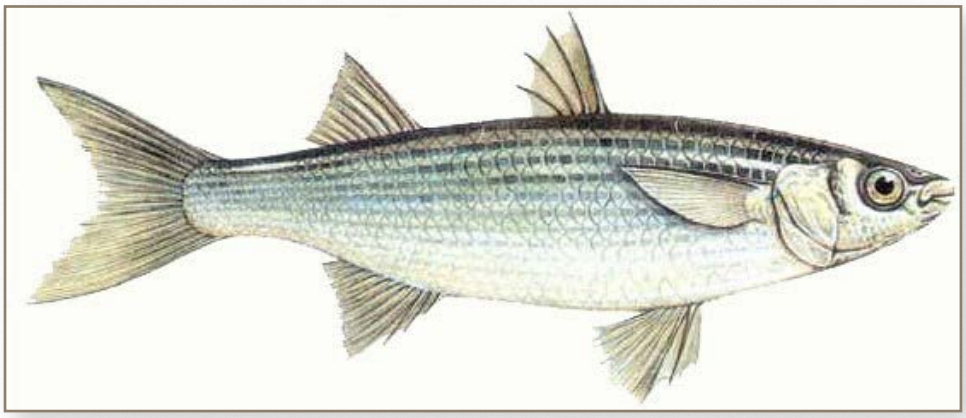
_____
_____
_____
_____
___

The achieved result	Yes	No	Must learn more
I can determine the parts of the fish body.			
I know the types of fish fins and their importance and I can show them in the picture.			
I understand the importance of scales in the life of a fish.			
I can determine the age of a fish.			
I understand the shapes of the fish body and the importance of the colour of the fish body to live in water.			
I understand the fish external constitution to adapt to live in water.			

Annex 3

Pages 120 and 121 from the textbook

(R. Gribuste, D. Brante. Bioloģija 8.klase.)



The fish, its constitution and breeding.

External features fish.

Fish are aquatic vertebrates that use gills to breathe but fins provide their movement.

The body. As most species of fish live mainly in the water their body and all its functions are particularly adapted to this environment. Fish have a streamlined shape that makes their swimming nimble. This body shape helps them to overcome the water resistance. The fish which are rather motionless and do not move much living close to the bottom, for example, flounders have got a flat body that makes it hard to spot them. The fish such as eels that live in narrow places, crawl in caves or cracks, have a thin or a snake-like body. It means the shape of fish depends on the way it lives.

The body of the fish consists of 3 parts: the head, the waist and the tail. Fins are organs that help fish to move.

The body cover (age). Most fish have scales that cover the body. Scales are arranged in rows like tiles of the roof. The front part of the scale is sunk in the skin but the other part of it lies down closely on the next scale. They are fixed in a flexible way not causing fish any difficulties to move the body. The fish found in Latvia have two kinds of scales- with a smooth or jagged edge. That is why you have a different feeling holding a carp or a perch in your hands. There exist fish that have no scales at all, e.g. catfish.

While fish are growing, their parts of the body, such as scales grow as well. In summer when fish feed intensively their scale zone is wider while in winter their scale growth is insignificant and therefore the zone is narrower. It is possible to determine how old the fish is by counting the scale growth zones of winter and summer.

Most species of fish live 12 up to 20 years. Carps living in the captivity have been recorded to live up to a 100 years.

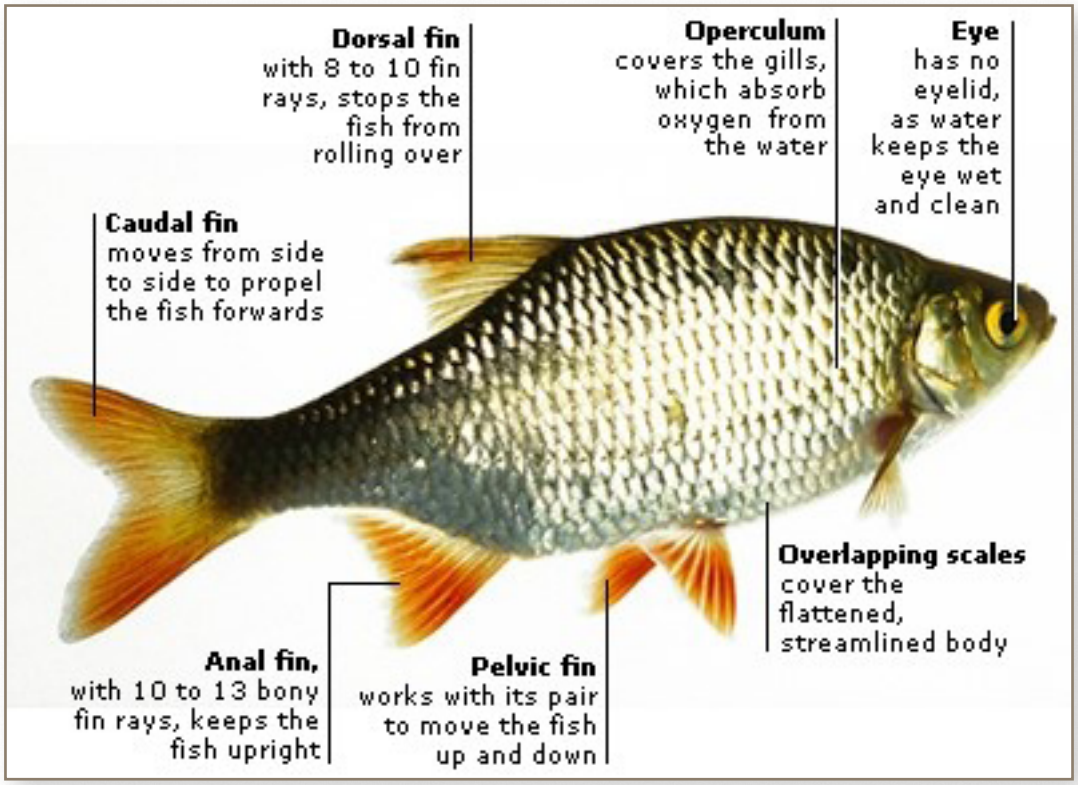
Scales protect the fish body from injuries. If traumas occur, new scales grow instead of the old ones but the new scales are easy to distinguish according to their size and how they are arranged.

From outside scales can be covered by a layer of slime exuded by skin glands. Slime lessens friction between the fish body and the water and protects the body from harmful microbes.

Fish colour matches the surroundings. Some fish, especially the ones living closer to the surface have dark colour on their back but their belly is silver white. Due to that colour composition fish are difficult to spot looking into the water (from above) as well as in the depth. Fish can change their colour. If the body of water becomes overgrown, the fish colour becomes darker but when it is cleaned up the fish colour becomes light again. Matching their colour to the surroundings makes it easier for fish to feed or hide. Fish like flounders can change their colour very fast matching it to the background where they are.

Fins. Fish use fins to swim. Each fin consists of skin membrane which is supported by fin rays.

Fish have odd number of spins of the tail, spine and the anal fin, as well as even fins of the chest and belly. Each kind of fins has its own functions.



Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Biology
Country where the lesson came from	Latvia
Country/person who used it	Italy
Level/age of students	Eleven years old
Date	October 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Partially
Did it fit your curriculum?	Yes
Other remarks	-
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	In Italian
Was time enough?	That recommended
Was it easy to pass the information onto students and putting up the task?	Not entirely
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Discrete
In which extent did you reach the predicted aims and outcomes?	It was not easy to manage the group work

What was student's reaction/feedback?	Non entirely understood
Was the methodology and materials suitable for the activity?	Text book, video
Could the activity plan be improved? If so, how would you improve it?	Certainly. With a lower level suitable for the school program
Other remarks	

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Biology. The external constitution of a fish.
Country where the lesson came from	Latvia
Country/person who used it	Biology teacher Daiva Makauskiene. Lithuania
Level/age of students	15-16 years
Date	2017-05-16

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear.
Did it fit your curriculum?	In our programme information about coating, moving and sensory organs is in different topics. We do not deal separately the features of fish, we integrate them into separate topics e.g. Body covering a variety of organisms; Organisms and support a variety of movement; Reactions to the environment.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Lithuanian
Was time enough?	We were short of time for summarizing and conclusions, but we did it during the break.

Was it easy to pass the information onto students and putting up the task?	There were no problems when conveying the information to students. Students had to work hard in groups when preparing presentations. They had to remember what they had learned before, they had to revise the material, to look through students` books, encyclopedias, discuss and decide how they will do it and who will do the presentation.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	We have an instruction of group work evaluation (which we agreed on at the beginning of the school year). Students were evaluated using the group work evaluation instruction and the sheets which they filled in. They got cumulative score.
In which extent did you reach the predicted aims and outcomes?	We repeated and summarized the topics which we analysed this year: Body covering a variety of organisms; Organisms and support a variety of movement; Reactions to the environment.
What was student's reaction/feedback?	Students liked the lesson. They had no time to make Power point presentations in class, but they volunteered to make them at home.
Was the methodology and materials suitable for the activity?	I think they were suitable. Students like group work. Worksheets with questions and tasks are clear. The teacher had to check the numbers of the pages, because different literature is used.
Could the activity plan be improved? If so, how would you improve it?	If there is no aquarium in the classroom, we can observe live fish (caught by fishermen) in the jar. That`s what we did. After the lesson we released them back into the river.
Other remarks	

Country:	Portugal
School:	Escola Daniel Sampaio
Lesson/subject:	Biology / Information Literacy/ English
Level:	17 years old/12th grade

SCIENTIFIC OUTREACH THROUGH ARTICLES ON BIOLOGY TOPICS: SCIENTIFIC AND INFORMATION LITERACY

ICT support, equipment needed

Computers, internet, video projector.

Teaching aims

Developing competences:

* Applying biology knowledge acquired in class on understanding some of the newest discoveries in this scientific field.
* Improving general knowledge in Biology.

* Writing Scientific outreach article, according to the format of these type of texts.
* Selecting, validating and using information in an educated way.
* Respecting copyright on using information sources.
* Science public outreaching.

Learning outcomes

* Oral presentation of the research.
* Written articles, published on School Library website.

Methodology/methods

* Working in small groups
* Writing a Scientific outreach article about a recent discovery in Biology, presenting it to the class and preparing it to be published on the School Library website, combining Biology knowledge with oral/ writing skills in English, and mater of article format rules

Lesson phases and timing:

1st phase (1 hour)

Introducing the activity to the students. Discussing the differences between a Scientific Article and a Scientific Outreach article.

2nd phase (20 days)

Researching on recent scientific discoveries. Writing Scientific Outreach article (in Portuguese and in English) about one recent scientific discovery and prepare an oral presentation.

3th phase (2 hours)

Oral presentation of the article in English to the class.

4th phase

Publishing the articles on the School Library website.

Evaluation/evaluation tools

Via observation of the presentations and monitoring the whole process, both as a group and as individual students. See criteria below:

CRITERIA	
GROUP EVALUATION	POINTS
Theme Fulfilment	10
Scientific contents explicitness	50
Scientific Correction	20
Work Structure	20
Organization of ideas and spell-checking	10
Selection and processing of information	10
INDIVIDUAL EVALUATION - ORAL	POINTS
Diversified and appropriate resources and dexterity in its use	15
Mastery of the presentation content	40

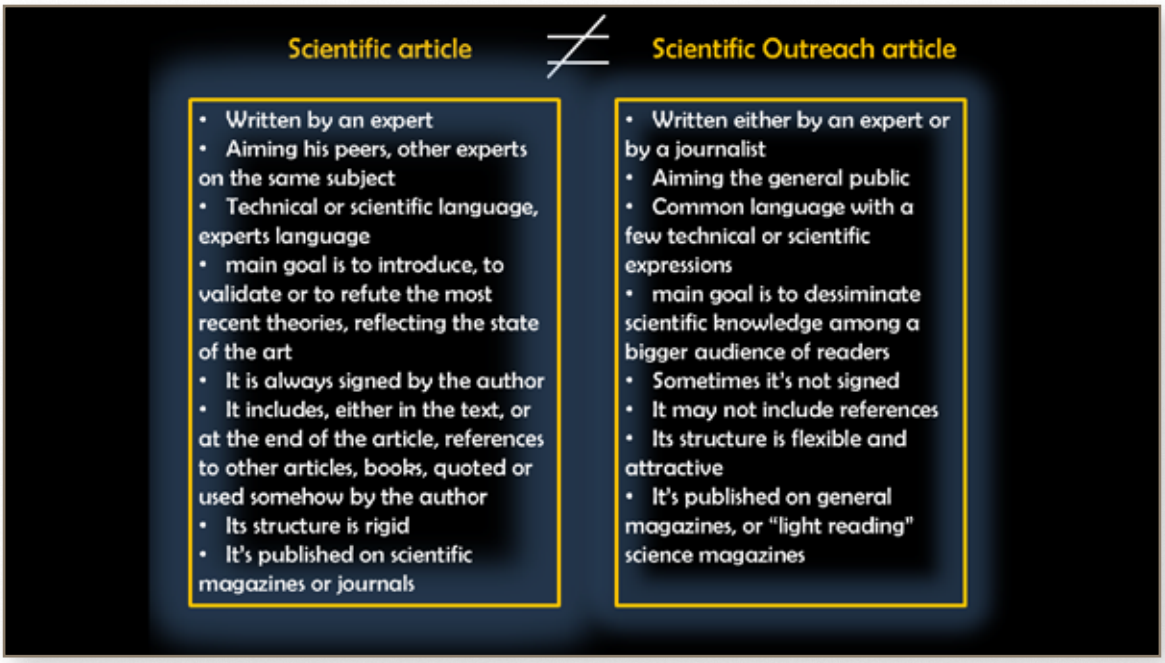
CRITERIA	
Communication skills	10
Interaction with colleagues and teacher	15
Failing deadlines	-5
Total	200

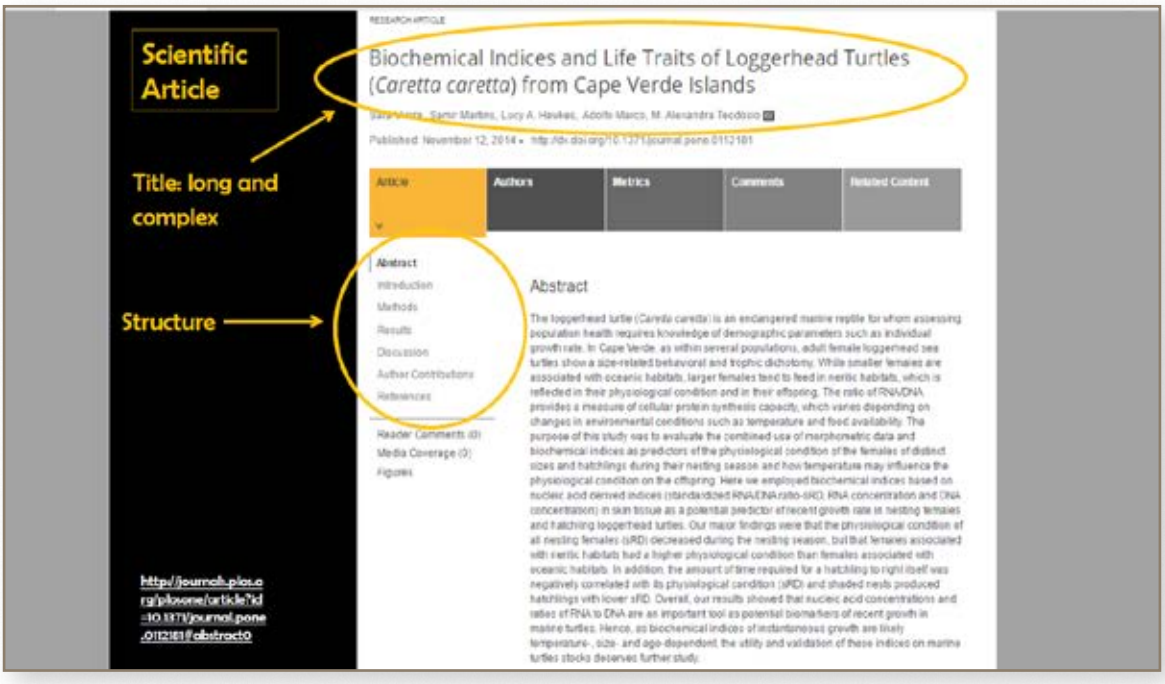
Materials/resources, worksheets

PPT presentation Activity Guide Sheet Evaluation Excel Sheet.

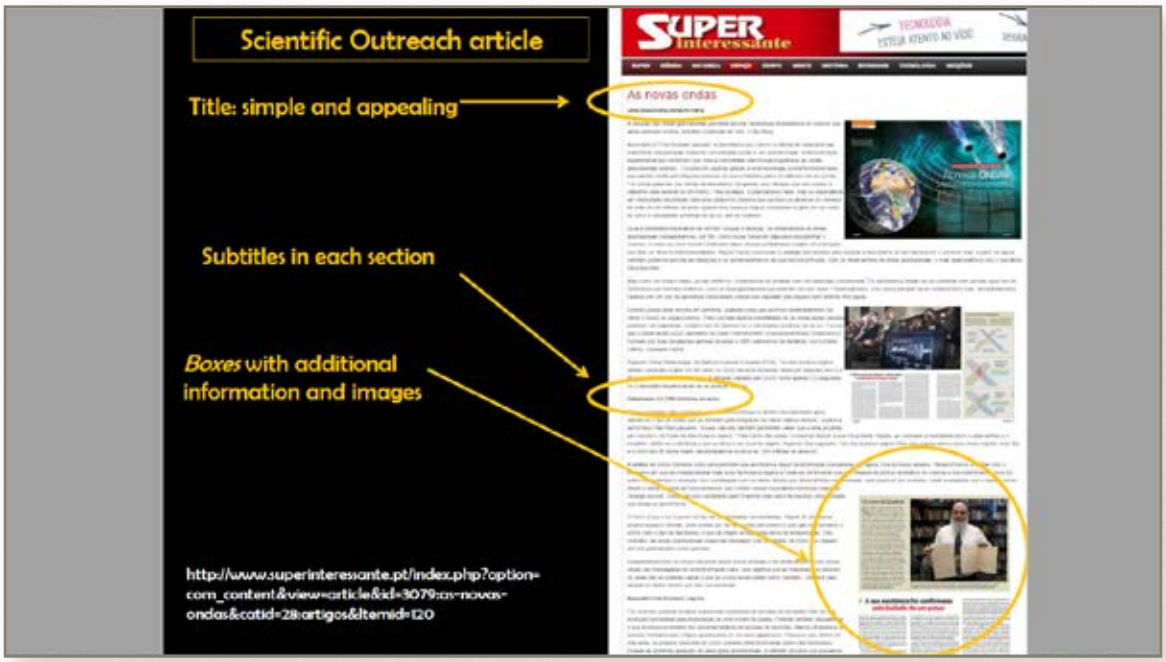
Annex

Introductory Presentation to the students about the 2 main types of scientific article






Scientific Article
Bibliographic references
References


Scientific Outreach article
Title: simple and appealing
Subtitles in each section
Boxes with additional information and images
As novas ondas

What kind of article do we want then?

- an article with the accuracy of a scientific one regarding bibliographic references, but...
- with a flexible and attractive structure and layout as a Scientific Outreach article and aiming the general public.

Maybe something like this...

Scientific Outreach article on *Bibliblog*

Initial highlight excert from the article

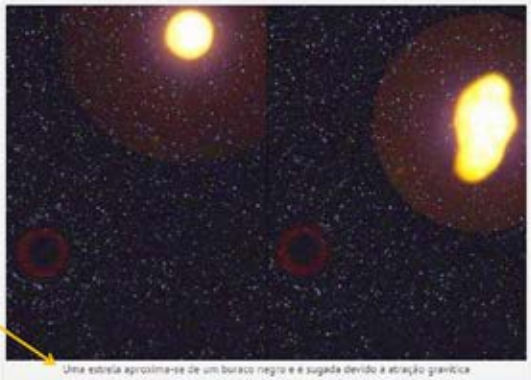
Image with subtitles

https://bibliblogue.wordpress.com/2013/02/13/bibliciencia-35-buracos-negros-os-glutoes-do-universo-por-duarte-santiago/

BibliCiência (35) - "Buracos Negros, os 'glutões' do Universo", por Duarte Santiago

13/02/2013 por Bibliblog

"Um buraco negro é um corpo celeste que é originado por um colapso de estrelas com massa muito superior à do Sol. Nestes corpos, a atração gravítica é tão elevada que nada, nem mesmo a luz, consegue escapar à sua atração pelo que, desta forma, os buracos negros "consomem" tudo o que existe na sua proximidade.



Uma estrela aproxima-se de um buraco negro e é sugada devido à atração gravítica

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Information literacy
Country where the lesson came from	Portugal
Country/person who used it	Mehmet METIN (Biology Teacher)
Level/age of students	9th grade (15-16 years old)
Date	01-10-2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes The instructions were clear.
Did it fit your curriculum?	No, it didn't. That is why we applied it to the 9th grades.
Other remarks	Our 12th and 11th grades don't have Biology classes. We only have Biology classes for the 9th and 10th grades in our curriculum.
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Turkish
Was time enough?	Yes, it was enough.(40 minutes)
Was it easy to pass the information onto students and putting up the task?	No, it wasn't. We have struggled, because the age group level wasn't old enough to carry out the activity of writing article.
AFTER THE LESSON/ACTIVITY	

How did you do the evaluation?	We want students to write an article about information literacy. They have made some researches on internet , gained some info, and made an outline and the They have created an article. Then we shared the articles on the school biology board.
In which extent did you reach the predicted aims and outcomes?	Partly. Some students wrote very nice and interesting ones.
What was student's reaction/feedback?	Students interest and curiosity in diseases, increased in a positive way because it is directly related to real life.
Was the methodology and materials suitable for the activity?	We can not make an objective assessment because we do not have enough resources to write a scientific article with the 9th grade topics in our curriculum.
Could the activity plan be improved? If so, how would you improve it?	No.
Other remarks	It was an interesting activity for me and my students if only we had biology classes for 12th grades at our school.

