



# Young physicists' tournament

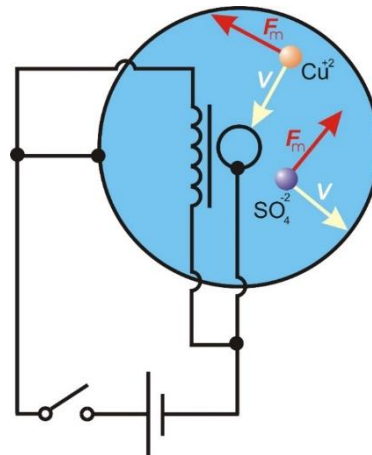
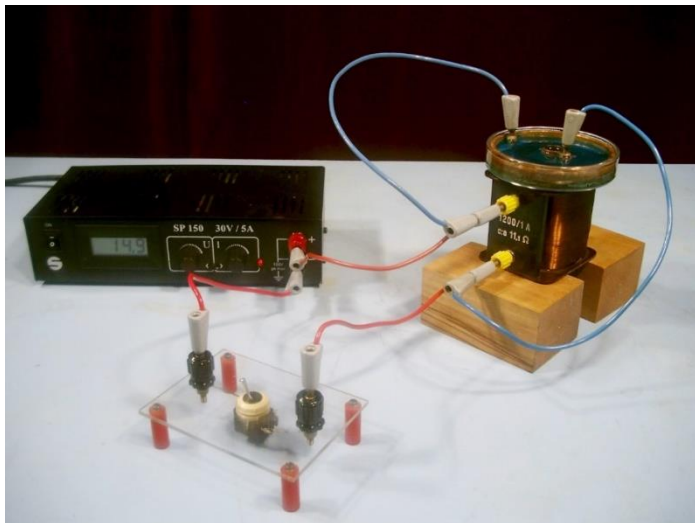
## Turnaj mladých fyzikov

Marián Kireš



# Magnetic Force in an Electrolyt

A shallow vessel contains a liquid. When an electric and magnetic field are applied, the liquid can start moving. Investigate this phenomenon and suggest a practical application.



**Marián Kireš, Zuzana Ješková**

The Physics Teacher ♦ Vol. 45, January 2007

[DOI: 10.1119/1.2409511](https://doi.org/10.1119/1.2409511)



# Ice freezes again

A wire with weights attached to each end is placed across a block of ice. The wire may pass through the ice without cutting it. Investigate the phenomenon.





# Gaussian cannon

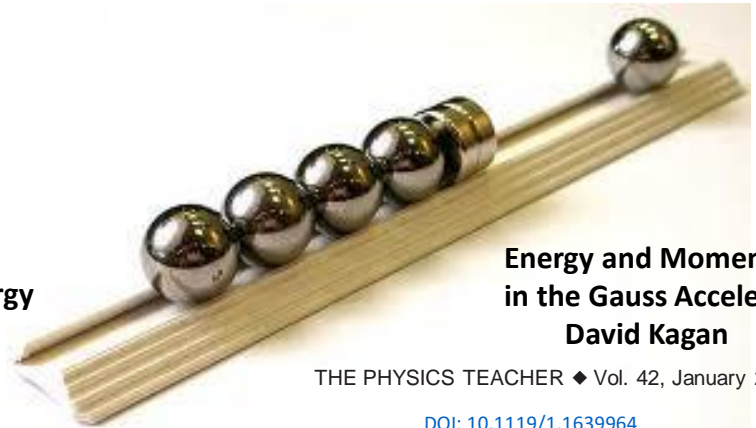
A sequence of identical steel balls includes a strong magnet and lies in a nonmagnetic channel. Another steel ball is rolled towards them and collides with the end ball. The ball at the opposite end of the sequence is ejected at a surprisingly high velocity. Optimize the magnet's position for the greatest effect.

## The Gauss Rifle and Magnetic Energy

James A. Rabchuk

THE PHYSICS TEACHER Vol. 41, March 2003

DOI: [10.1119/1.1557504](https://doi.org/10.1119/1.1557504)



## Energy and Momentum in the Gauss Accelerator

David Kagan

THE PHYSICS TEACHER ♦ Vol. 42, January 2004

DOI: [10.1119/1.1639964](https://doi.org/10.1119/1.1639964)

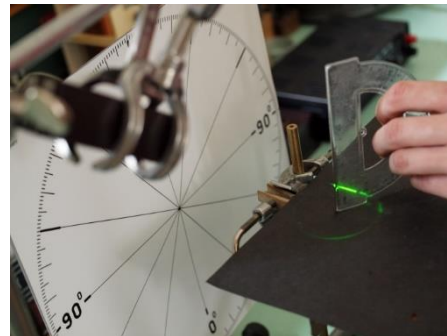
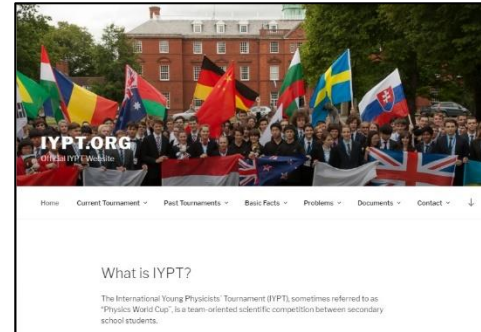


# What made us interested..

- <http://iypt.org>

## International Young Physicists' Tournament

- is a team-oriented scientific competition
- secondary school students
- original solutions to scientific problems
- 17 problems are formulated by the International Committee
- scientific discussions, called Physics Fights





# What made us interested...

## Stage regulations

## Physics Fight

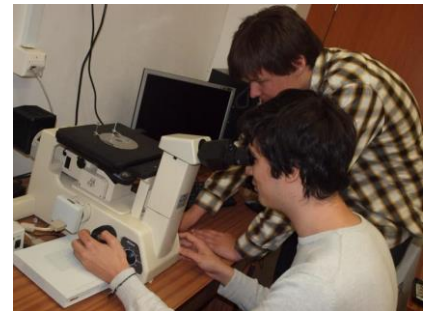