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Biology. Science innovations
Country where the lesson came from	Portugal
Country/person who used it	Lithuania. Biology teacher Daiva Makauskiene
Level/age of students	Students aged 17-18
Date	2017-09-24

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear
Did it fit your curriculum?	It fits the curriculum, because the students who learn biology at extended course have to get acquainted with biology achievements and they have to know how to present them to community.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Lithuanian
Was time enough?	Students were preparing their presentations for two weeks and we needed three lessons to make presentations in class.
Was it easy to pass the information onto students and putting up the task?	Students didn't face any problems while conveying the information. Students had to do their best when preparing their presentations. They will prepare their presentations in English after Christmas holidays because it takes time.

AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	They were evaluated by a credit. They will get a mark after a full task (after English presentation)
In which extent did you reach the predicted aims and outcomes?	We improved general knowledge of biology, we adjusted it understanding discoveries in this science sphere, we learned how to write a science article and present it to the class.
What was student's reaction/feedback?	Students liked the lesson and the preparation for it. It motivated to interest in innovations, raised a lot of questions.
Was the methodology and materials suitable for the activity?	Yes, they were.
Could the activity plan be improved? If so, how would you improve it?	The activity plan was clear.
Other remarks	

Feedback on the lesson/activity (3)

GENERAL INFORMATION	
Subject and topic	Scientific outreach through articles on Biology
Country where the lesson came from	Portugal
Country/person who used it	Italy
Level/age of students	13 years old
Date	November 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes
Did it fit your curriculum?	Yes, it did in particular about respecting copyright on using information sources
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	In Italian and in English
Was time enough?	No, it wasn't, because the level of the articles was high.
Was it easy to pass the information onto students and putting up the task?	Yes, it was easy to pass the information onto students, but it was difficult to put up the task.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	We haven't realized the oral presentation and the article because so highly in reference of our students level

In which extent did you reach the predicted aims and outcomes?	
What was student's reaction/feedback?	Students were involved to understand the difference between scientific outreach article and scientific article
Was the methodology and materials suitable for the activity?	
Could the activity plan be improved? If so, how would you improve it?	Our plan is to write something during this year in order to improve our skills.
Other remarks	

Country:	Turkey
School:	Mersin Deniz Ticaret Odasi Mesleki Ve Teknik Anadolu Lisesi
Lesson/subject:	Biology
Level:	9-10 grade 14-16 years old

MULTI ALLELE AND CO-DOMINANCE: BLOODTYPING AND CROSS-MATCHING

ICT support, equipment needed

Interactive whiteboard, Teachers book, Students books.

Teaching aims

The purpose of this activity is to delineate the different types of gene expression and how alleles interact with each other. Students will be working on exercises to help solidify the concepts of dominance, co-dominance, incomplete dominance, etc.

Learning outcomes

Students will be able to:

* Examine examples of allele dominance
* Synthesize information from multiple alleles
* Classify common types of inheritance patterns
* Survey and evaluate real examples of pedigrees
* Solve simple blood typing problems and realize its importance
* Think critically about variance among populations

Methodology/methods

Presentation, Discussion, Question and Answer, Demonstration.

Lesson phases and timing:

1st phase (5 min.)

Teacher emphasizes that blood exchange is very crucial in the event of an accident or injury. She/he focuses on the benefits of knowing the blood types of types the individuals around us in case of emergency situations.

2nd phase (60 min.)

The terms Multiple Allele and Co Domination is defined and the difference between co-dominance and incomplete dominance is explained. The summary of subject is presented to the students via interactive board.

3rd phase

Students take notes. While telling the students blood Exchange between blood groups ,Antibodies are examplified as dogs in front of their houses. A protein is examplified as girls/blonde children. B protein is examplified as boys/brunette. Anti A antibody resembles the dog that does not like girls/ blonde children. Anti B antibody resembles the dog that does not like boys/ brunette children.

0 blood group without antibodies resemble to a family without children so 0 blood group can be a guest to anybody that is It can give blood to every blood group.

4th phase (10 min.)

It should be noted that our school is not an academic but a vocational school. Examplifying the topic this way will ease the students to understand and remember the blood exchange.

5th phase (25 min.)

In the third lesson Sample question solutions are made and the subject is reinforced. Sample questions are solved on the interactive board by explaining.

Evaluation/evaluation tools

Formative assessment through questioning gives educators a grasp on student learning. More concrete evidence of learning will be seen in student output (faces lab, case studies). This information will assist the teacher in evaluating the effectiveness of the instruction at various checkpoints in the lesson, primarily in between the two lessons. If time permits there will be an open discussion of the topics covered in the lesson. This could also be used as formative assessment.

The questions below are homework to be done at home.

1. Describe the words multi-allelity and co-domination.
2. Learn the blood groups of your family members
3. Write the questions about the genetics of blood groups and blood groups for YGS and LYS exam

Materials/resources, worksheets

Worksheets.

Cooperation with math teachers for the calculus of probabilities.

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Biology. Co-dominance.
Country where the lesson came from	Turkey
Country/person who used it	Latvia. Anna Barbaniška
Level/age of students	16-17 years old, Form 11
Date	April 18, 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear with the exception of the attachments, because they were in Turkish. I used similar materials (worksheets) in Latvian instead of the provided ones in the Lesson plan.
Did it fit your curriculum?	Yes, it fitted the curriculum.
Other remarks	In our school this topic is not viewed as widely as in the given sample.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	Yes, it was enough.
Was it easy to pass the information onto students and putting up the task?	Yes, students understood this topic well. They like genetic topics and usually understand it well.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	It was formative assessment.

In which extent did you reach the predicted aims and outcomes?	The purpose of this activity to delineate the different types of gene expression and how alleles interact with each other was achieved.
What was student's reaction/feedback?	Students were working on exercises hard. They were interested in the lesson and had no difficulties with the tasks.
Was the methodology and materials suitable for the activity?	The methodology was suitable but I made some changes because materials were in Turkish.
Could the activity plan be improved? If so, how would you improve it?	Yes, worksheets should be translated in English. Student's self-assessment can be provided.
Other remarks	I received feedback when checking the tasks that were right for almost all the students.

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Biology – Multi allele and co-dominance (related with blood types)- Blood type and cross-matching.
Country where the lesson came from	Turkey
Country/person who used it	Portugal/ Carla Vaz
Level/age of students	12th grade/ (17-18 years old)
Date	2017 – 11 - 17

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The first part of the lesson plan whit the teaching aims, learning outcomes, methodologies and activity phases and timing where clear but because the examples where in Turkish, that was not so clear.
Did it fit your curriculum?	Yes, it did. This topics are included in the program of 12th grade in Biology.
Other remarks	I chose this lesson because this substance is inserted in the course curriculum, however, is only taught further ahead
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Portuguese.
Was time enough?	No it wasn't. Because I had to take some time recalling the basics of genetics (Mendel laws).

Was it easy to pass the information onto students and putting up the task?	It was relatively easy to pass the task to the students because they like very much this topics, but it was not easy to put up the task because I had to use my own resources.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Evaluation was made by questioning the students
In which extent did you reach the predicted aims and outcomes?	I accomplish the part that concerned to understand the concepts of dominance, co-dominance and incomplete dominance.
What was student's reaction/feedback?	Although we had no time to explore the co-dominance and multi allele using as the example the different blood types, students liked the lesson.
Was the methodology and materials suitable for the activity?	The methodology and the lesson phases were suitable. The material I couldn't use.
Could the activity plan be improved? If so, how would you improve it?	Yes, adding a video like this: https://www.youtube.com/watch?v=xfZhb6lmxjk
Other remarks	Although this activity fits our curriculum perfectly I couldn't use the evaluation tools and the exercises that were sent in the lesson plan because they were in Turkish.

Country:	Italy
School:	Istituto Comprensivo di Uggiate Trevano - Secondary School
Lesson/subject:	Biology
Level:	12-13 years old

THE RESPIRATORY SYSTEM

Abstract: the activity was realized with an initial teacher's presentation about the anatomy and the functions of the respiratory system. The classroom was divided in groups to realized the practical laboratory experiences. Then concluding activity was a quiz to evaluate lesson.

ICT support, equipment needed

Interactive Whiteboard

Teaching aims

Students will be able to:

* Understand the anatomy and the functions of the respiratory system
* Identify the functions of the various organs of the respiratory system
* Distinguish the phases of respiration
* Develop practical and teamwork skills
* Accomplish proper scientific investigations and develop scientific reasoning

* Propose explanation based on the evidence derived from the experimental work

Learning outcomes

Students are able to make a model of the respiratory system

Methodology/methods

* Work teams
* Reading informations
* Explanation
* Questions and discussions
* Hands-on experiences

Lesson phases and timing

1. Teacher's presentation - **15 minutes**
2. Group work - **30 minutes**
3. Practical laboratory experiences - **1 hour**
4. Concluding activity - **30 minutes**

Evaluation/evaluation tool

Quiz (see annex)

Materials/resources, worksheets

Power Point presentation, plastic bottles, rubber balloons, drinking straws, scissors, suction cup, mirror, freezer bags, sponge, thermometer, syringe without needle, lime water, glass.

Annex 1

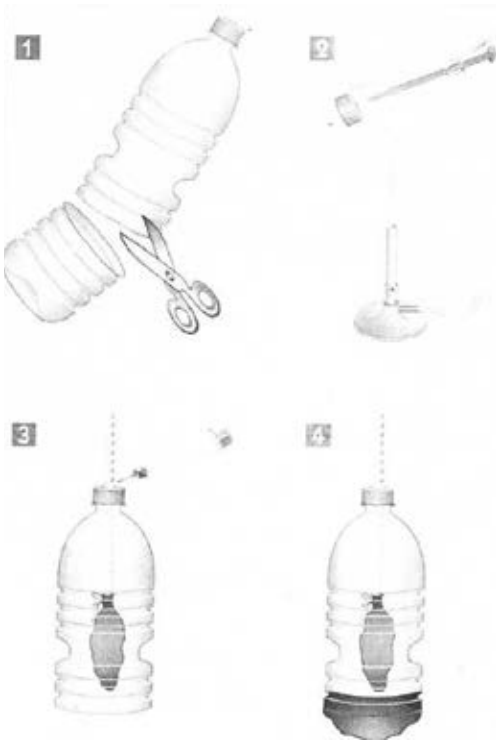
The mechanisms of the inspiration (inhalation) and expiration (exhalation)

Goal:

Build a model that mimics the mechanisms of inhalation and exhalation.

Material list:

* An empty plastic bottle of mineral water (1.5 litres), together with the plastic cap
* Two rubber balloons A drinking straw
* A tube of adhesive
* A strip for closing refrigerator bags Scissors
* A nail of the same diameter of the drinking straw A gripper



* A free flame (e.g. a candle, gas, Bunsen burner)

Method:

Cut the bottle with the scissors at about 5 cm from the bottom **(1)**. Holding it with a gripper, heat the nail with the flame and make an hole in the cap of the bottle at the center **(2)**.

Place the drinking straw inside a balloon and fix it tightly with the strip, so that the air can pass inside the balloon but only via the drinking straw.

Place the drinking straw together with the balloon inside the bottle, starting from the bottom and passing through the top. By doing so, the balloon should remain inside the bottle, while the drinking straw is outside.

Add the tap to the drinking straw and check everything. If you close the bottle with the tap, the balloon has to be at the center of the bottle. Stick the straw to the cap with the adhesive, in order to seal the contact zone **(3)**

Cut the second balloon under the mouthpiece and use it to add the bottom part of the bottle. You might proceed by attempts, so that the cut balloon is perfectly attached to the bottle **(4)**.

Note and reply:

If you hold the bottle with one hand while pulling down the bottom part, what can you observe ? If you pull the bottom upwards, what do you observe?

Conclusions:

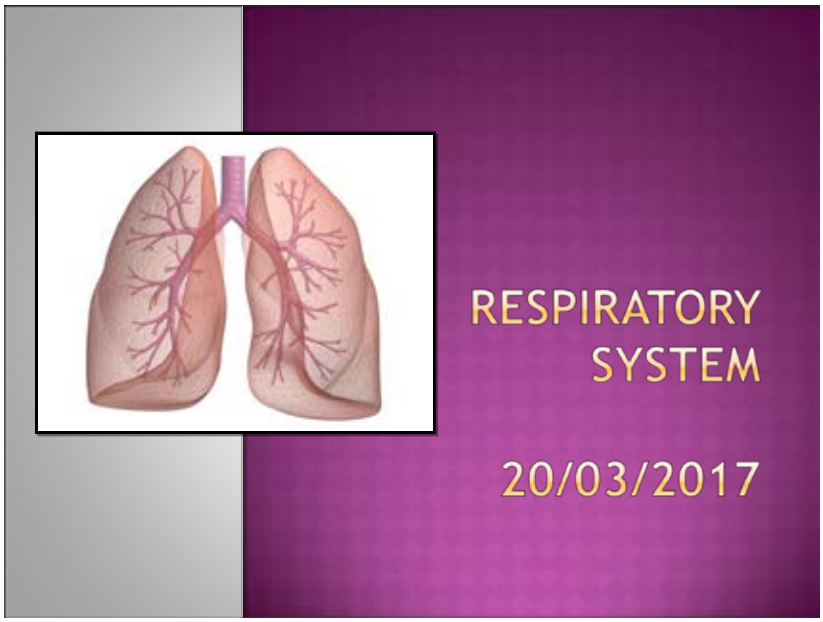
The bottle behaves as the thoracic cage, the bottom as the diaphragm and the balloon attached to the straw as the lungs. If you pull the bottom downwards, the volume inside the bottle increases and the pressure decreases with respect to the outside: the air entering the balloon makes it

bigger. When you pull upwards, the volume decreases, the pressure increases and the air in the balloon is pushed outside.

Do you think the model you built entirely describe what happens in the thoracic cage, or is it incomplete? In this model, it is obviously not possible to observe variation in the volume of the thoracic cage due to the movements of the ribs, but only due to the action of the diaphragm.

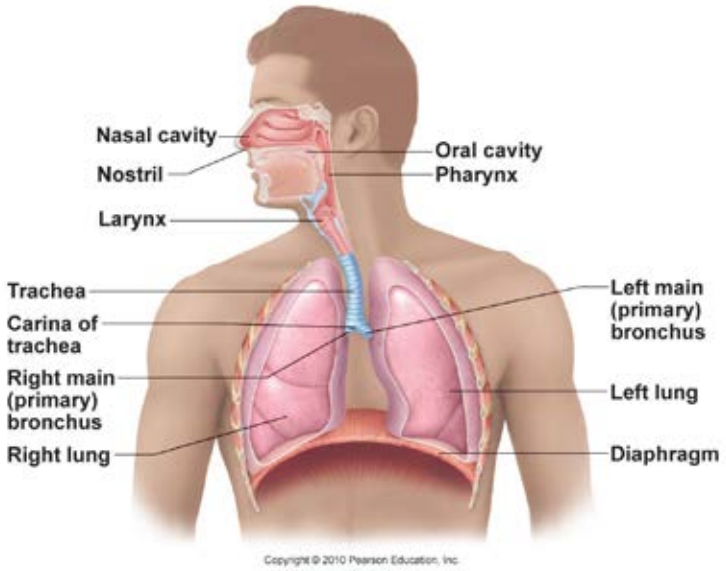
However, the physical principle is the same.

Annex 2



RESPIRATORY SYSTEM

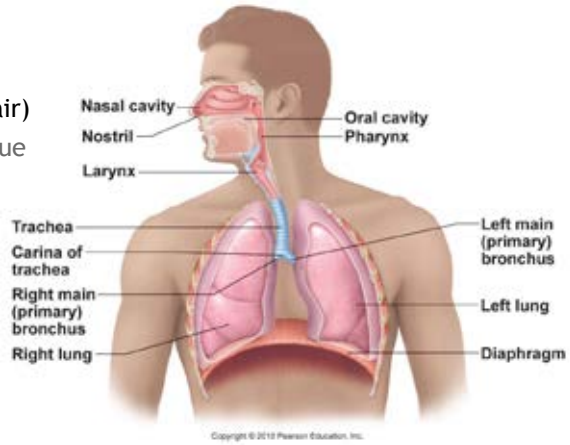
Functions: supply O_2 to the blood and remove CO_2



ANATOMY

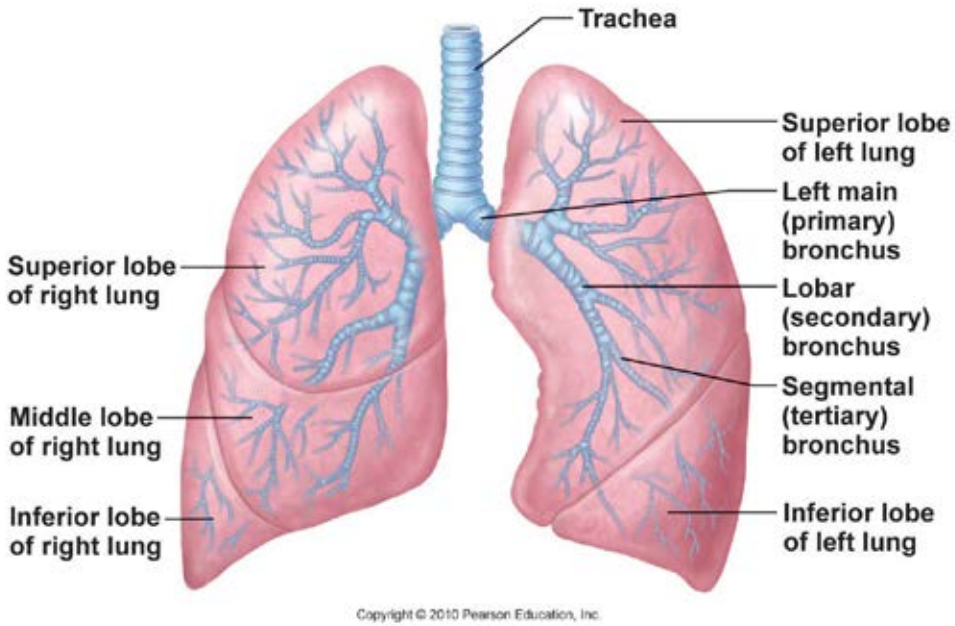
Nose/mouth: filtered, warmed, humidified
- Mucus traps bacteria & foreign debris
- Cilia sweep mucus toward throat
- → digested by stomach

- Pharynx: throat (passage for food/air)
  - Tonsils: clusters of lymphatic tissue
- Larynx: contains vocal cords
  - Epiglottis: covers larynx when liquids/food swallowed
- Trachea: windpipe; lined with cartilage (C-shaped)



- Bronchi: branches to lungs
- Bronchioles: smaller branches
- Lungs → Alveoli: air sacs for gas exchange

LUNGS



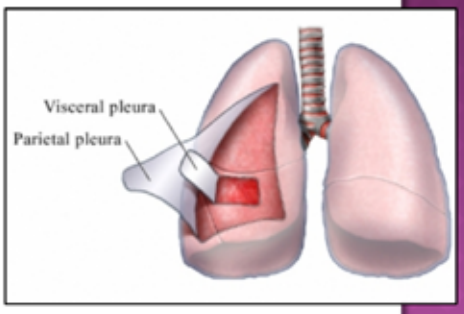
Anatomy and Physiology of the pleura

Our lungs are wrapped in a membrane - the pleura

The pleura is made up of two sheets:

one is attached to the lungs, and one to the rib cage.

The pleural cavity contains a fluid which acts like a lubrificant.



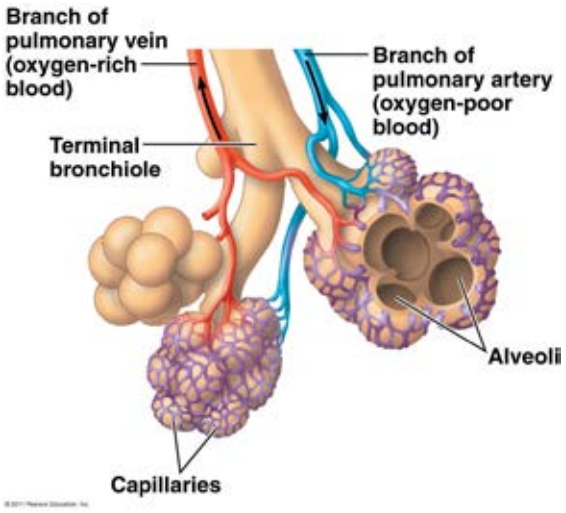
Lung adhesion to the rib cage

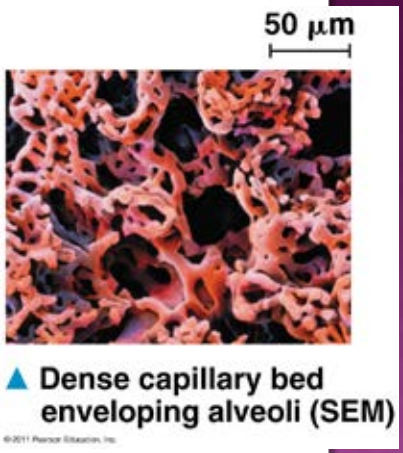
The human lungs work similarly to …

A suction cup!

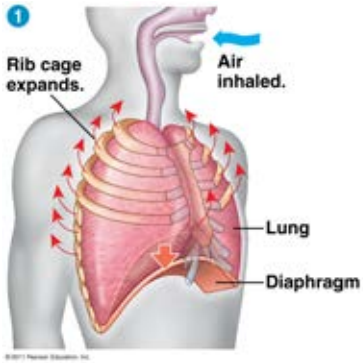
Let's test it!

ALVEOLI

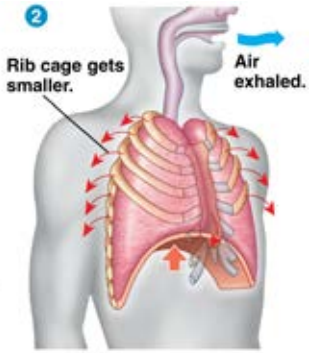




INSPIRATION VS. EXPIRATION



Air flowing into lungs



Air leaving lungs

Muscles:

Diaphragm: dome-shaped muscle separating thoracic and abdominal cavities

External intercostals: pulls ribs to elevate rib cage → inspiratory muscles

Internal intercostals: depresses rib cage

Inspiration	Expiration
Diaphragm contracts & flattens	Inspiratory muscles relax
External intercostals lifts rib cage	Rib cage descends, lungs detract
Lungs stretched to larger size	Gases forced out
Air pressure inside lungs decrease	
Air sucked into lungs	

LET'S EXPERIMENT!

Cut the bottle
Place the drinking straw inside a balloon
Fix the balloon tightly with the strip
Place balloon+drinking straw inside the bottle (from bottom to top!)
Add the tap to the drinking straw

The balloon has to be at the center of the bottle
Stick the straw to the cap with the adhesive tape

Place another balloon at the bottom (**cut** out the mouthpiece!)

LET'S CONCLUDE

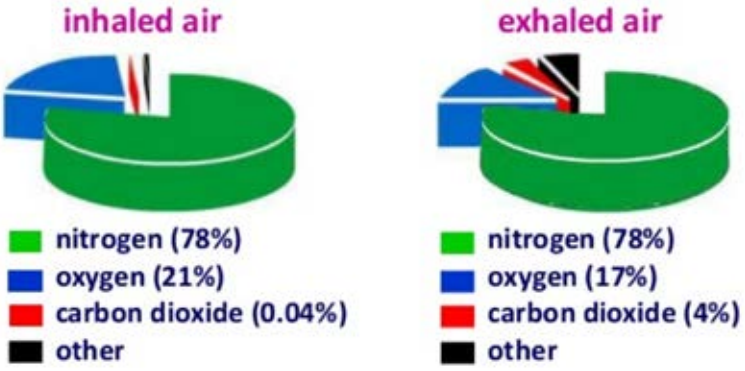
1) The bottle **behaves as** the thoracic cage
2) The bottom **behaves as** the diaphragm
3) The balloon **behaves as** the lungs

4) If you pull the **bottom downwards**:
   - the volume inside the bottle …?...
   - the pressure …?...
5) If you pull the **bottom upwards**:
   - the volume inside the bottle …?...
   - the pressure …?...

6) Think about a possible "**upgrade**" :)

AIR

What are the differences between inhaled and exhaled air?



What are the properties of exhaled air?

It is hot

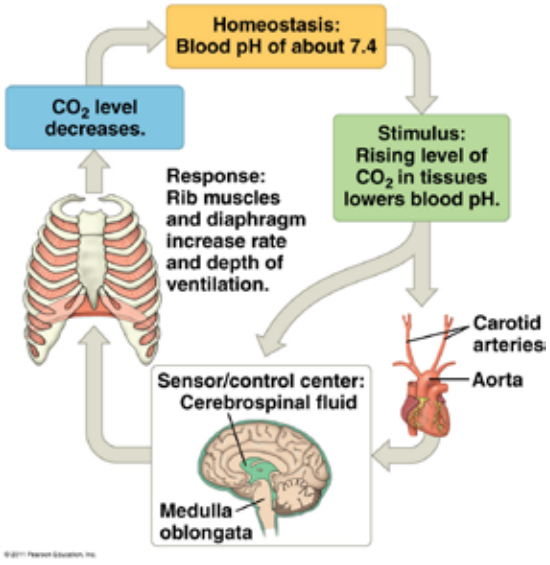
It contains more water vapour than inhaled air ...

... and more carbon dioxide with respect to the air outside

CONTROL OF RESPIRATION

Control center = **medulla oblongata**

- Responds to *pH changes in blood*
- High CO_2 → carbonic acid forms → lowers pH
- O_2 sensors in the aorta and carotid arteries

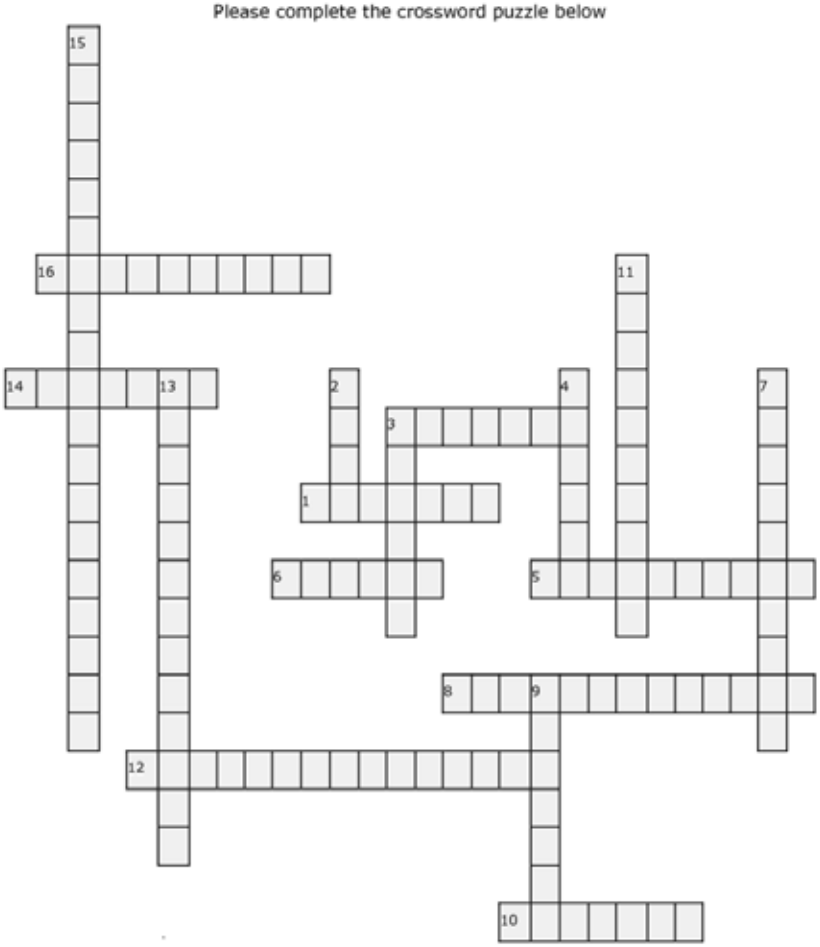


Annex 3

Name: _____

Respiratory system

Please complete the crossword puzzle below



Across:

1. The trachea branches off into two _____.
3. The windpipe
5. When we breathe out.
6. A type of epithelial cell that secretes mucus.
8. When haemoglobin binds its first

Down:

2. How many oxygen molecules can haemoglobin bind?
3. A decrease in pH cause haemoglobin to be in a _____- state.
4. The voice box.
7. Cells in the alveoli.
9. _____ membranes line the

Country:	Italy
School:	Secondary School "G.B. Grassi" Uggiate Trevano
Lesson/subject:	Biology / Genetics
Level:	13-14 years old

INHERITANCE OF CHARACTERS

Abstract: the activity was realized with an initial discussion about Mendel laws. This permit to raise the problem, to announce topic and to learn goals and tasks. Then the individual work allows to formulate conclusions and do an evaluation to the lesson.

ICT support, equipment needed

Whiteboard; power point presentation; maps; charts.

Teaching aims

Developing competences:

- Learning to learn – students raise hypothesis themselves,
- Communication – discussing the work in the classroom,
- Cognition – while analysing the findings and results through the theoretical material,
- Initiative and creativity – evaluating results and reaching conclusions.

Learning outcomes

The objectives that the teacher wanted to reach were to get students to learn about the beginning of Genetics, to listen for specific information, to read for detailed information as well as to use scientific terms. By the end of the lesson the students will be able to know how the inheritance works, to understand the differences of characters between people and also to use appropriate scientific terms.

Methodology/methods:

* Discussion – raising the problem, announcing topic, learning goals and tasks,
* Individual work –formulating conclusions, evaluation.

Lesson phases and timing:

Initial activity (20 min.) – in the classroom – introduction of this new topic to the class

Main activity (40 min.) – in the classroom – show the slides speaking about genetics with examples regarding Mendel laws

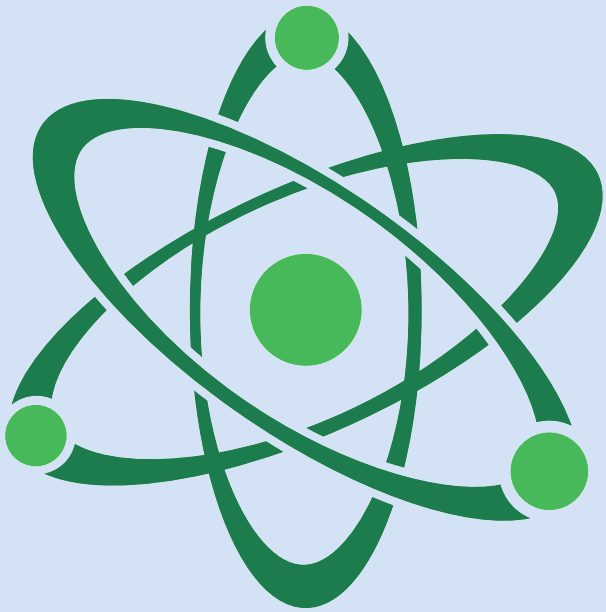
End of lesson (5 min.) – coming back to learning tasks and discussing with students to have feedback (asking questions during the lesson) about genetics.

Evaluation/evaluation tools

Oral tests.

Materials/resources, worksheets

Text book, other books provided by the teacher, photocopies and websites.



PHYSICS LESSONS

Country:	Turkey
School:	Mersin Deniz Ticaret Odasi Mesleki Ve Teknik Anadolu Lisesi
Lesson/subject:	Physics
Level:	9 Grade 14-15 years old

THE NATURE OF PHYSICS

ICT support, equipment needed

Videos taken from EBA, Interactive whiteboard, Teachers book, Students books.

Teaching aims

The purpose of this activity is to understand branches of physics and the nature of physics,To be able to classify the sizes in physics, To be able to classify magnitudes in physics as scalar and vector, To be aware of the principles and laws of physics that are important in our lives and in our immediate environment.

Learning outcomes

* Students will be able to answer the question, What is physics?
* The student realizes that physics is studies the object, phenomenon and event in the various sub-fields.

- The student learns that The laws and theories in physics; is used to explain some events in chemistry, biology and other sciences.
- She/he explains the importance of observation (qualitative and quantitative) and experimentation in physics.
- The student realizes that physical events are based on quantitative observation rather than qualitative observation.
- Classify quantities in physics as basic and derived.
- Measures the basic quantities in physics using appropriate measuring tool and unit.
- Defines units of basic sizes in the SI unit system and converts them to the upper and lower floors.
- Explain that every measurement made may be faulty and that this error is caused by the measuring method, the measuring device, the measuring instrument and the medium.
- Classify quantities in physics as scalar and vector.
- Realize the use of scientific methods when reaching the principles of physics, laws and theories.
- Experiments have been carried out to test hypotheses and theories.
- Describe the use of modelling and mathematics when necessary in describing physical phenomena with examples.
- We recognize the principles and laws of physics which play an important role in our lives and in our work and in the workings of our bodies with examples.

Methodologies/methods

Presentation, Discussion, Question and Answer, Demonstration

Lesson phases and timing:

1st - Introducing the subject to the students (45 min.)

Mechanics energy conservation law; potential & kinetics energy;

2nd - Discussing in small groups the problem-question (15 min.)

Which one of the objects will fall first? A plastic bottle full of water or an empty plastic bottle?

3rd - Experimental activity (30 min.):

1. The students will drop the two objects (for instance, a plastic bottle full of water and an empty plastic bottle) with different mass and similar shape, at the same time from the same height. (students can film the fall with their mobile phone).
2. The students will drop the same objects, simultaneously, from different heights.
3. The students will take conclusions after calculate the velocity of the bottles immediately before they reach the ground, by applying the mechanics energy conservation law.

4th - Students will watch the videos from BBC:

https://www.youtube.com/watch?v=E43-CfukEgs

https://www.youtube.com/watch?v=KDp1tiUsZw8

Hammer vs. Feather - Physics on the Moon.

Evaluation/evaluation tools

1. What is the observation? Types of observations? Give examples.
2. What are the sub-fields of physics?
3. 10dm + 0,2 hm + 7dam = ... dam
   2700mA + 0,036kA + 5 A = ... A
4. A scientist measures a physical size under the same conditions, using the same measuring instrument, with more than one experiment and gets different results So what is the source of measurement errors?
5. What is the measurement?
6. A basketball player with a real length of 214 cm is measured separately by 3 observers. Which of the following is the most reliable? Why?
   1. 216 cm.
   2. 217 cm.
   3. 213 cm.
7. What is Scientific Method?
8. What are the steps of the scientific method?
9. What is modelling?
10. Write 2 sample models in physics
11. Design one controlled test setup and make the appropriate explanations for the purpose of the experiment.

Materials/resources, worksheets

Worksheets.

Annex I - The Field work of Physics

Physics, It is a science that deals with sub-fields such as mechanics, electricity, magnetism, optics, thermodynamics, atom physics, nuclear physics and solid state physics.

Physics is the life's itself.

If we take a look at what we do as we live our life, we can see that physics is life's itself.

When we look at what we do to live; breathing, feeding, moving, working ,spending energy and with the others which are on the agenda; global warming, pollution of rivers and seas, cell phone, printer, computer, satellites, spaceships and many more that you can think of are also subjects to physics. Physics takes its subjects from living and non-living nature. It tries to explain natural events on a mathematical basis.

We move to reach the school, to meet our friends, but also there are other movements, you all know it. Physics examines whys and hows under the title of "Mechanic". Daily events like Striking of a lightning, turning a bulb on, electric charge are examined under the title of "Electrics". Lights reflection on mirror, formation of rainbow, how the light goes through the glass without breaking are examined under the title of "Optic". Temperature, heat, wind, steam boilers, thermometers, are examined under the title of "Thermodynamic". Matter, atom that create matter, particulars in atoms are examined under the title of "Atom Physics". Features of metals, crystals, are examined under the title of "Solid State Physics". As you can see above, all of these are not the subjects which are out of daily life.

The reason of water flowing in our houses is the pressure difference. Physicists make researches on this subject and we make use of these even if we are unaware of it. We love to use our cell phones and computers and

the people who has developed the working principles of these devices are physicists.

People who discovered that mercury and alcohol expand when heated (which we use in our thermometers.) are also physicists. We look at these thermometers and get the temperature rates of the day. Based on the rates of temperature, we choose what to dress and make a plan for the day.

Physics examines place of substances in space. This is about the calculation of volume of matters. You can say that you don't care. You can say that you don't calculate the volume of matters in daily life. Would you like to know how many times we make calculations of volume of matters? While buying a shoe, you wouldn't want to buy a shoe that is too narrow or too loose. What you do without taking a pen and paper is comparing you foot and the shoe. Think about why did your parents reject to buy the bag you wanted to buy. If the first reason is that they didn't like it, the second is because it is either to small or too big. Once again, what you do is the calculation of volume. While buying clothes, while getting another person in the car, while buying a house and so on. What you do is the calculation of volume. As you can understand from these basic examples, physics is interested in life and you make use of its subject unawarely.

Nature Of Physics

Back then, humanity was scared of the effect of sun when the sun sets and earth becomes dark. Then, they tried to understand the reasons of weird moves of the moon. They began to guess the dates of solar eclipses more easily than the weather of the next day. Way before than the first dinosaur was on the face of Earth, Moon was rotating around our planet. A satellite built by humans which can be considered as moon can rotate around our planet for a long time. How does the satellites move? How can we build our own moon? How can we go to the Moon?

Physics makes us answer these kinds of questions. It gives us the power to guess the event before it occurs and control it, and help us go deep of the unknown and understand it. The things which we learn from Physics helps to emerge new things. New questions come up as the old questions are answered. If we didn't use Physics therms, most of these questions would've never been asked.

In physics, all kinds of tools and equipments are used. Just like almost all the experiences and acts of humans, physicist's main tool is wonder. Then, language is needed to explain to himself and to others what he thinks, does and want to do. Mathematics, which we can think as quantity's and relations' special, very clear, elastic and universal language is also another tool for a physicist; by the way, his own eyes, ears and hands are really important. He takes them as his first tool to gain knowledge about what is going on in the world he tries to understand and control. Then, He need to use different kinds of tools, equipments and machines to help his sense organs and to create special events to examine.

Before Galileo, there was no astronomic telescope. Once Galileo built the first telescope by combining 2 lens and observed four satellites rotating around the Jupiter, much more and much better telescopes was built. With the help of these telescopes; asteroids, dwarf planets and much more were found between the orbits of Jupiter and Mars.

Time, Space and Matter

Most common physics devices are inside the human body. We gain most of our knowledge about the structure of the universe with our eyes. Our ears which can hear are as important as our eyes. Then, our various senses of touch. The most important touch organ is undoubtedly fingertips; with our fingertips, we understand the physical structure of objects. We form a judgement with our muscles pulling and pushing sensitivity. Sensations we get by touching includes heat, cold and stability. Sense of smell and taste, which are subjects of chemistry rather than physics, are also an important

source for our knowledge about the outside world. These main devices in our body are called sense organs. Other organs of our body actively participates the passive perception of our main organs. For example, some of them require the move of our arms and legs.

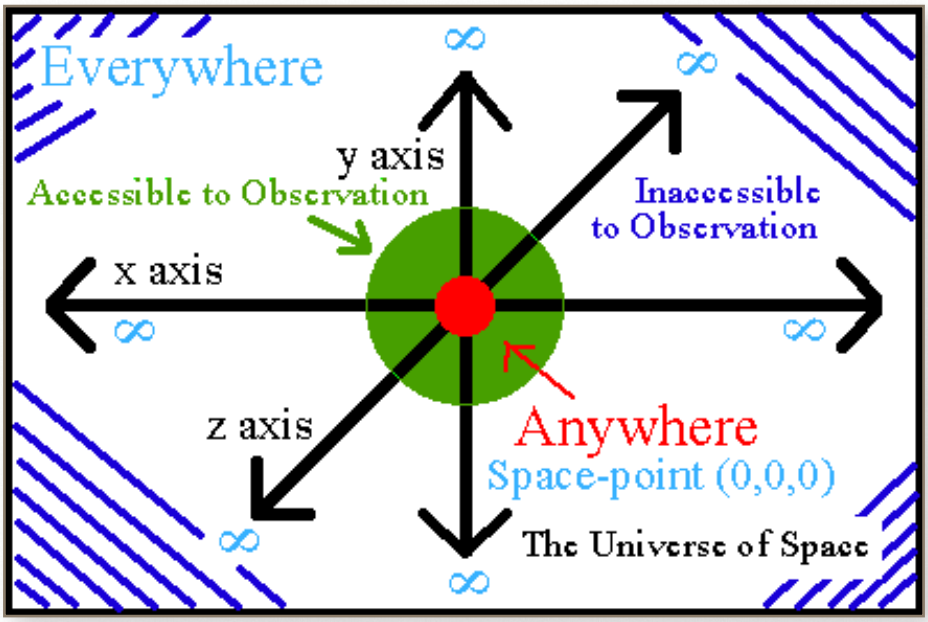
The five sense organs are not the only sense organs that nature has given to us. In our brain and nervous system, there are much more complex and superb observation devices. How these devices work is a subject that science is yet to understand. To understand what good these devices does to humans can be understood by observing the simple animals which lack them. An interesting example for this would be an octopus. In reality, this is an eight-legged, coloured, elegant and smart animal. To make it move, a slowly moving object that will make it attack would be enough. If we reward the right moves with some food, and punish the wrong moves with a weak electric shock, it would learn to attack some targets and not to attack some others. A blind octopus perceives the world with its suction cups. With its sense of touch, it learns to differentiate smooth bar and rough bar, and, a cube and a ball which has the same diameter. But while lifting a two bars which has the same length and shape, it can't differentiate the heavier one even though it forces its muscles more than the other. It can't understand where his eight legs are or how he moves them. Because it doesn't have these superb devices, it recognizes the world by only seeing it. Perceiving the positions, forces around our fingers and arms, playing violin or tennis are just some of our complex talents.

Annex II - SPACE: Space is anywhere and everywhere.

The Cosmological Principle (a k a The Primacy of Existence):

(Spatial) *The Universe, as observed from any place, in every direction looks and behaves roughly the same.*

(Temporal) *The Universe is observed today roughly as it always has been and roughly as it always will be.*



Anywhere	*= a place from which one measures distance and direction.*
Everywhere	*= all distances and directions from anywhere.*
Cosmological Horizon	*= the distance beyond which observations cannot reach.*

Space is everywhere. This simple statement of direct observation and experience is irrefutable. Space is – *everywhere*. It defines everywhere in the Universe **with no points excluded**.

Space is directly observed and experienced. The human body takes up space. The planets, stars, and galaxies take up space. There is space inside of molecules and atoms. Space is over you, under you, around you, inside you, outside you, here, there, *anywhere*, and *everywhere*.

The boundary that actually exists with empirical support (Rudnicki, Arp et al.), The *cosmological horizon*, is two-fold in nature. First there are limits to human tools of observation. There exists distances beyond which no telescope, or other instrument can reach. Improvements in technology continue to

occur. Therefore the limits of our observational capability continue to expand, yet, there will always exist that boundary that is the limits of observations. Second, there exists a distance beyond which the sources have not and cannot reach us. These boundaries, taken together, form the contemporary concept of the cosmological horizon.

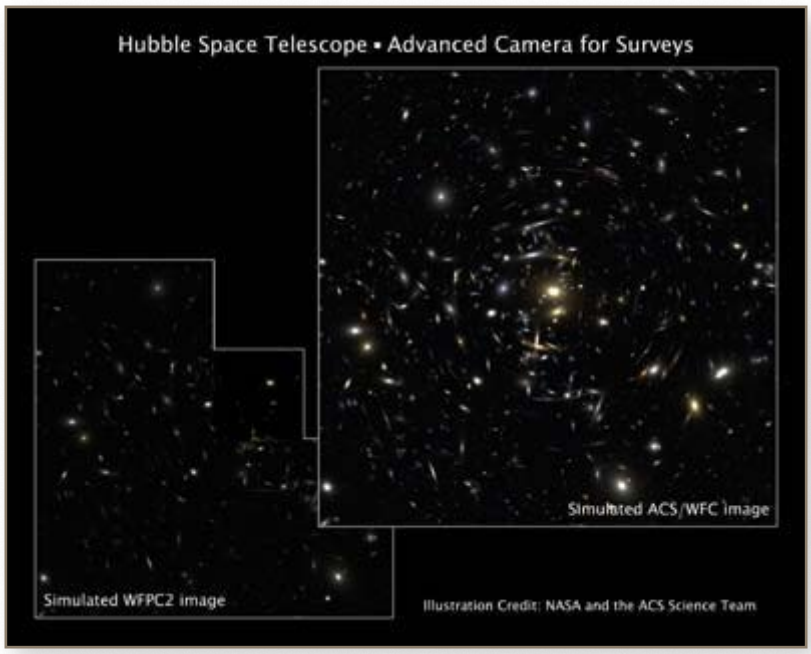


Photo courtesy NASA and the ACS science team.

This NASA illustration – compares the camera quality and resolution of Hubble's Wide Field Planetary Camera (WFPC) vs. The Advanced Camera for Surveys (ACS). The ACS covers twice the area, has twice the sharpness, and is up to five times more sensitive to light than its earlier counterpart, the WFPC.

Existence of Dimension:

Space defines and describes a **potential** – *everywhere.*

Space consists of three dimensions: length, width, and height. Space is located through a process of abstraction in which we relate the objects in space to each other, in space. Objects occupy space, taking up length, width,

and height, and objects relate to each other, and to space, according to the relationships of – *distance* – and – *direction* -. Geometry is the study of shape, involving these special – *spatial* – relationships.

How do we know there are only three dimensions, and not 4, 10, 11, or even 26 dimensions? The answer is found in the *direct observation* of distances and directions. With three dimensions, we account for **every** distance and **every** direction. **All of space is described.** We can therefore locate – *everywhere and anywhere* – from - *anywhere and everywhere* -. There is – nowhere – left to describe!

Existence of Centers:

Space defines and describes a **particular** *anywhere* within a **potential** *everywhere*.

The center of everywhere is anywhere.

The center of such an infinity of points is any arbitrary point, and space will be the same from each and every center, called, *the origin*, identified as space point (0,0,0) chosen arbitrarily.

The geometries of objects can be described in space, **only in relation to a chosen center.**

The **origin** is overlaid onto a three dimensional grid to relate points in space by distance and direction, from the origin, to any and all other points, according to the context of the measurements.

Origin (Space Point (0,0,0))

Octant 1:	**+x,**	**+y,**	**+z.**	**Octant 5:**	**-x,**	**+y,**	**+z.**
Octant 2:	**+x,**	**+y,**	**-z.**	**Octant 6:**	**-x,**	**+y,**	**-z.**
Octant 3:	**+x,**	**-y,**	**+z.**	**Octant 7:**	**-x,**	**-y,**	**+z.**
Octant 4:	**+x,**	**-y,**	**-z.**	**Octant 8:**	**-x,**	**-y,**	**-z.**

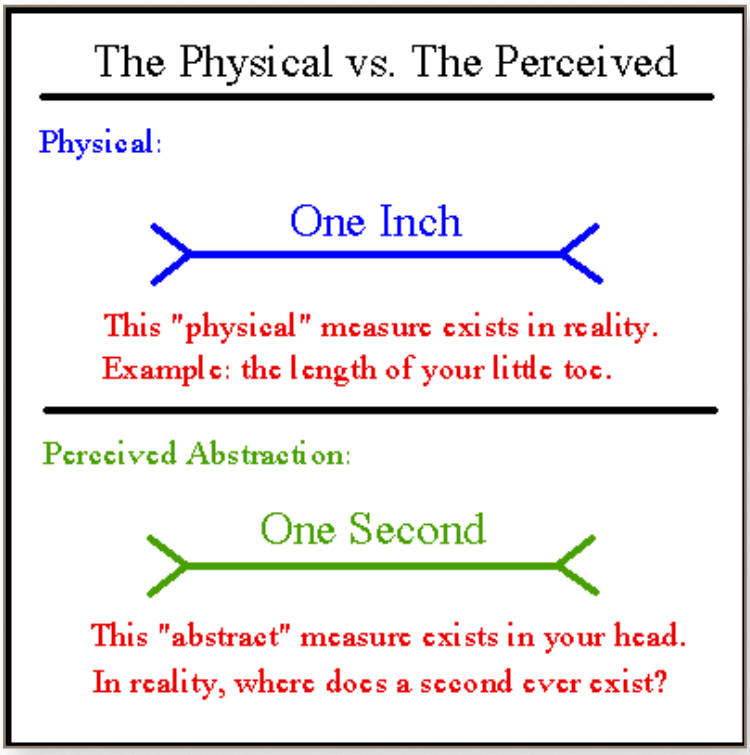
It can be shown that mathematics is rigorously and internally consistent. Such internal consistency, however, does not require any *external* validation. In fact, external validation of mathematics often admits absurdity in reality. Take, for example, imaginary numbers. There is no such number as the - *square root of minus one* -. These concepts are labelled - *imaginary* – precisely because they have no **real** existence. Nonetheless, they exist in the context of mathematical models, and serve a useful function toward making useful predictions about reality. Imaginary numbers are common in calculations involving electricity.

Additional - *imaginary* - dimensions are clearly mathematically feasible. There is no limit to the number of dimensions that one can define *mathematically*. Yet, there exists no physical reference to reality. Imaginary dimensions retain mathematical properties, just as imaginary numbers do, but refer to nothing real, in the physical sense.

Imaginary dimensions exist only in the context of mathematical processes.

For instance, Einstein refers to time – *as a dimension* -. Space-time is a claimed aspect of a four-dimensional universe. Einstein is treating spans of time as real and actual lengths existing in reality, just as there exist real and actual lengths corresponding to spatial shape, and spatial distance in the classic sense.

The distinction is: Perceiving a Physical Reality vs. Perceiving an Abstract Reality.



There is no physical length of time in reality. Only the present moment is real.

There is no length to the present moment and therefore, no way to navigate lengths of time. Instead, we consider histories, and predict futures, by means of abstract time spans. Actual, physical reality, according to direct experience and observation, limits time to only the present moment. Only the present moment ever actually, physically exists.

Spatial dimensions refer to physical characteristics of matter: length, width, height, distance, and direction.

Time refers indirectly to reality, manifested in measures derived from related facts of matter and existence.

All that exists independent of observation.

Combining these three facts one concludes:

The spatial relationships of matter exist as a function of time, all such relationships of matter, anywhere and everywhere in space there exists matter, where all matter is always in the present, anywhere (in space) time is measured.

Annex III - MATTER: Matter matters.

Matter vs. Space: The Universe is a system of objects in spatial relations.

The Universe is comprised of all the systems of matter/energy that exist in reality. These exist without respect to any consciousness. They exist *independent* of observation. Objects interact with one another in many ways, including motions, collisions, merges, flows, disintegrations, and all other types of *real* actions which fall under the auspices of the science of physics.

In the real world, one locates and measures – *rigid bodies* -. Measures of length, width, and height are physical properties of matter. This is what it means to have *dimension*. To describe *physical* objects, one measures *actual* distances and directions related as length, width, and height. These measurements are made based on the context of the object(s) measured. Space and matter have physically manifested distances and directions in reality.

Space applies to every possible physical location in the Universe. Matter applies to objects of *finite* length, width, and height, within the – *potential infinity* – of space. At any one place, at any one time, space is either empty, or occupied, but not both. Empty space is devoid of matter/energy, at that place, at that time. Occupied space contains matter/energy, at that place, at that time. The motions of matter/energy systems determine whether any particular place, at any particular time, will be empty, or occupied.

Matter has geometry. It takes up, or uses space. Matter might have much possible geometry, in each case in the context of the specific matter. Matter can be solid, liquid, gas, plasma, and energy, even a combination of these. In all cases there exists qualities to these objects we call geometry.

Geometries can be, and often are, quite complex. However, there are essentials to all geometries: size, shape, volume, limits, and boundaries. Essentials help identify the objects, allow for distinguishing objects one from another, allow for comparisons to, and contrasts of objects according to their characteristic *identities*.

The Principle(s) of Realism:

The Principle of Realism:	Reality exists, independent of observation.
Mass/Energy Conservation:	Matter cannot be created or destroyed, only transformed. Mass transforms into energy. Energy transforms into mass.
The Principle of Mechanics: (The Law of Causality)	Real actions have real causes, and real effects.

In relating – *rigid bodies* – one to another, even in the most complex discovery of those relationships, there remains always **one and only one physical reality**. That reality is the reality according to the principle of realism, the reality of the conservation of mass/energy, and the reality of causality via the principle of mechanics. This ensures confidence in our *physical descriptions* of natural occurrences. Common sense and logic are verified and fortified with respect to Nature.

Classical Mechanics provides a *physical* description of Nature at a macroscopic scale. Quantum Mechanics describes Nature on a microscopic scale. Both classical and quantum mechanics provide *real* interpretations of *actual* (experimentally verifiable) processes with respect to real matter/energy

systems. For instance, it is known that – *length contraction* – naturally occurs in matter as a function of its gravity potential. There is a natural change of the Bohr radius of an electron. It is *not* necessary to use a hypothesis of the constancy of light. Instead, via the principle of mass/energy conservation, Quantum Mechanics verifies and validates the fact of length contraction as a naturally occurring reality of matter.

Quoting Marmet: "When we apply the principle of mass/energy conservation, the electron mass increases. Now when we apply quantum mechanics, and we calculate what happens when the electron of an atom, which increases its mass (due to kinetic energy), we find that the size of the Bohr radius increases. This is fairly simple to calculate without requiring any new theory, just classical physics. Using the same quantum mechanics and the same more massive electron, we also calculate that an atomic clock slows down. Therefore this provides the link between quantum mechanics and the phenomena previously attributed to relativity.

However, if we think about that calculation, we have seen that we have a change of length of matter, and a change of clock rate, which is explained by quantum mechanics, but this is no longer relativity. There is no space distortion. There is no time distortion. It is just simple, logical classical physics. Matter gets physically longer and clocks get slower because mass/energy is conserved. All this is done using classical physics. There is no need of relativity. Relativity is redundant. The phenomena that were previously interpreted using Einstein's relativity are now the result of a simple calculation in classical physics and quantum mechanics." – **End Quote (Marmet).**

(Reference: Marmet, Einstein's Theory of Relativity vs. Classical Mechanics.)

The Principle of Relativity:

Existence exists, as observed.

In relating - *rigid bodies* - to one another using relativity alone, as Einstein did, implies a different reality for EACH and EVERY observer, at least as is with respect to EACH and EVERY *frame of reference*. Very early in Einstein's book (*Chapter 3, Space and Time in Classical Mechanics*) the demonstration of this change in context (from realism to relativity) becomes apparent:

Quoting Einstein: I stand at the window of a railway carriage, which is traveling uniformly, and I drop a stone on the embankment, without throwing it. Then, disregarding the influence of the air resistance, I see the stone descend in a straight line. A pedestrian who observes the misdeed from the footpath notices that the stone falls to earth in a parabolic curve. I now ask: do the "positions" traversed by the stone lie "in reality" on a straight line or on a parabola? Moreover, what is meant here by "motion in space"? - **End Quote (Albert Einstein)**

Einstein proceeds to produce *two separate realities*, one for the passenger, and one for pedestrian. Einstein claims: BOTH realities are "equally true".

1. The passenger's reality: The stone travels straight down.
2. The pedestrian's reality: The stone traverses a parabolic curve.

Wait a minute!!!!! There's only one stone!

Combining the Two Realities:

The fact is that Einstein has **dropped the context** of - *frame within frame* - motion. He implies the stone *belongs* to the moving frame, just as the stone *belongs* to the stationary frame. Via the Principle of Realism, the stone has - *an existence independent of observation* -. In Einstein's example, the stone transitions between the two frames of reference. Prior to its release, the stone is under the influence of the moving frame because the passenger in

the moving railcar is carrying the stone. Upon release, the stone begins to lose the energy attributed to the motion of the car, even as it gains momentum from the gravity of Earth, - *which has been pulling down on the stone, the railcar, and the moving observer throughout the exercise* -. The ACTUAL stone, takes an ACTUAL curved path, due to both the lateral force of the railcar, and the downward force of gravity acting upon the stone, both at once. This is clearly - *frame within frame* - motion. In this example, the stationary frame contains the motions, and the stationary frame is the *preferred frame* in the classic sense. By properly considering each and every motion of each and every *rigid body* involved in the exercise, simple classical mechanics provides the real description and interpretation, of the motions of the objects involved.

The background of Euclidian space is not meant to be the end of it. It is the start of further refinements. Euclidian space is the infinite potential of distance and direction. *Matter matters*. Essential to relativity, is the idea of - *rigid bodies* - and - *curved space* -. **Einstein presumes matter systems when placing origins**. What this means is that relativity uses a non-Euclidian approach to configure the points in terms of curves instead of lines, - *outward from respect to a SPECIFIC origin* – which is the center of a matter system. In both perspectives, Euclidian or non-Euclidian, it is the *same space* that is being configured.

The common - *relativistic* - vernacular is: SPACE CURVES IN THE PRESENCE OF MATTER.

The implied corollary becomes: IN THE ABSENCE OF MATTER, SPACE IS EUCLIDIAN.

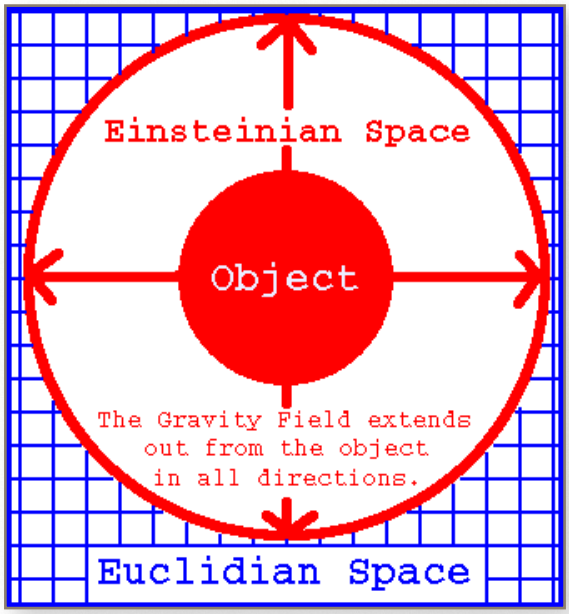
Matter matters: *In the absence of matter, there simply isn't anything to relate.*

The Axiom of Matter: Matter matters.

The Cosmological Principle (a k a The Primacy of Existence):

(Spatial) The Universe, as observed from any place, in every direction looks and behaves roughly the same.

(Temporal) The Universe is observed today roughly as it always has been and roughly as it always will be.



Newton's Universal Law of Gravitation:

$$F_{gravity} = \frac{Gm_1 m_2}{r^2}$$

where $G = 6.67 \times 10^{-11}\ N\ m^2/kg^2$

(G is the Universal Gravitational Constant)

It is taught in the Standard Theory that gravity is the dominant force in the universe, i.e., that gravity affects all matter, and overwhelms all other forces, such that the universe has a "shape" which is: open, closed, or flat, and that the universe arose from a *singularity*, i.e., The Big Bang.

Objective analysis shows this is false, and that gravity reduces to effectively zero over large enough distances. (The Inverse-Square Law)

Therefore, the universe, as a whole, obeys the perfect cosmological principle, rephrased here as:

1. The universe extends in all directions indefinitely;
2. The universe has an infinite age;
3. The universe is homogeneous on a large scale;
4. The density of matter/energy is finite and constant, except for local irregularities;
5. The universe is in a *steady-state* without expansion and without creation of matter;
6. The universe complies with the principle of mass/energy conservation.

(Reference: A.K.T. Assis, "*A Steady State Cosmology*," paper reprinted and edited by Halton Arp, et. al., *from the book* Progress in New Cosmologies: Beyond the Big Bang.)

Quoting Einstein: "Every description of events in space involves the use of a rigid body to which such events have to be referred. The resulting relationship takes for granted that the laws of Euclidean geometry hold for *distances*, the distance being represented physically by two marks on a rigid body.

I wish to show that space-time is not necessarily something to which one can ascribe a separate existence, independent of the actual objects of physical reality. Physical objects are not – *in space* – but these objects are – *spatially extended* -. In this way the concept – *empty space* – loses its meaning." **End Quote (Einstein).**

Preferred Measures:

Matter has an existence independent of the observer. It is a fact that length contraction naturally occurs. This has *real* but *natural* effects upon our ability to measure. The – *standard meter* – has a different length in each different frame of reference. The – *standard clock rate* – varies in the same proportion due to the fact that the Bohr radius of an electron

changes in those different reference frames. With respect to proper measure, one must adjust the measures so that the problem consists entirely of **like units** (proper units), a fact which is mathematically justified.

Due to its independent existence, there is a distinction that must be made between what a thing actually is, and what a thing is – *observed* – to be. There are distinctions between *actual* motions and measures, and *observed* motions and measures. To conform to *realism*, one must distinguish the characteristic measure(s) of a thing – *as it actually is* -, from what it is observed to be, which must, by definition, include *relativistic distortions* of measure.

To find the – *preferred measure* – is to find the measure of a thing with respect to – *as the thing is at rest* -. Any measure taken of a thing from a frame different than its – *rest frame* – will produce a relativistic distortion of the measure(s) taken. The rest frame is that frame which provides a measure of a thing as if it is at rest. The rest frame is that frame in which the motions and measures can be - *classically described* – independent of observation. In all frames of reference outside of that rest frame, a relativistic distortion is produced.

For instance, in Einstein's example of a passenger in a moving railcar, a pedestrian, and a stone, there is a system of motions and measures – with respect to each and every component.

1. An **origin** with respect to the railcar.
2. An **origin** with respect to the embankment.
3. An **origin** with respect to the stone.

The experiment has three distinct stages or phases with respect to time:

1. The **time** the stone spends in the railcar frame, held by the passenger.
2. The **moment** the stone is released.
3. The **time** the stone spends descending down to the embankment.

Now we can see that there are several *perspectives*, which might be maintained, of which three are pertinent to the discussion:

1. A perspective from the railcar, entirely.
2. A perspective from the embankment, entirely.
3. A combined perspective: the independent perspective, with respect to the stone.

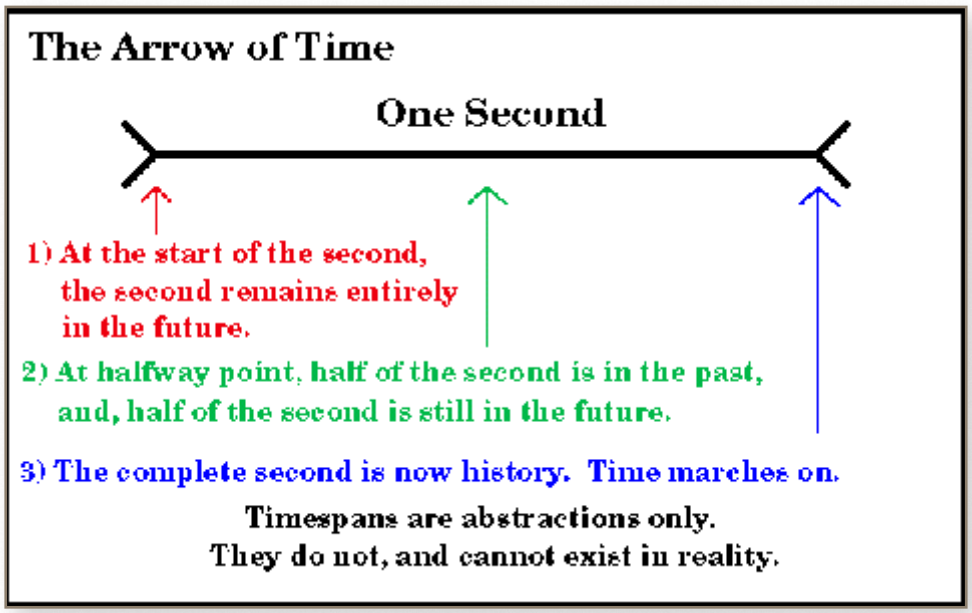
Perspectives one and two are *relativistic*. During phase 1, the stone distorts with respect to the pedestrian, but is observed at rest with respect to the passenger. Phase 2 is only a moment. The stone transitions from the moving to the stationary frame. During phase 3, with respect to the passenger, the stone begins to distort as the stone moves away from his rest frame. With respect to the pedestrian, the stone travels from a full distortion to the stone at rest. It is only through an independent perspective, that one can distinguish between relativistic distortion, and natural – *classic* – measure.

Annex IV - TIME: Time is everywhere in the present, anywhere it is measured.

Clocks - *measure* - time. It is true that due to the fact of length contraction, there is a corresponding change to atomic resonance and frequencies with respect to gravitational potentials and accelerations. Atomic clocks run at different rates. Pendulums swing at different rates. Mechanical gears change their ratios.

Q: How does that slow or speed up time?

A: It doesn't affect time at all. It creates an error (distortion) of measure.



Time exists as a continuum. Everywhere (in space) time exists *as the present moment exists*. Anywhere time is measured, one must account for the clock rate as appears in that frame, which is only an – *apparent clock rate* -. The flow of *real time* is not affected by measure, because *time exists independent of observation*. Only the present moment is real. Only the present moment exists. Every point in space experiences the same moment, at the same time. This is the *present moment*. A series of moments is an abstraction of time. For

abstract purposes, a series of moments becomes a group abstract: *past*, *present*, and *future*.

One way to distinguish axiomatic concepts is that the axiom is used even in the process of denying it.

Examine the statement: *The Universe is 20 billion years old.*

Notice the implied axiom of time. The Universe was *born* 20 billion years ago. 20 billion years accumulation of - *Earth Seconds* – have passed, and the Universe is *now* in the present 20 billion years later.

The implication is: *Time is everywhere in the present, anywhere it is measured.*

Real time has flowed at the constant rate of *Earth seconds* for 20 billion years!

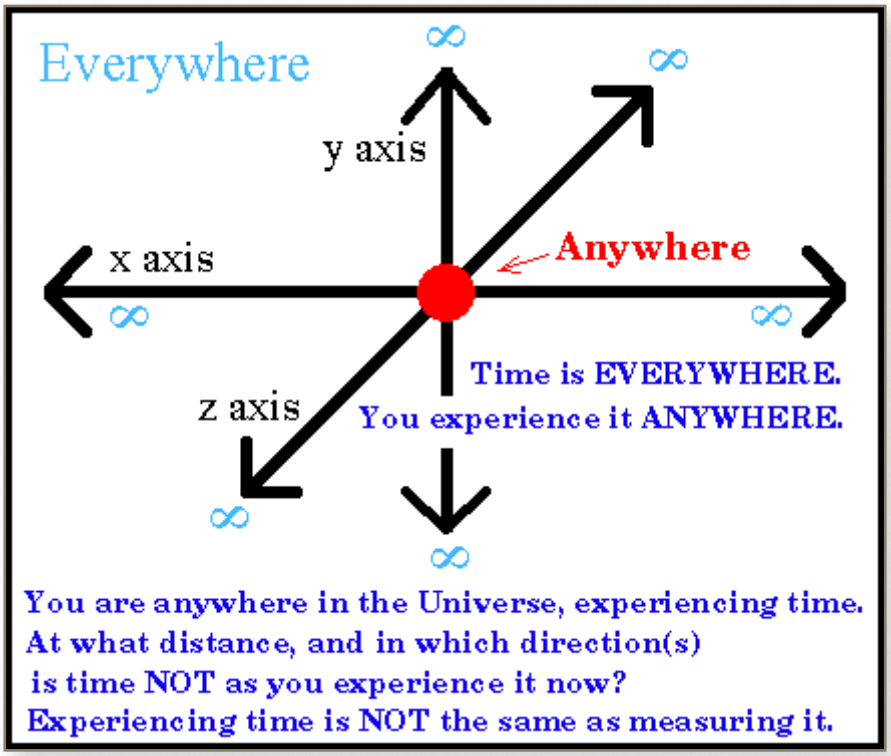


Figure – The Metaphysical Relationship of Space to Time

The Present: A single instance of moment, which exists only for a moment, as a moment. The present moment is the *only real instance* of time. The present moment is the **now**, expressed in *all of space at once* with *no places excluded*.

Time is a continuum of present moments, one after another, smoothly flowing. There is no discreet moment of time, and no means of "escaping" the present moment.

The Past: The series of moments having passed that no longer exist. The present becomes the past, the series of moments we call *history*. The past exists only in human memory as abstraction. Events of the past occurred in the then present. Thereby present moments become part of history.

The Future: The series of moments, which has yet to occur. Like the past, the future does not exist except as abstraction: in this case, the anticipation of the continuation of present moments. Any *real* action that *will* occur will occur in the present, at the appropriate *future* time.

The axiom of time further expresses that *time is not a real dimension*, but instead, an abstract one. One can't – *navigate* – time. There is no such thing as *time travel*. There is no means, nor mechanism for such a thing, except as the fantasy of the human imagination. One can't travel to the past to - *experience the past* - as one would experience the present. One must wait for the future to arrive by natural means. There is no choice in the matter. The facts preclude such bizarre absurdities.

The Law of Synchronous Time:

Time flows everywhere as a – **continuum** – at a constant, invariant rate. Time is measured *anywhere* – **in proper units** – relative to the measurer, and to existing conditions in the physical environment, i.e., the measurer's "rest" frame.

The Universe exists in the present. Each and every object in existence exists in the present. Real time is the same single moment, experienced as a single moment, in the same exact instant of time everywhere in the present, anywhere time is measured.

There is no size to a point.

There is no length to a moment.

Distances exist physically. Space is a physical continuum.

Time spans are abstract. Time is an abstract continuum.

The Measures of Time:

The measure of time is indeed relative. The rate that time flows is fixed. The choice of a – *unit measure* – is completely arbitrary: any unit measure will do. One may choose any physical mechanism such as the spin of the Earth, or a more sophisticated method, like the atomic vibration of a cesium atom. The measure of time has nothing – directly – to do with light. Indirectly, light has an inherent - *speed of propagation* – which can be used to measure *distance*.

Q: How is time relative?

A: It relates speed and distance.

The planet Earth traverses several distances over time. One such distance, - *orbital distance* -, is the distance Earth makes to complete one orbit around the Sun. Another such distance is the – *rotational distance* – which the Earth makes by spinning on its own axis. We call the time it takes to make that distance a *day*.

Using the rotational distance, the unit measure we call a *second* becomes:

1/60th of 1/60th of 1/24th the time it takes planet Earth to spin once on its own axis.

Another way to manifest this relationship of speed and distance is the – *atomic measure* -. The cesium atom is commonly used in *atomic* clocks. Time is measured by accepting a standard unit measure, a specific accumulation of moments, which, in the case of atoms is a fixed number of periodic *oscillations*.

The unit measure of time must be a - span of time - of fixed duration.

Real Time vs. Virtual Time:

The Principle of Realism: Existence exists, independent of observation.

The principle of realism states that time exists independent of the observer. The axiom of time describes *real* time. Relativity, by contrast, describes *virtual* time. The reason for this is that time does not depend on light, but Einstein chose light, as his mechanism for measure. It's true that physical lengths and clock rates vary with gravity potential and acceleration.

There exists a metaphysical dependency at the source of Einstein's proposal:

Time does NOT require light. Light propagates distance OVER time.

To illustrate this, consider a completely sealed room, sealed to *light*. The room is twenty feet by twenty feet square. There is a single door to the room, a single light in the middle of the room, and a light switch on the far wall opposite the door. Strewn about the room are several pieces of furniture, a table, and some chairs. There is no light in the room. A person enters through the door, and the door is closed, trapping the person in the room *with no light*. The object of the experiment is for the person to find the light switch. The turning on of the light ends the experiment.

Q: What can be said about space?

A: Space contains the furniture, and the person, spatially related around the room.

Q: What can be said about time?

A: The person takes time to find the light switch and turn on the light.

Q: What can be said about light?

A: There isn't any light.

Finally, when the person trips the light switch, the light begins propagating at the speed of light. It will take time for the light to propagate around the room.

Virtual Time: The Issue of Simultaneity

Einstein *presumes* the constancy of light, using it as a standard of measure. Einstein brings up the issue of "simultaneity." He uses the example of two lightning strikes, observers at a train embankment, and observers on a train. Einstein has built a classic "straw man."

Lightning is a well-understood EVENT. When the lightning strike occurs in REAL TIME, several EFFECTS are created in the same instant.

1. A lightning flash occurs in the atmosphere.
2. A thunderous sound wave is created as the air is disturbed.

It is proper to conclude that the lightning flashes - *and the accompanying thunder* - are created together. These – *events* – are created simultaneously. Yet, it is also clear that one will *observe* the light long before one ever *hears* the thunder. The thunder is simply lagging behind the light. The lag increases over distance. This occurs simply because sound travels slower than light.

Einstein discovered that: *motion skews observation.*

Einstein did not consider: *the distinction between the event itself, and the observations of it. The taking of observance to be the event, and the use of light as a standard for determining time, creates the notion of Virtual Time, and Virtual Reality, where reality exists, by means of observation.*

The Principle of Mechanics: Real actions have real causes, and real effects.

It is REAL EVENTS that are simultaneous, not the observance of those events.

The Implications of Lagging Light:

Let's examine a REAL event: The shining of the Moon, as seen from Earth. It should be obvious that BOTH the Earth, and the Moon exist together, *in the present.*

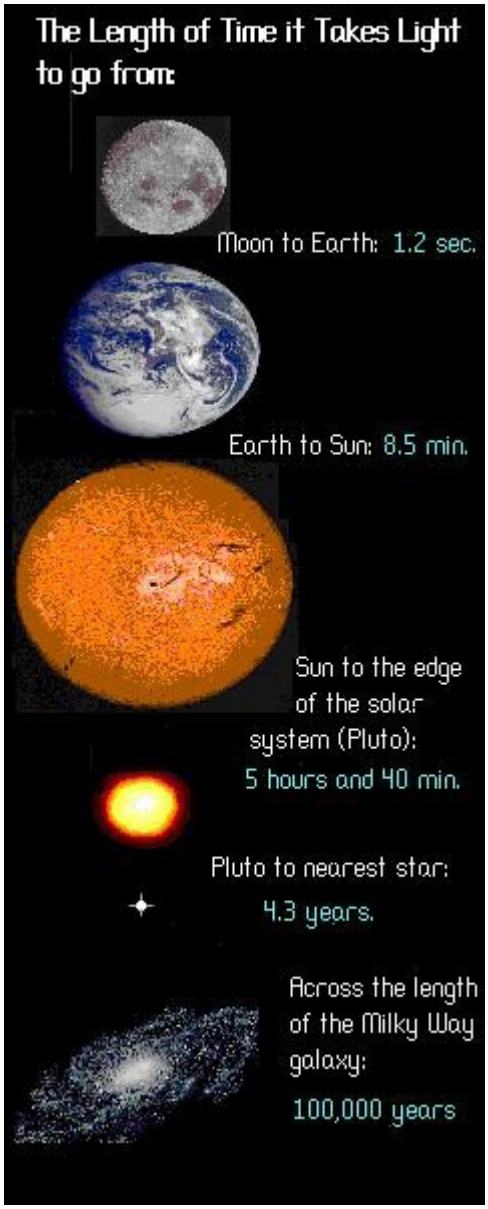
FACT: *Light from the Moon takes approximately 1.2 seconds to reach Earth.*

FACT: *As we exist in the present, we see the Moon as it was 1.2 seconds ago.*

FACT: *We've placed men on the Moon, confirming that it's a real object, with an existence independent of observation.*

CONCLUSION: The Moon and the Earth both exist in the present.

This phenomenon - of seeing objects *in the past* - does NOT indicate that time has a length. The object itself is NOT in the past! Rather, we see a "virtual universe" where evidence of the past is to be found in the analysis of light from these sources.



The *actual object* which is being scrutinized has continued to evolve, but, we cannot detect (yet) the changes that have occurred to that object during the time it has taken the light to travel from there to here.

As is clear from the graphic on the left, this issue is only a matter of scale. For the Moon, the lag is 1.2 seconds, for the Sun, 8.5 minutes, and for the Alpha Centauri system (our nearest stellar neighbour) the lag is approximately 4.3 years.

Barring some catastrophic event that might occur during the lag, and assuming the object under scrutiny is still in existence, it is proper to conclude that the object has evolved that amount of time (the time of the lag) beyond what we see, and that the object exists at the *present* time.

At this very moment light from Alpha Centauri is leaving its source, and will arrive here on Earth approximately 4.3 years from now. Of course, the Alpha Centauri system will be 4.3 years older then, than it is now.

The Milky Way is 100,000 light years across, a huge distance. Light from the farthest reaches of the Milky Way takes a very long time to reach Earth. Since we're part of this galaxy, you may rest assured that the Milky Way presently exists.

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Physics. The topic was changed: Constant current. Its strength, tension, conductor resistance.
Country where the lesson came from	Turkey
Country/person who used it	Rasa Bertuliene. Lithuania.
Level/age of students	17-18 years.
Date	2017-05-15

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The instructions, lesson plan and the method were clear.
Did it fit your curriculum?	I changed the topic, because we learn in junior classes about science of physics, physical phenomena, physical bodies and principles. We have this topic at the beginning of the school year. That`s why I adjusted this method to the topic which was on the programme.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Lithuanian.
Was time enough?	Yes, it was enough.
Was it easy to pass the information onto students and putting up the task?	We explained the new material, then students were making questions up to the topic for other students and answered each other`s questions. Students had no difficulties with the tasks.

AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students were evaluated with pluses or minuses. They were evaluating each other.
In which extent did you reach the predicted aims and outcomes?	The work went on smoothly. We discussed the theory, solved a few tasks and answered the questions.
What was student's reaction/feedback?	All students worked hard. They understood the topic. Students liked to ask each other questions.
Was the methodology and materials suitable for the activity?	The material was suitable, but we adjusted just a few things as the topic was changed. The suggested method was suitable for this lesson.
Could the activity plan be improved? If so, how would you improve it?	The activity plan was good.
Other remarks	

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Physics. The topic was changed to "Measure in Sciences"
Country where the lesson came from	Turkey
Country/person who used it	Paula Paiva, Portugal.
Level/age of students	14-15 years.
Date	2017-11-13

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	The instructions, lesson plan weren't enough clear. The lesson/activity phases were in Turkish.
Did it fit your curriculum?	Part of the content fitted the curriculum. I applied the content at an experimental lesson, where the students had to measure basic quantities that may be faulty, by systematic and/ or accidental errors. After that the students had to explore the results.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Portuguese.
Was time enough?	The time for it was not indicated on the lesson plan, so the students spent 135 minutes with the activity
Was it easy to pass the information onto students and putting up the task?	The subject was explained, and the students put it in practice in an experimental lesson.

AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	In relation to the evaluation of the competences developed with this activity these were integrated in the general process of assessment of the class.
In which extent did you reach the predicted aims and outcomes?	This activity was very useful for sciences, as the observation and the measurement are two important competences to develop.
What was student's reaction/feedback?	All students were involved in tasks. They understood the contents and they liked to applied it, at the same time.
Was the methodology and materials suitable for the activity?	No, the material wasn't suitable, I had to adjust to our student's book and our materials. We didn't have access to EBA and to the worksheets. The suggested method was suitable for this lesson.
Could the activity plan be improved? If so, how would you improve it?	Part of the activity plan was in Turkish, so we had to come up with the rest – a completely version in English would improve the lesson plan
Other remarks	

Country:	Portugal
School:	Escola Daniel Sampaio
Lesson/subject:	Physics
Level:	9/10 grade: 14 - 16 years old

ENERGY CONSERVATION LAW

Which object will fall first? A plastic bottle full of water or an empty plastic bottle?

ICT support, equipment needed

Mobile phone, tape measure, computer, projector and internet.

Teaching aims

The purpose of this activity is that students recognize their wrong alternative concept ideas – most of the students think that a heavy object would fall faster than a light object.

Learning outcomes

The students will be able to conclude that if no air resistance is present, the rate of descent depends only on the height the object is dropped down, no matter how heavy the object is. This means that two objects will

reach the ground at the same time if they are dropped simultaneously from the same height.

Methodologies/methods

* Group work - small groups of 3 students each;
* Experimental activity.

Lesson phases and timing:

1st - introducing the subject to the students (45 min.)

Mechanics energy conservation law; potential e kinetics energy;

2nd - discussing in small groups the problem-question (15 min)

Which one of the objects will fall first? A plastic bottle full of water or an empty plastic bottle?

3rd - experimental activity (30 min):

1. The students will drop the two objects (for instance, a plastic bottle full of water and an empty plastic bottle) with different mass and similar shape, at the same time from the same height. (students can film the fall with their mobile phone).
2. The students will drop the same objects, simultaneously, from different heights.
3. The students will take conclusions after calculate the velocity of the bottles immediately before they reach the ground, by applying the mechanics energy conservation law.

4th - students will watch the videos from BBC:

https://www.youtube.com/watch?v=E43-CfukEgs

https://www.youtube.com/watch?v=KDp1tiUsZw8

Hammer vs. Feather - Physics on the Moon.

Evaluation/evaluation tools

* Answers of the questions worksheet teacher's self-assessment.
* Students interest and commitment to the task.

Materials/resources, worksheets

Videos, Worksheet, Tape Measure, 2 Plastic Bottles or other objects, scales.

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Physics – Energy conservation law
Country where the lesson came from	Portugal
Country/person who used it	Turkey / Ayşe BOLAT (Physics teacher)
Level/age of students	10th Grade (15-16 years old)
Date	10.11.2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, they were clear.
Did it fit your curriculum?	No it didn't.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Turkish
Was time enough?	Yes, it was.
Was it easy to pass the information onto students and putting up the task?	Yes, it was.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	The students were given a chance to ask question the revision was made.
In which extent did you reach the predicted aims and outcomes?	The sections that students didn't understand were repeated.

What was student's reaction/feedback?	Since the curriculum is not appropriate, the students looked at it as an activity.
Was the methodology and materials suitable for the activity?	We couldn't provide an atmosphere without air. That's why we couldn't embody the subject in students mind.
Could the activity plan be improved? If so, how would you improve it?	Activity was entertaining because it is helping the students to motivate. If it fitted to our curriculum. The method could have had really fruitful results.
Other remarks	We couldn't make evaluation because it didn't fit our curriculum. It unfortunately lacked the dimension of assessment and evaluation.

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Physics. Energy conservation law
Country where the lesson came from	Portugal
Country/person who used it	Rasa Bertuliene. Lithuania
Level/age of students	17-18 years
Date	2017-05-11

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes. Instructions, lesson plan and activities were clear.
Did it fit your curriculum?	We learned the theory of this topic earlier (according to the programme in October). Now we had a revision and practical work.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Lithuanian
Was time enough?	Yes, we had enough time.
Was it easy to pass the information onto students and putting up the task?	At first I explained to the students why we were going to do that activity, then we did it. We also did revision of the topic.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students got points to cumulative score. The maximum they could get was 5 points. Later the points will be converted to the mark which they will get to register.

In which extent did you reach the predicted aims and outcomes?	The work was successful. All the experiments were done. We had some problems with deductions.
What was student's reaction/feedback?	All students worked seriously. They said that they found out why all bodies fall in the same way.
Was the methodology and materials suitable for the activity?	The material was suitable. Students liked the video material from BBC very much.
Could the activity plan be improved? If so, how would you improve it?	The activity plan is good. Now I am planning to do such a practical work in October when we will be doing this topic.
Other remarks	

Feedback on the lesson/activity (3)

GENERAL INFORMATION	
Subject and topic	Physics. Free fall.
Country where the lesson came from	Portugal.
Country/person who used it	Latvia/physics teacher Ā.Andrejeva
Level/age of students	15-16 years old. Form 11.
Date	February 2, 2017.

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear.
Did it fit your curriculum?	The instructions fit the curriculum partially. The law on the loss of energy was not included.
Other remarks	The first part of the material was not applied to the lesson.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	Yes. Part 2 and part 3 took 40 minutes.
Was it easy to pass the information onto students and putting up the task?	Yes, students discussed in small groups the problem-question and had an experimental activity.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Students did self-evaluation after the experiment in Part 2.

In which extent did you reach the predicted aims and outcomes?	After experimental activity students came to the conclusion that if no air resistance is present, the rate of descent depends only on the height the object is dropped down, no matter how heavy the object is. They understood that two objects will reach the ground at the same time if they are dropped simultaneously from the same height.
What was student's reaction/feedback?	Students carried out the experiments with interest especially while using different objects with different surface area.
Was the methodology and materials suitable for the activity?	Yes, especially the display of the vacuum tube.
Could the activity plan be improved? If so, how would you improve it?	No.
Other remarks	The website list provided was really useful.

Country:	Lithuania
School:	Pakruojis 'Atzalynas' Gymnasium
Lesson/subject:	Physics
Level:	Form 3 (17-18 years old)

MAIN STATEMENTS OF MOLECULAR KINETIC THEORY

ICT support, equipment needed

* Book by: P. Peciuliauskiene 'Physics for 11-12th grade. Macro systems' (2012).
* Computer.
* Multimedia.
* Internet.

Teaching aims

Pupils' skills development:

* Interprets macro system's physical conception.
* Increases the knowledge about materials particles (atoms, molecules, ions).

* Analyses interface forces action patterns.

Knowledge and understanding:

* Know macroscopic sizes.
* Identify material particles.
* Know the features of material particles.
* Describe Brownian motion.
* Provide examples of diffusion application.
* Understand the meaning of interface forces.

Learning outcomes

You will get familiar with the molecular kinetic theory while listening to the teacher, with the help of the demonstration and textbook information on the Internet page (http://lietuviu7-8.mkp.emokykla.lt/lt/mo/praktika_ir_kuryba/minciu_zemelapis5/,scenario.23,position.8) all of you will create a 'Mind map'. Moreover, you will learn about the three main statements of the molecular kinetic theory.

Methodology/methods

* Explanation of new material.
* Demonstration.
* Learning together.
* Consultation.
* 'Mind map'.

Lesson phases and timing

Time	Teacher's activity	Students' activities	Methods, forms of work, tasks for students	Means of work, sources of information
1 min.	**Warm-up.** 1. Formulating the problem. 2. Announcing the topic.	Write down the topic. Listen.	Conversation.	Notebook.
15 min.	**I. Explaining the new material.** 1. Concept of the macro system physics. 2. Main statements of molecular kinetic theory. 3. Body structure. 4. Molecular measurements. 5. Molecular movements. 6. Diffusion. 7. Molecular reaction.	Write down the main ideas, definitions. Master theoretical knowledge of the subject. Watch the demonstration. Answers teacher's questions. Remember physics knowledge gained in the 8th grade.	Interpretation. Demonstration.	Textbook. Computer. Multimedia. Internet. Internet link.
20 min.	**II. Consolidation.** 1. Announcing learning tasks. 2. Creating a 'Mind map'.	Do the tasks designed to them. (The selected student sits on front of the computer and others tell him what to type).	Learning together. Consultation. 'Mind map'.	Computer. Multimedia. Internet. Internet link. Textbook. Notebook.
7 min.	**III. Reflection.** 1. Analysing students' composed 'Mind maps'. 2. Coming back to the learning task(s) and examining what students have learned during the lesson.	Answer the questions. Explain definitions.	Conversation (Questions & Answers).	Computer. Multimedia. Internet. Picture.

Time	Teacher's activity	Students' activities	Methods, forms of work, tasks for students	Means of work, sources of information
1 min.	**IV. Evaluation.** 1. Each student evaluates his/her work during the lesson.	Evaluate themselves.	Conversation.	
1 min.	**V. Homework.** 1. # 1.1 in the p. 7. 2. Summary from the textbook. 3. Analysis of the picture.	Mark their homework.		Notebook.

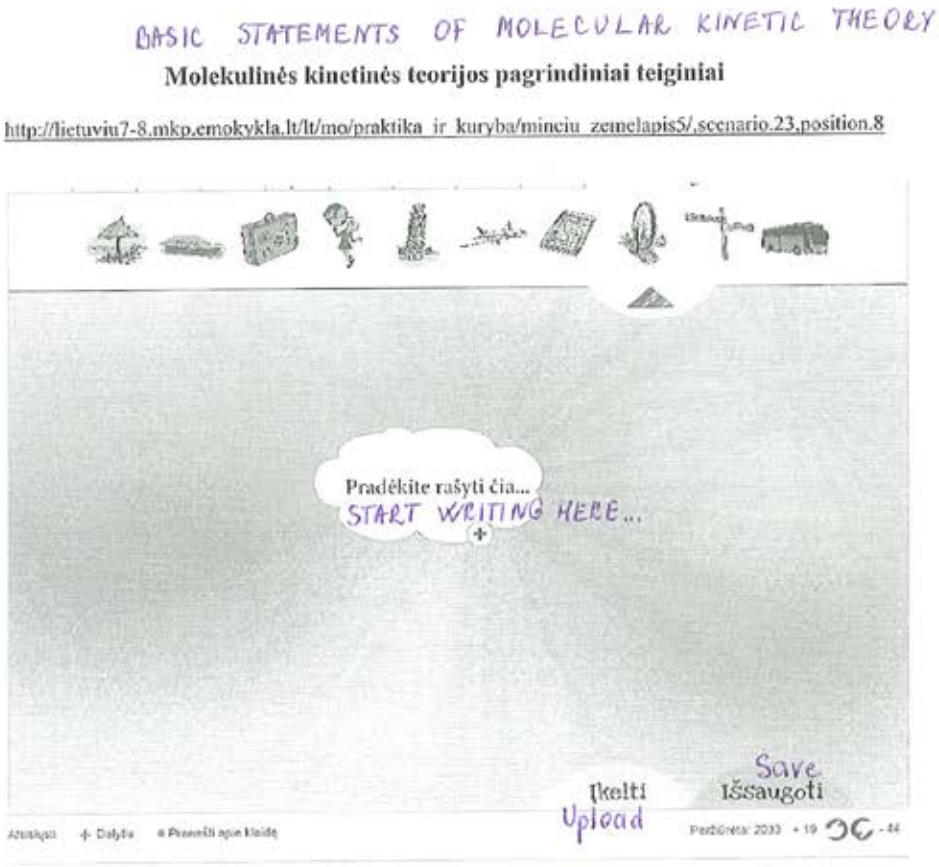
Evaluation/evaluation tools

Each student evaluates his/her work during the lesson – conversation.

Materials/resources, worksheets

* Book by: P. Peciuliauskiene 'Physics for 11-12th grade. Macro systems' (2012).
* For creating the Mind map - demonstration and textbook information on the Internet page (http://lietuviu7-8.mkp.emokykla.lt/lt/mo/praktika_ir_kuryba/minciu_zemelapis5/,scenario.23,position.8) – example Annexes 1 and 2 as separate attachments to this lesson plan.

Annex 1


BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kinetinės teorijos pagrindiniai teiginiai
http://lietuviu7-8.mkp.emokykla.lt/lt/mo/praktika_ir_kuryba/minciu_zemelapis5/,scenario.23,position.8
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START WRITING HERE...
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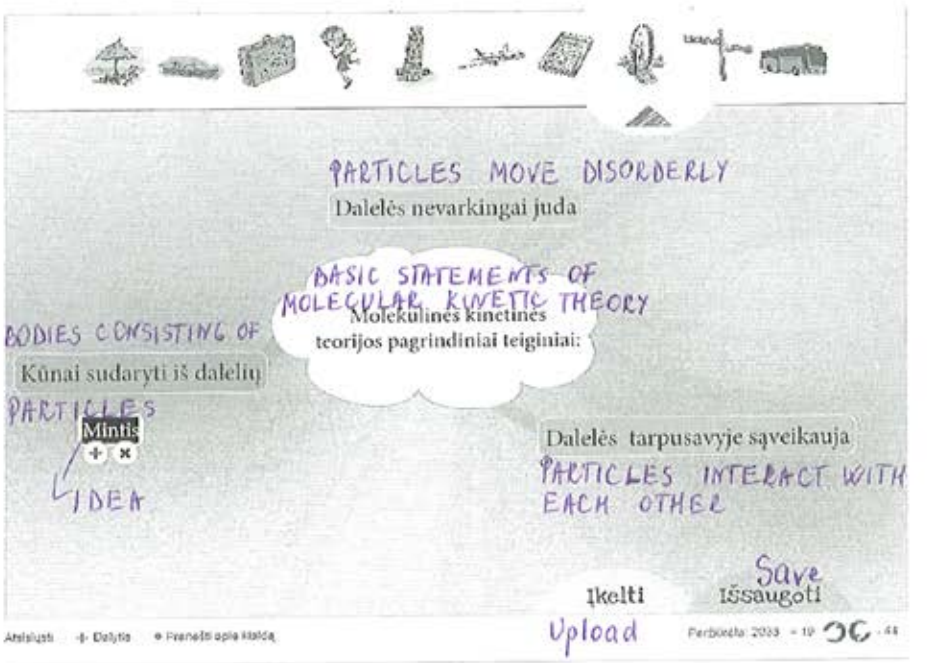
PARTICLES MOVE DISORDERLY
Dalelės nevarkingai juda
BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kinetinės teorijos pagrindiniai teiginiai:
BODIES CONSISTING OF
Kūnai sudaryti iš dalelių
PARTICLES
Minti
IDEA
Dalelės tarpusavyje sąveikauja
PARTICLES INTERACT WITH EACH OTHER
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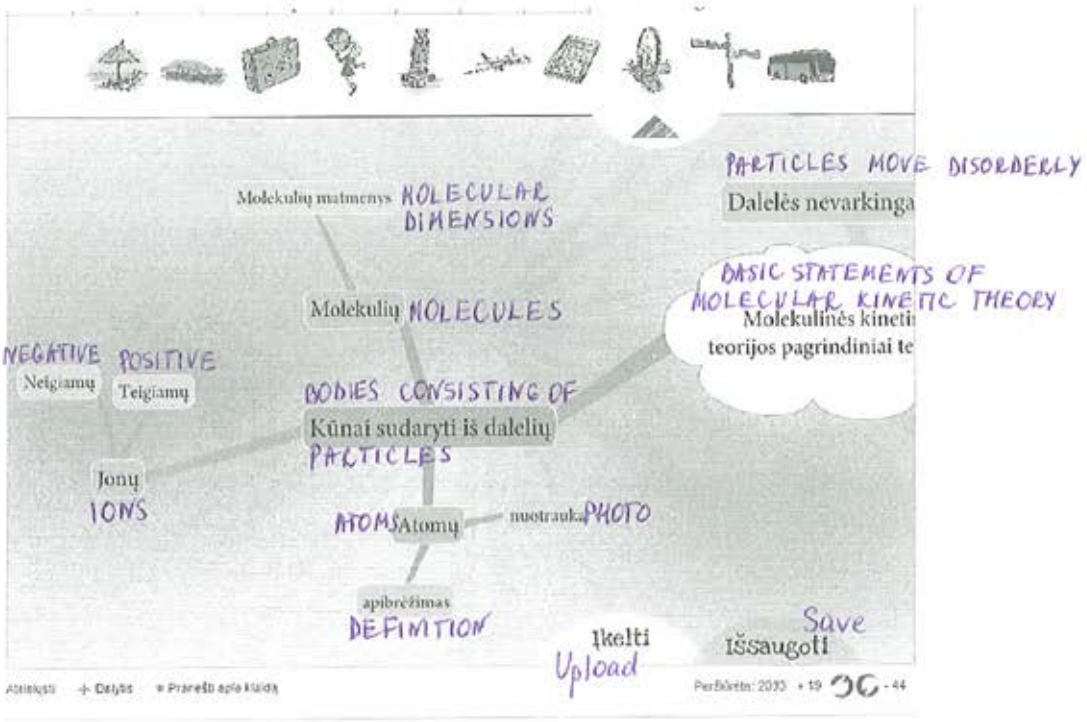
PARTICLES MOVE DISORDERLY
Molekulių matmenys MOLECULAR DIMENSIONS
Dalelės nevarkinga
BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kineti
teorijos pagrindiniai te
Molekulių MOLECULES
NEGATIVE POSITIVE
Neigiamų Teigiamų
BODIES CONSISTING OF
Kūnai sudaryti iš dalelių
PARTICLES
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ATOMS Atomų nuotrauka PHOTO
apibrėžimas
DEFINITION
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Upload
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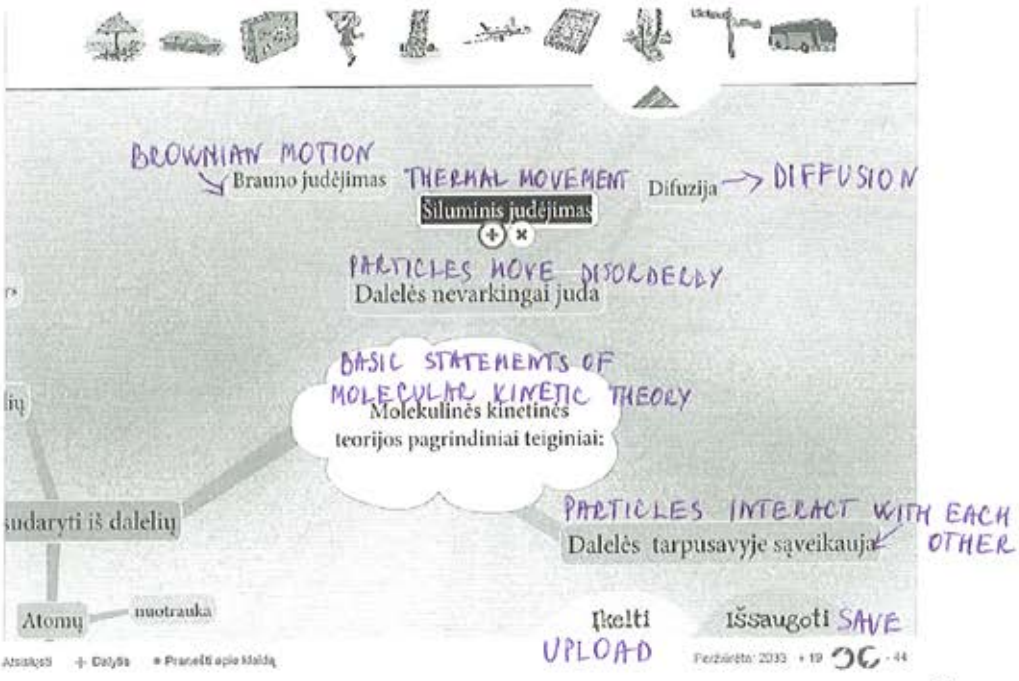
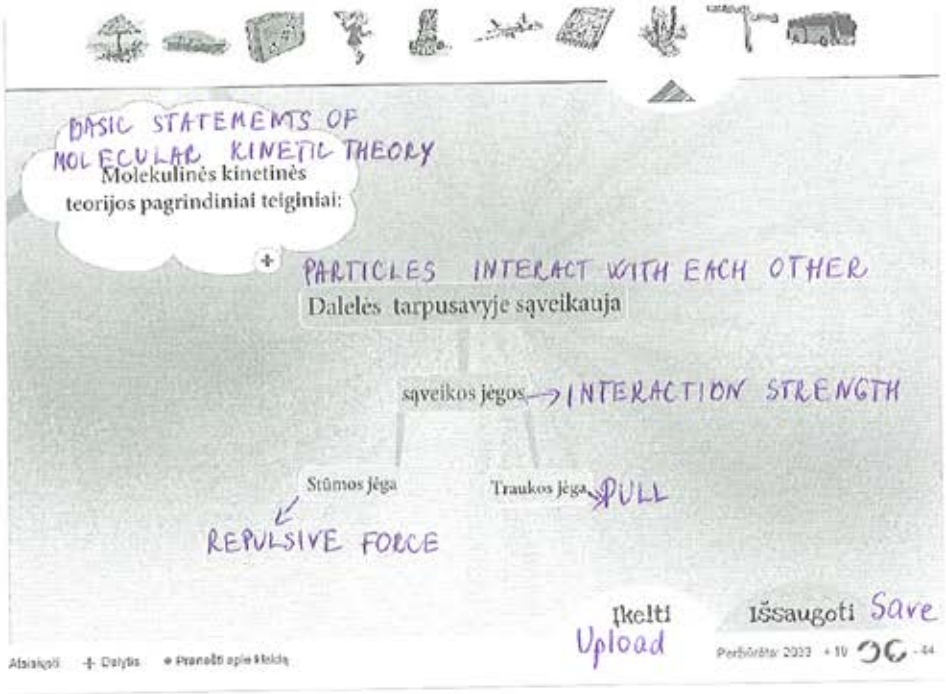
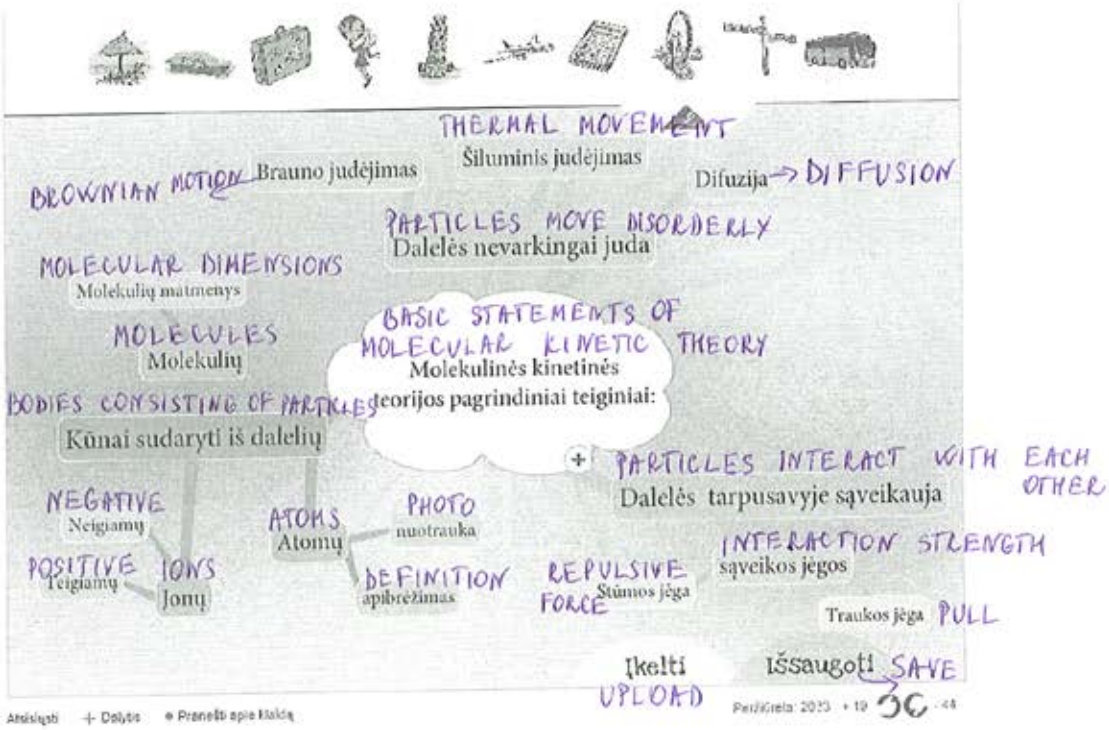
Išsaugoti


BROWNIAN MOTION
Brauno judėjimas
THERMAL MOVEMENT
Šiluminis judėjimas
Difuzija → DIFFUSION
PARTICLES MOVE DISORDERLY
Dalelės nevarkingai juda
BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kinetinės
teorijos pagrindiniai teiginiai:
sudaryti iš dalelių
PARTICLES INTERACT WITH EACH OTHER
Dalelės tarpusavyje sąveikauja
Atomų nuotrauka
Įkelti
UPLOAD
Išsaugoti SAVE


BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kinetinės teorijos pagrindiniai teiginiai:
PARTICLES INTERACT WITH EACH OTHER
Dalelės tarpusavyje sąveikauja
sąveikos jėgos → INTERACTION STRENGTH
Stūmos jėga
Traukos jėga PULL
REPULSIVE FORCE
Įkelti
Upload
Išsaugoti Save


THERMAL MOVEMENT
Šiluminis judėjimas
BROWNIAN MOTION Brauno judėjimas
Difuzija → DIFFUSION
PARTICLES MOVE DISORDERLY
Dalelės nevarkingai juda
MOLECULAR DIMENSIONS
Molekulių matmenys
MOLECULES
Molekulių
BASIC STATEMENTS OF MOLECULAR KINETIC THEORY
Molekulinės kinetinės teorijos pagrindiniai teiginiai:
BODIES CONSISTING OF PARTICLES
Kūnai sudaryti iš dalelių
PARTICLES INTERACT WITH EACH OTHER
Dalelės tarpusavyje sąveikauja
NEGATIVE
Neigiamų
ATOMS
Atomų
PHOTO
nuotrauka
POSITIVE
Teigiamų
IONS
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DEFINITION
apibrėžimas
REPULSIVE FORCE
Stūmos jėga
INTERACTION STRENGTH
sąveikos jėgos
Traukos jėga PULL
Įkelti
UPLOAD
Išsaugoti SAVE

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Physics. Molecular kinesthetic theory
Country where the lesson came from	Lithuania
Country/person who used it	Latvia/physics teacher Ā.Andrejeva
Level/age of students	16-17 years old, Form 11
Date	September 20, 2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear.
Did it fit your curriculum?	Yes, the instructions fit the curriculum.
Other remarks	The Internet resource was offered in Lithuanian therefore it was not used in the lesson.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	Latvian.
Was time enough?	Yes, it was.
Was it easy to pass the information onto students and putting up the task?	The websites such as "Uzdevumi.lv" and "Fizmix.lv" were used in the lesson.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	The homework was given to students. The results were analysed.

In which extent did you reach the predicted aims and outcomes?	Analysing the students' composed 'Mind maps' and coming back to the learning tasks and examining what students have learnt during the lesson.
What was student's reaction/feedback?	Each student evaluated his/her work during the lesson, joined in the conversation with the classmates.
Was the methodology and materials suitable for the activity?	Methodology was suitable.
Could the activity plan be improved? If so, how would you improve it?	This lesson plan could fit the lesson after translating the Internet source and the worksheets in Latvian.
Other remarks	

Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Physics. "Main statements of molecular kinetic theory"
Country where the lesson came from	Lithuania
Country/person who used it	Portugal – chemistry and physics teacher Paula Paiva
Level/age of students	14-16 years old, 10th grade
Date	7 December, 2017 and 4 January, 2018

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear.
Did it fit your curriculum?	Most of the content fitted my curriculum in the context of "Structural units of matter" and "Chemical Bonds".
Other remarks	The Brownian motion was not addressed, because it didn't belong in the curriculum. Also, the website to create a "Mind Map" was in Lithuanian, so the students had some difficulties working on it.
DURING THE LESSON/ACTIVITY	
In which language did you taught the lesson?	English and Portuguese.
Was time enough?	No, the students spent more time than expected doing the "Mind Maps".

Was it easy to pass the information onto students and putting up the task?	Yes, it was. The subject was learned in 8th grade, but with less profundity.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Through the commitment demonstrated in accomplishing the task, and through the analysis and discussion of the Mind Maps.
In which extent did you reach the predicted aims and outcomes?	This task was useful for the students as it helps them to systematize their knowledge.
What was student's reaction/feedback?	All the students were involved in the tasks. They all understood the contents and they enjoyed to do the Mind Maps.
Was the methodology and materials suitable for the activity?	The methodology was suitable.
Could the activity plan be improved? If so, how would you improve it?	This activity plan could be improved by including the simulations on the website https://phet.colorado.edu/en/simulation/atomic-interactions and https://phet.colorado.edu/sims/html/states-of-matter/latest/states-of-matter_en.htmlin
Other remarks	The site for creating the "Mind Map" would have been easier to use if the page was in English.

Country:	Latvia
School:	Balvi State gymnasium
Subject:	Physics
Level:	Primary or secondary school students

SOLAR SYSTEM IN 100 STEPS

ICT support, equipment needed

Information about the solar system may be found on the Internet.

Teaching aims

To strengthen students' knowledge of the solar system, sizes and distances in the solar system.

Learning outcomes

Make models of planets and a solar system model, according to the given measures.

Methodology/methods

Work in groups (pairs).

Lesson phases and timing:

1. The teacher suggests using the scale of 1000 km - 1 cm forming the planet models.
2. Students are divided into groups/pairs and draw a planet (or the Moon and small planets) and the Sun in their group/pair.
3. Using information sources students find diameters of the planets and form the model planet.
4. Groups are presenting their models of the planets.
5. Students examine the distances of the planets to the Sun, choose the appropriate scale for the solar system which is 100 steps.
6. They explore the Solar system objects motion around the Sun.
7. Students go outside (it should be the place bigger than 100 metres) with their made objects. At the beginning of the route place the Sun.

    1 step - Mercury

    1 step - Venus

    1 step - Earth and Moon (finger width space between planets)

    1 step - Mars

    9 steps - Jupiter

    12 steps - Saturn

    25 steps - Uranus

    28 steps - Neptune

    25 steps - Pluto
8. Move the planets.

Evaluation/evaluation tools

Can evaluate the presentation about planets.

Materials/resources, worksheets

Measuring tapes, pencils, felt pens, wires, natural materials, balloons, newspaper, glue, adhesive tape, information sources, the books with tables.

Additional information

The teacher could ask the students to make planet models at home and start the lesson with the planet presentations.

Feedback on the lesson/activity (1)

GENERAL INFORMATION	
Subject and topic	Physics – Solar System in 100 Steps
Country where the lesson came from	Latvia
Country/person who used it	Turkey / Ayşe BOLAT (Physics teacher)
Level/age of students	9th grade (14-15 years old)
Date	10.11.2017

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes, the instructions were clear.
Did it fit your curriculum?	No, it didn't
Other remarks	In Turkey we have this topic during the secondary school curriculum.
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Turkish
Was time enough?	Yes, it was enough.
Was it easy to pass the information onto students and putting up the task?	Yes, it was.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	I have observed the students presentations at the end of the class.

In which extent did you reach the predicted aims and outcomes?	As the subject was already interesting for the students we have reached the satisfying results.
What was student's reaction/feedback?	Because they've already had knowledge about solar system. I had some problems in class management.
Was the methodology and materials suitable for the activity?	Yes, it was.
Could the activity plan be improved? If so, how would you improve it?	We can improve the plan by adding further topics like the phases of the moon, gravitational force etc.
Other remarks	Some of the students were willing to make models of the planets and they are given tasks to make these models for the second term. In short we are very delighted to do this activity although the difficulties and differences.

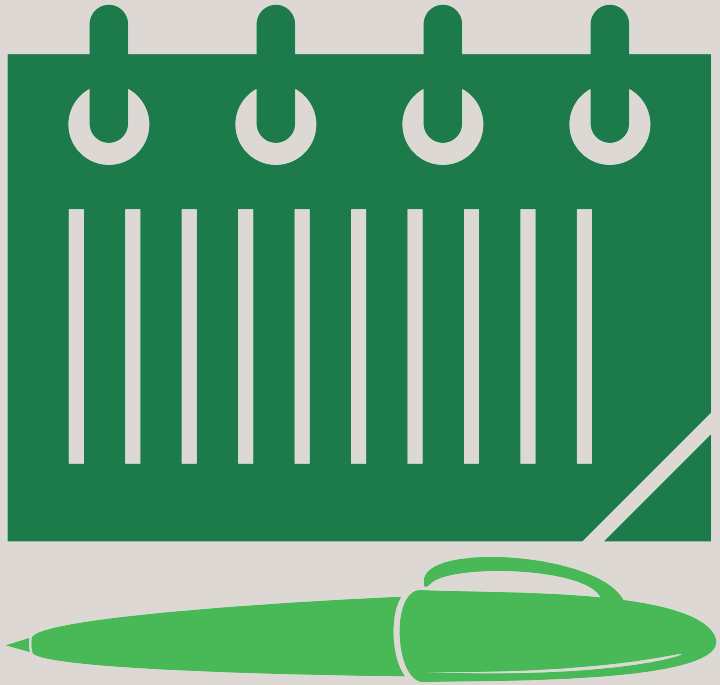
Feedback on the lesson/activity (2)

GENERAL INFORMATION	
Subject and topic	Physics. Solar system in 100 steps method
Country where the lesson came from	Latvia
Country/person who used it	Rasa Bertuliene. Lithuania.
Level/age of students	17-18 years
Date	2017-05-10

BEFORE THE LESSON/ACTIVITY	
Were instructions enough/ clear?	Yes. Instructions, lesson plan and activities were clear.
Did it fit your curriculum?	According to the curriculum we will have astronomy next year.
Other remarks	
DURING THE LESSON/ACTIVITY	
In which language did you teach the lesson?	Lithuanian.
Was time enough?	We worked on this topic for two lessons and were short of time.
Was it easy to pass the information onto students and putting up the task?	At first I explained why we are doing it, later we were making models of the planets and their position in space.
AFTER THE LESSON/ACTIVITY	
How did you do the evaluation?	Each student got a mark to the register for this project.

In which extent did you reach the predicted aims and outcomes?	The project was successful. Students made models of the planets and represented the solar system.
What was student's reaction/feedback?	Everybody worked hard. Students liked making models . It was not difficult to stand according to 100 steps model, but it was difficult to move in circles according to the scale.
Was the methodology and materials suitable for the activity?	The material was suitable, but I think it is more useful for younger students.
Could the activity plan be improved? If so, how would you improve it?	The activity plan is suitable.
Other remarks	

PROJECTS



MATHS DAY

The Maths Day is an important event organized by Maths and Science teachers of the Primary and Secondary School in Uggiate Trevano, Italy. The aim is to motivate pupils to study these subjects in a practical way, using laboratories, games and a creative teaching methodology.

MATHS AND CARD GAMES
Children learn how to play cards and make calculations and strategies for winning. **Activities:** learning and playing card games.
CREATIVE MATHS GAMES
This workshop is dedicated to recreational maths and mind games. You can try a lot of classic recreational maths games such as puzzles, magic tricks, strange situations… **Activities:** playing some recreational maths games.
MATHS AND GEOGRAPHY
Pupils play various orientation games and think of geographic problems about maps. **Activities:** paths to follow and draw; maps painting game.

MATHS AND MUSIC

Here you can discover how to make simple mathematical compositions with musical notes and listen to some music composed with special mathematical principles.

Activities: making rhythmical composition, listening to canon melodies, composing a minuet with dices.

MATHS AND ORIGAMI

In this workshop children realise simple origami using geometry words (name of shapes, angles, symmetry axis, …)

Activities: realising origami

MATHS AND COOKING

This is a special workshop of the Maths day! Children make some cocktails, sweets and fruit sticks using recipes, doses, measures and calculations.

Activities: eating, drinking and…having fun!

MATHS AND HANDICRAFT

Pupils make some bracelets and necklaces using geometrical patterns following the rhythm of colours.

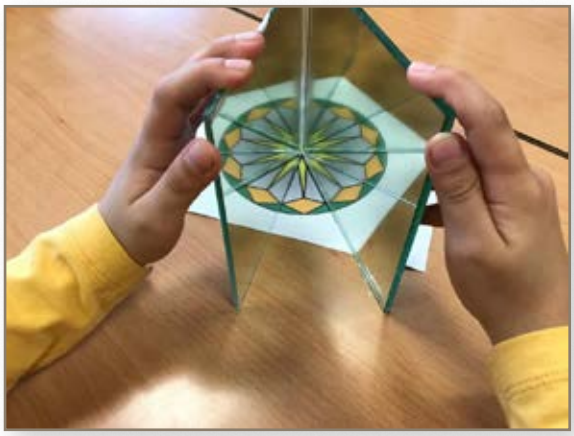
Activities: making your own bracelet, necklace.

MATHS AND ART (ROSE WINDOWS)

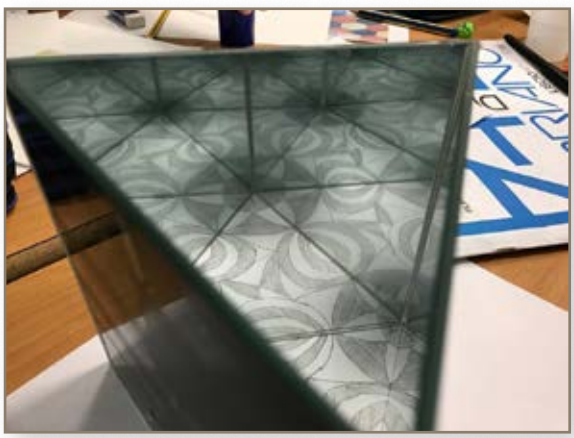
Maths in art: using mirrors and exploring rose windows and mandala.

Activities: creating or reproducing rose windows using mirrors.










SCIENCE FAIR

During our projects' third teaching and learning mobility in Turkey. Relevant to the proposal made for the Project, We have organized a Science Fair at our school with 20 projects which our students prepared. Having agreed earlier , Our Erasmus plus Project partners brought their projects to present during our Science Fair. It brought an international dimension to our Fair and students from our partner countries had a chance to meet and collaborate with Turkish students.

TUBİTAK 4006 Science Fair is organized to encourage the secondary school students to perform research in the fields of Natural and Social Sciences (mathematics, physics, chemistry, biology, computer sciences, geography, history and sociology) to direct their research and support their individual progress.

The Requirements needed to be involved in the Fair

1. Be secondary school students from Turkey or Turkish Republic of Northern Cyprus
2. Each student can apply with only 1 project and each project can be prepared by a maximum of 2 students.
3. Each project can be observed by only 1 adviser. An adviser can contemporaneously consult more than 1 project. Having adviser within projects however is not a necessity.
4. Projects are prepared according to the 'Project Guide'.
5. Applying or participating contestants with the same or similar projects in different project contests before the deadline of this Contest cannot apply.

6. Contestants participating in “Energy Productivity Projects Contest” with the same project cannot apply.

Application Period: January and/or February

Awards :

1. Medals and Certificates
2. Additional points to the National University Examination for successful students for the first time of their entering the exam
3. Students of successful projects can be sent to international project contests as representative of TÜBİTAK.
4. Successful students in international project contests can claim a place in the State Universities without taking the National University Examination.
5. Successful students in international project contests, who are placed in the fields of Natural Sciences at the Universities, are directly fellow of the National Undergraduate Scholarship Program.

BIOLOGY DAYS

This project could be organized for students in your school or for an international group of students. It may be organized for four groups of students and the topics of each experiment could be different (the descriptions of the experiments below have been provided by teachers of Pakruojis Atžalynas Gymnasium).

The aim of the project

* To encourage students to become interested in science.

The expected results

* During the project, pupils will develop their creativity, foreign language communication skills and working in a group competences, improve the skills of data collection, systematization, analysis and formulation of conclusions.

* In experiments with laboratories Nova 5000 and LabMate, they will improve their computer literacy skills. They will develop their theoretical knowledge and apply it in practice.

Experiment 1

Determination of the Amount of Vitamin C in Different Types of Juice

Objectives:

1. To determine the concentration of the vitamin C using the iodometric titration method.
2. To compare the concentration of the vitamin C in different types of juice.
3. To compare the concentration of the vitamin C in manufactured juice and fresh juice.

Equipment and materials:

* Burette;
* Measuring flask;
* Conical flask for titration;
* Chemical glasses;
* Pipettes;
* Distilled water;
* Dish for washing;
* Laboratory stand;
* Funnel;
* Magnetic stirrer;
* 0,01 M I_3 solution;
* 3 M HCl solution;

* 1% starch kleister;
* Different types of fresh juice;
* Different types of manufactured juice.

Workflow:

1. We wash the burette with iodine solution twice and fill it in with iodine solution till 25 ml's mark.
2. Using the pipette we pour 20 ml of the prepared juice to conical flask.
3. Using the pipette we add 20ml of distilled water.
4. Using the pipette we add 5 drops of 3 M HCL.
5. Using the pipette we add 10 drops of starch solution.
6. We are dripping iodine solution from the burette till we see the blue colour that stays for at least 20 seconds.
7. When we titrate, the solution is being mixed with magnetic stirrer.
8. We measure the volume of titrated iodine solution.
9. We repeat the titration three times with all kinds of juice.

The data of vitamin C concentration

1. We write the titration data for fruit juice in the table.

The capacity of hit out iodine solution

Types of juice	I Titration, ml	II Titration, ml	III Titration, ml	Average value, ml
Fresh orange juice				
Manufactured orange juice				

Types of juice	I Titration, ml	II Titration, ml	III Titration, ml	Average value, ml
Fresh grapefruit juice				
Manufactured grapefruit juice				
Fresh tomato juice				
Manufactured tomato juice				

2. We calculate the concentration of vitamin C in all types of juice.

The concentration of vitamin C is calculated by equivalent terms, mol/l.

$$V_1 \times C_1 = V_2 \times C_2;$$

The meanings of symbols:

V_1 - hit out iodine solution capacity.

V_2 - juice capacity taken for titration.

C_1 - concentration of iodine solution.

C_2 - concentration of vitamin C in juice.

$$C_2 = \frac{V_1 \times C_1}{V_2}$$

The concentration of vitamin C is calculated by equivalent terms, which is expressed in mol/l. Units used in the food industry are mg/100ml.

3. We recalculate the concentration of vitamin C into the units which are adopted in the food industry (mg/100ml of juice).
4. We write the results of the calculation in the table.

The concentration of vitamin C in different types of juice

Type of juice	Concentration of the vitamin C, mol/l	Concentration of the vitamin C, mg/100ml
Fresh orange juice		
Manufactured orange juice		
Fresh grapefruit juice		
Manufactured grapefruit juice		
Fresh tomato juice		
Manufactured tomato juice		

5. We draw 3 column diagrams:

* The concentration of the vitamin C in all types of fresh juice;
* The concentration of the vitamin C in all types of manufactured juice;
* The concentration of the vitamin C in both manufactured and fresh juices.

Conclusions:

1. The comparison of the concentration of the vitamin C in different types of juices.
2. The comparison of the concentration of the vitamin C in different types of manufactured and fresh juice.
3. The capacity of the juices that match the daily norm of the vitamin C.

Determination of pH in different types of juice

Objectives:

1. To learn how to use the sensors and to learn how to determine pH by using NOVA 5000 laboratory.
2. To decide which type of juice has the biggest and the lowest pH.
3. To compare pH in manufactured juice and fresh juice.

Equipment and materials:

* NOVA 5000 laboratory and pH sensors;
* Chemical glasses;
* Different types of fresh juice;
* Different types of manufactured juice;
* Distilled water;

* Dish for washing.

Workflow:

1. We fill in the chemical glass with 50 ml of juice.
2. We turn on NOVA 5000 laboratory.
3. We put pH sensor into the chemical glass with juice.
4. We keep doing the measurement till the pH graph stops changing.
5. We save the data.
6. We wash the sensor by using distilled water.
7. Using this method we measure pH in all types of juice.
8. We write the results into the table.

pH in different types of juice

Type of juice	pH
Fresh orange juice	
Manufactured orange juice	
Fresh grapefruit juice	
Manufactured grapefruit juice	
Fresh tomato juice	
Manufactured tomato juice	

Conclusions:

1. We decide which kind of juice is the most acidic.
2. We decide which juices are more acidic – manufactured or fresh.

Experiment 2

Exploration of Pectin Operation Conditions

Theoretical introduction

Pectin is a natural polysaccharide, water soluble fiber, contained in apples and other fruits, in almost all berries, juicy vegetables. It is abundant in carrots, radish, beets, tomatoes, currants, apricots, plums, quinces, oranges, strawberries.

In the food industry pectin is used as a thickener for the production of jam and marmalade.

Pectin improves digestive function, reduces cholesterol levels in the blood. The digestive enzymes do not decay pectin, it is metabolised by intestinal microflora. So pectin is like a prebiotic - nutritional bacterial substance. By increasing the viscosity and volume of the intestinal contents, pectin reduces constipation, stimulates bowel movements, absorbs toxins and helps to remove them. Therefore, it is an essential for a healthy diet. With a daily consumption of 500 g of fruit, the body receives about 5 g of pectin.

The enzyme pectinase breaks down the pectin. It forms in some fruits under natural conditions. When making fruit or vegetable purée, squeezing juices pectinase is used to increase the yield of the final product and improve its consistency.

Pectinase-producing bacteria are used to separate flax, hemp, jute fibers more quickly from wood.

Pectin is one of the materials, which constitutes plants cells walls. It puts cells together and provides stiffness for tissues. The amount, composition and structure of pectin depends on the plant species and age. They differ between separate parts of the plants. When fruits mature, pectin breaks down between the cells, cells separate and the fruit softens. There is a lot of pectin in bananas, oranges, grapefruits, peaches, plums and some vegetables.

The pectin degradation is catalysed by an enzyme - called pectinase. Destruction of pectin in fruit cell walls stimulates the release of juices. This quality of pectinase is used in industry for bigger yield, also in wine production, because pectinase provides limpidity for wine. By the amount of juice it is possible to determine, how active pectinase is and this depends on different conditions. There are also inhibitors in plant cells, which slow down enzymes activity. That's why in apple juice production, apple puree is held in air for about half an hour, for inhibitors oxidation to happen. After that, when the temperature is 300 C, pectinase is added to the puree.

Work course

1. Weigh 0.2 g of enzyme pectinase. Pour into 50 ml measuring flask, pour a little of distilled water, dissolve and pour water till 50 ml lower meniscus.
2. Weigh 1 g of sugar and 1 g of citric acid. Weigh 5 bits of 50 g of the same kind of apples, equally crush them and pour 8 ml of pectinase solution in the first four flasks and 50 ml of distilled water in all five, mix everything:

    2.1 Leave the first mix for control

    2.2 Heat the second mix till $+40^0$ C

    2.3 Add 1 g of sugar to the third mix

2.4 Add 1 g of citric acid to the fourth mix

2.5 Fifth mix is only distilled water and apples

3. Mix and wait for 30 min, after that pour the mixes into funnels with filters and watch the filtration course for 25 min. Every 5 min. write down the volume of juices.

Laboratory work results

In detail describe work and observations.

Laboratory work conclusions

Draw a graphic, showing the juice release speed dependence on the temperature and medium composition.

Submit, how it is possible to customize this experiment practically.

Annex 1

Influence of temperature and medium on enzyme pectinase activity

Aim:

To investigate the influence of temperature, edible salt, sugar, citric acid on the enzyme pectinase activity.

Description of the laboratory work

Materials and tools:

1. Apples – 250 g
2. Pectinase – 0,2 g
3. Citric acid – 1 g

4. Sugar – 1 g
5. Water – 250 ml
6. Measuring cylinders 100 ml - 5 pcs.
7. Funnels – 5 pcs.
8. Knife – 1 pcs.
9. Grater – 1 pcs.
10. Scales – 1 pcs.
11. Measuring flask 50 ml – 1 pcs.
12. Pipette 10 ml – 1 pcs.
13. Glass rod – 5 pcs.
14. Thermometer – 1 pcs.
15. Heating device - electrical tile – 1 pcs.
16. Gauze filter – 5 pcs.
17. Chemical glasses 100 ml – 5 pcs.
18. Plastic teaspoons – 5 pcs.
19. Plates – 5 pcs.
20. Syringe 2,5 ml – 1 pcs.

Work course

1. Weigh 0.2 g of enzyme pectinase. Pour into 50 ml measuring flask, pour a little of distilled water, dissolve and pour water till 50 ml lower meniscus.

2. Weigh 1 g of sugar and 1 g of citric acid. Weigh 5 bits of 50 g of the same kind of apples, equally crush them and pour 8 ml of pectinase solution in the first four flasks and 50 ml of distilled water in all five, mix everything:

   2.1 Leave the first mix for control

   2.2 Heat the second mix till $+40^0$ C

2.3 Add 1 g of sugar to the third mix

2.4 Add 1 g of citric acid to the fourth mix

2.5 Fifth mix is only distilled water and apples

3. Mix and wait for 30 min., after that pour the mixes into funnels with filters and watch the filtration course for 25 min. Every 5 min. write down the volume of juices.

Laboratory work results

In detail describe work and observations.

Laboratory work conclusions

Draw a graphic, showing the juice release speed dependence on the temperature and medium composition.

Submit, how it is possible to customize this experiment practically

Experiment 3

Synthetic and Natural Dyes

Work purpose:

To investigate the influence of natural and synthetic dyes on fabrics.

Tools and materials:

Pots, fabrics, gloves, stove, vinegar, vegetables, colourful drinks, onion husks, eggs, scissors, cotton pads, sweets. Tools for painting on hands with natural extracted paints.

Work process:

1. Preparation of work place. Paint separation.
   1.1 The work place is covered.
   1.2 Fresh plants, from which we will produce paint, are crushed and soaked in soft warm water. They are welded in the same water. We take off the leak and pour into the dyeing dish.
   1.3 We press juice from other plants.
2. Colouring materials and colour fixation.
   2.1 Place the material in a pre-heated solution of chemicals up to 40° C stir and boil for 15-20 minutes. After that paint.
   2.2 We put the materials into the paint and boil them. The longer the colour is stored, the darker it will be.
3. Drying.
   3.1 We dry it at room temperature.
4. Paint on hands with natural paints.
5. Artistic presentation of the work.
6. Results and discussion

Experiment 4

Cell as the Basis of Life - Photosynthesis Reaction Rate Dependence on Light Intensity

Knowledge and perception

Describe photosynthesis as a process which happens in plant cells when light energy is used to synthesise organic molecules. Link

this usage of organic molecules with plant growth, the formation of new cells, cellular respiration and nutrient storing.

Link light intensity with plant growth

Theory justification of the experiment

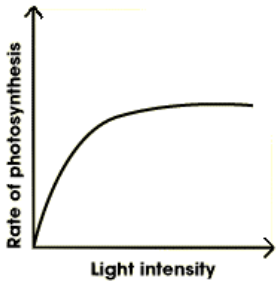
Chloroplasts - The main role of chloroplasts is to conduct photosynthesis, where the photosynthetic pigment chlorophyll captures the energy from sunlight and converts it and stores it in the energy-storage molecules ATP and NADPH while freeing oxygen from water.

Photosynthesis - is a process used by plants and other organisms to convert light energy into chemical energy that can later be released to fuel the organisms' activities. It is largely responsible for producing and maintaining the oxygen content of the Earth's atmosphere, and supplies all of the organic compounds and most of the energy necessary for life on Earth. Light intensity, temperature and concentration of CO_2 are important factors of photosynthesis.

Factors affecting photosynthesis

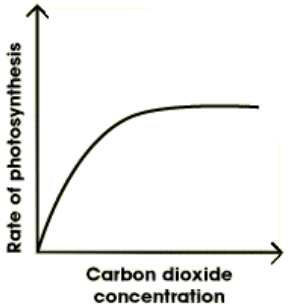
Three factors can limit the speed of photosynthesis: light intensity, carbon dioxide concentration and temperature.

Without enough light, a plant cannot photosynthesise very quickly, even if there is plenty of water and carbon dioxide. Increasing the light intensity will boost the speed of photosynthesis.

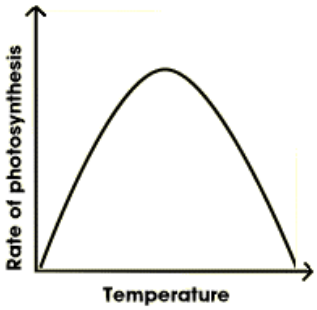


Sometimes photosynthesis is limited by the concentration of carbon dioxide

in the air. Even if there is plenty of light, a plant cannot photosynthesise if there is insufficient carbon dioxide.



If it gets too cold, the rate of photosynthesis will decrease. Plants cannot photosynthesise if it gets too hot.



Mini Experiment No.1

Examination of gas released during the process of photosynthesis

Objective:

Examine the gas that is released during the process of photosynthesis.

Hypothesis:

During the process of photosynthesis plants release oxygen.

Requirements:

* A few branches of an aquatic plant
* Test tube
* Ruler
* Light source (120 watt halogen bulb)
* Baking soda solution
* Crystallising dish
* Funnel

Procedure:

* Make a baking soda solution (add 50 grams of baking soda per 1000 ml of water).
* Fill the crystallising dish with the solution.
* Put a few branches of water plant under the funnel and put it in the crystallising dish. (As shown in the picture).

* Put the test tube filled with water on the funnel.
* Put the crystallising dish 50 centimetres away from the light source.
* The test tube will be full of gas when there will be no water left in it.

* Take of the test tube off while leaving it underwater and then put your thumb over the top of the test tube and take it out from the crystallising dish.
* Put a smoldering piece of wood in the test tube.
* If the wood stars to burn, that means there is oxygen in the test tube.

Mini Experiment No.2

Photosynthesis rate dependency on the light intensity

Problem statement:

Illuminated plant cells forms organic molecules and releases oxygen.

Objective:

Examine how light intensity affect photosynthesis speed.

Hypothesis:

If the intensity of light is greater, then the rate of photosynthesis increases.

Requirements:

* A few branches of an aquatic plant
* Beaker
* Ruler
* Light source (120 watt halogen bulb)
* 1 litre bottle full of water
* Laboratory Nova 5000
* Temperature and oxygen sensors

* Distilled water
* Rubber cork (for oxygen and temperature sensors)

Procedure:

* A few branches of an aquatic plant are kept in a big beaker full of distilled water.
* Put the 1 litre bottle between the beaker and the light source to avoid change of the temperature.
* Turn on laboratory Nova 5000.
* Connect oxygen sensor to the 1st input and temperature sensor to the 2nd input of the laboratory Nova 5000.
* Put oxygen sensor in the beaker with the plant.
* Put temperature sensor in the bottle with distilled water.
* Choose data capturing every one second (make 500 points).
* Make a mark on a table every 10 cm starting from a light source. Place the lamp 50 cm away from the beaker. Allow the plant to adjust to the light intensity for a couple minutes.
* Change the distance to 60, 70, 80, 90, 100 cm and repeat every experiment three times.
* Write the results.

Number of repetitions, Oxygen concentration mg/L	Distance from the light source, cm					
	50	60	70	80	90	100
1						
2						
3						
Average						

* Submit the results graphically.

Conclusion:

As light intensity decreases (distance between lamp and plant increases) the volume of oxygen (or the rate of bubble production) decreases. This indicates that the rate of photosynthesis decreases with light intensity.

Do the same experiment with Nova 5000, but now put the aquatic plant in baking soda solution.

Objective:

Examine photosynthesis speed dependency on baking soda concentration.

Hypothesis:

Process of photosynthesis will be faster in baking soda solution than in distilled water. Requirements, Procedure and data capture is the same as in the previous experiment, but now you need to make a baking soda solution and put the water plant in it. To make a good baking soda solution you need to add 10 grams of baking soda per 200 ml of water.

Write the results.

Number of repetitions, Oxygen concentration mg/L	Distance from the light source, cm					
	50	60	70	80	90	100
1						
2						
3						
Average						

Mini Experiment No.3

Photosynthesis rate dependency on the light wavelength

Objective:

Examine how visible (white), green and blue coloured-light affect photosynthesis speed.

Hypothesis:

Process of photosynthesis will be the most intensive under the visible (white) light.

Requirements:

* A few branches of an aquatic plant
* Beaker
* Ruler
* Light source (120 watt halogen bulb)
* Baking soda solution
* 1 litre bottle full of water
* Laboratory Nova 5000
* Rubber cork (for oxygen and temperature sensors)
* Temperature and oxygen sensors
* Blue screen
* Green screen

Procedure:

* A few branches of an aquatic plant are kept in a big beaker full baking soda solution (you need to add 10g. of baking soda per 200ml of water).
* Put the 1 litre bottle between the beaker and the light source to avoid change of the temperature.
* Turn on laboratory Nova 5000.
* Connect oxygen sensor to the 1st input and temperature sensor to the 2nd input of the laboratory Nova 5000.
* Choose data capturing every one second (make 500 points).
* Put the oxygen and temperature sensors in the beaker.
* Put the beaker and the screen 1 meter away from the light source.
* Write the results.

Number of repetitions, Oxygen concentration mg/L	Distance from the light source, cm
	100
Visible light	
Blue light	
Green light	

* Submit the results graphically.

Do the simulation of this experiment in the Nova 5000.

Number of repetitions, Oxygen concentration mg/L	Distance from the light source, cm
	100
Visible light	
Blue light	
Green light	

* Submit the results graphically.
* Compare both graphs.

Questions:

* Which colours of the light plants absorb the best?
* What is the length of those light waves
* What frequency are those waves?
* Can plants perform photosynthesis using infrared or UV light?
* What would happen to vegetation if the sun suddenly stopped shining?

ABOUT SCHOOLS

BALVI STATE GYMNASIUM

Balvu Valsts ģimnāzija

278 students (forms 7-12, aged 13-18/19) study in Balvi State Gymnasium and the staff consists of 42 teachers. There are 16 class groups – 9 forms on primary level and 7 ones on secondary level. In 1930 the school was established as Balvi Town Gymnasium but in 2009 it was renamed Balvi State Gymnasium. The process of learning is based on the students and teachers' respect to each other.

Balvi State Gymnasium offers the following educational programs:

On primary education level (forms 7-9) students can choose 3 study programs:

1. The second stage of elementary education program
2. The second stage of elementary education program with a focus on the humanities and social sciences (with in-depth studies of the English language)
3. The second stage of elementary education program with a focus on mathematics, natural sciences and technologies (with in-depth studies of mathematics and science subjects)

Students are offered 4 programs **on secondary level (forms 10-12)**:

1. Arts and social sciences education program, educational program with a focus on mathematics, natural sciences and technologies,

2. Educational program with a focus on mathematics, natural sciences and technologies (with sub-program in computer design)
3. General education track.

Students and teachers have at their disposal light-filled, inviting and comfortable classrooms, a computerized library and reading rooms, 2 computer classrooms, state of the art science equipment, and organized sports opportunities. The school employs and offers the services of a psychologist and a social pedagogue, as well as Support group. The teachers are creative in their work and share their experience with the teachers of the district as the school is the Methodological center of the district. The school has a good cooperation with other schools of the neighbouring districts and with state gymnasiums of the country. One may refresh ones memories in the school's museum, or in the graduates' lounge. Guided by the school's experienced and qualified pedagogues, students are ensured a thorough education that will prepare them well for future academic studies.

There is at least one student from every class represented in the Students' Council. The Council plans and organizes different activities at school to make the students' life at school more interesting. Apart from good achievements in their studies, the students are active at sports and get the first places in different competitions in the country, they are good at art and music as well.

Traditional school events are: Knowledge Day, Teacher's Day, Parents' Days, Christmas Celebration, Introduction to Gymnasium Day, The Day of Gratitude to the students and their parents.

Contact details:

Contact person:	principal Inese Paidere
Phone number (school):	+37126419648, +37164522053
E-mail (school):	bpg@balvi.lv
Webpage:	www.bvg.lv

COMPREHENSIVE SCHOOL OF UGGIATE-TREVANO

Istituto Comprensivo di Uggiate-Trevano

The school is situated near the border with Switzerland, some distance from big cities like Milan but not far from places of touristic interest like Como lake. Uggiate-Trevano is a small town with a population of about 4,500 inhabitants. Being an area quite close to Switzerland, the highly developed industrial area north of Milan attracted a lot of migrant workers especially from the southern and eastern parts of Italy. In recent years the migrant workers have been joined by workers from other less-developed part of Europe(Ukraine, Romania, Albania) and from Northern Africa . The majority of pupils come from traditional families, but the number of pupils coming from atypical family background (divorce or single-parent or extended families) is increasing.

In the Primary school there are 290 pupils , in the Middle school 285 with a total of 70 teachers.

The students of the Secondary School learn English and German. After school clubs have been organized in order to improve conversation in both the foreign languages. The school of Uggiate-Trevano has always been interested in exchanges with students from European countries, also because the town has been twinned with a German town (Adelsdorf) for more than 15 years and with a French town (Ruaudin) for almost two years, and has been in contact with other European countries (Latvia, Lithuania, Estonia, Malta and Poland).

Uggiate-Trevano School has been experiencing different methods of teaching Science and Maths :

- In the Primary School pupils and Maths teachers organize the Pi-Day , this year they have organized different laboratories dedicated to the most important Mathematicians in our history and they have presented their work to parents and people of our community; in the secondary school a Science day has been organized by teachers and students of the secondary school to be presented to pupils of the primary school . Teachers always try to present works of reality to their pupils in order to teach the subjects in a more practical and motivating way. They have also created a blog where they put and explain all their works
- In the Secondary School teachers have experienced CLIL : English teachers and Maths/ Science/Technology teachers prepare lessons in English about various topics: astronomy, geology, the food-chain, about reusing and recycling, etc. Students do excursions on the territory to study the habitat and do experiments. They have also built a Greenhouse and planted some seeds and trees in the garden of the school.
- All the works are showed to the students' parents and to the community at the end of the school year on the occasion of the "Open Day".

The teachers of the school are always open to find new strategies of teaching and learning in order to motivate students even the weakest ones. Teachers of Uggiate-Trevano Institute like to work in team, have ICT skills and are open-minded and communicative.

Contact details:

Contact person:	Lorella Bencastro
Phone number (school):	+39 031 948997
E-mail (school):	coic83300v@istruzione.it
Webpage:	www.icuggiatetrevano.gov.it

PAKRUOJIS "ATŽALYNAS" GYMNASIUM

Pakruojo ,,Atžalyno" gimnazija

Pakruojis "Atžalynas" gymnasium is located in the Northern part of Lithuania. At the time Gymnasium is providing education for 308 students 1-4 classes (aged 15-19). There are 12 class groups. The institution is the only purified gymnasium in Pakruojis district. Education is provided by highly qualified teachers. 39 teachers are working in the Gymnasium. 19 of them have a teacher methodologist qualification category, 14 of them have a senior teacher category. There is also a social educator, a psychologist, 3 deputy heads and a headmaster.

Formal and non-formal education is provided in the gymnasium. Moreover, the institution is able to supply a formal Adult Education Program (the 2nd part of Basic Education and Secondary Education). The gymnasium has a natural science mobile laboratory, a well equipped gym, each classroom is provided with multimedia equipment. There are 2 computer classrooms. Students from Pakruojis town and nearby rural areas are educated in gymnasium which also has a dormitory. The school has 2 buses, so students have possibilities to go to educational trips, olympiads, contests, excursions. A great variety of non-formal education is being carried out in fields such as art, music, dance and

sports. School choir, boys` ensemble and folk dance groups are recognized in the country. We also have a Drama club, a Journalist club and an orchestra.

Teachers of our gymnasium are active participants of various projects, seminars, qualification training courses and community cultural events. To reach better results teachers use various innovative methods and their experience from different projects. The science teachers have great experience in using the natural science mobile laboratory and involving students in a learning process creatively. The teacher of Maths is experienced in creating a learning environment through utilization of technology. Some teachers were participants of international Adult Education projects. Educators also organise seminars for teachers of the district and country. Each year our gymnasium organises MADI (a national mathematicians` contest) with active participation of University lecturers. Also our gymnasium participated in a national project of media and information literacy. Gymnasium community has participated in international Comenius Project "The wealth of health, taste and culture" LLP-COM-DP-2011-LT-00066.

Contact details:

Contact person:	Kęstutis Razumas
Phone number:	+370 42152257
E-mail:	administracija@atzalynas.net
Webpage:	www.atzalynas.net

MERSIN CAMBER OF SHIPPING VOCATIONAL AND TECHNICAL ANATOLIAN HIGH SCHOOL

Mersin Deniz Ticaret Odası Mesleki ve Teknik Anadolu Lisesi

MDTO Vocational and Technical Anatolian High School is in Mersin Province on the south-Mediterranean coast of Turkey. The school is situated close to the harbour in Akdeniz district that turned to be attractive for the migrant families from neighbourhood cities for better economic and social conditions.

We have 320 students between the ages of 14-18 and a staff of 28 people. The students are accepted according to a central exam and physical performance exam before entering the school. They are uniformed and quite smart students. At MDTO Vocational and Technical Anatolian High School, general studies are provided to the students in addition to the

vocational lessons to prepare the students for higher education opportunities. We receive students for "machine" "ship deck" branches under marine education.

There are both general subjects on the curricula as well as the vocational ones. The graduates get into a job in accordance with their branches or study further for higher education. We have two separate buildings for education activities at school. The first one is the building of General subjects (Foreign language, Literature ,Maths ,Physics , Chemistry,Biology,Geography,Physical Education ,Guidance etc...)and the other one is Workshop building which is used for practicing vocational studies for our students. Our school has been giving education for four years. After graduation, students may attend to a two-year higher schools or can go to universities of their own field.

We would like to discover the other regions and will offer a new perspectives of outside world and good school based learning environments which are very important for the development of qualified European labour force in future.

As school we are experienced in projects. We have a Leonardo Da Vinci Project Partnership with 10 more countries on Counselling -Guiding services for the students. (http://careforvet.eu/). Project based learning contributed towards us to develop knowledge and understanding among students and educational staff of the diversity of European cultures and languages and its value; and to help young people acquire the basic life-skills and competences necessary for their personal development, for future employment and for active European citizenship and mostly of all to be proud of being European.

Our coordinator is a teacher of language and has participated in workshop in Italy for " CLIL (Content and Language Integrated Learning)" Workshop and has quite fluent language skills and coordinated a EU school project coordinated by Germany on Guidance System. The teacher has a quite sense of student friendly activities and has experience in editing and publishing the school magazine .

All of the key persons involved in the project take the responsibility of to developing institutional capacity via national and international projects to collect and report data related to the project. They have the ability to organize, work and cooperate in an international learning event, good command in using English, share their personal and institutional experience at large, have the networking skills and open to communication.

Contact details:

Contact person:	Özgür Ali NUR
Phone number:	+90 324 2339899
E-mail:	denizcilik33@gmail.com
Webpage:	http://mersinadml.meb.k12.tr

DANIEL SAMPAIO SECONDARY SCHOOL

Escola Secundária Daniel Sampaio

Escola Secundária Daniel Sampaio is the head unit of a public educational organization (Agrupamento de Escolas Daniel Sampaio) which includes 7 different units/schools from kindergarten to upper secondary school, with more than 3000 students, and a centralized administration and management.

ES Daniel Sampaio, on its own, has more than 1000 students and 100 teachers, and it's located in the southern suburban area of Lisbon (being though part of its metropolitan area) in the administrative region of Almada, with 175 000 inhabitants, working on economic sector of services far more than in industry or agriculture, with a constant growing population, near a seaside touristic area.

The school offers regular secondary courses (aimed to pursue university studies) in the areas of Natural and Economical Sciences, Humanities and Technologies, as well as 3 vocational courses on Tourism, ICT and Children Care, which match the needs of the local job market and using a network of local companies to provide students with a good in-job training. School also offers counselling to students on job and career guidance provided by the school psychologist

and through some formal and informal protocols with local enterprises and universities.

Either for ratings above the average on national rank of high school final exams, or for the quality and diversity of educational experiences provided to its students, the institution have been having, for several years in a row, more applying students than it can handle, which is, nevertheless, the best sign school project and management is leading to the right direction.

Being one of its major dimensions on school policies, Escola Secundária Daniel Sampaio has been building its internationalization for the last 15 years through:

* Multilateral partnerships with 12 different countries in the frame of former Socrates, Comenius and currently Erasmus+ KA2, covering working subjects from citizenship, to innovation and science;
* Bilateral partnership with schools from Hungary, Netherlands, Belgium and Germany for students exchanges – 20 students during two weeks (one in each country), which are very popular among students and parents and one of the reasons students claim to apply to ES Daniel Sampaio.

All these international programs are fully documented on school's European Club website: www.clubeuropeu.wordpress.com.

ES Daniel Sampaio has also a long tradition in sciences, which is reflected by the number of students applying for this branch of high school studies. Having a long-term partnership with the neighbour university (www.fct.unl.pt) its students and teachers often participate both in programmes and contests organized by the university, having won recently a first prize nationwide.

Joining these two fields of its expertise – international experience and vocation for sciences – it was more than suitable for school purposes and development to be part of SMiLES in 2016. This project allowed school, for the first time, to engage directly English speaking science teachers (Maths, Biology and Physics) in an international partnership. It also made possible

to engage, with a smaller or a broader scope of involvement, more than 100 science students from 10th to 12th grade. Most of them were the target of the lesson plans provided by other countries and tested in class, mostly in English language. A smaller part of them apply to take part in learning events organize by the schools of Italy, Lithuania and Turkey, being chosen, through an open competition, by their academic, communication and language skills.

In this learning/teaching events, students and teachers could experience in a more intensive way what the project was about, preparing the meeting, being able to give there their contribution and sharing the experience afterwards, being the best testimonies to motivate other students.

Thus, the school was certainly enriched by being an active part of this project, and no doubt it opened the way for new challenges to come.

Contact details

Contact person:	Fernando Rebelo
Phone number:	+351 212 945 650
E-mail:	direcao@ae-danielsampaio.pt
Webpage:	http://ae-danielsampaio.pt

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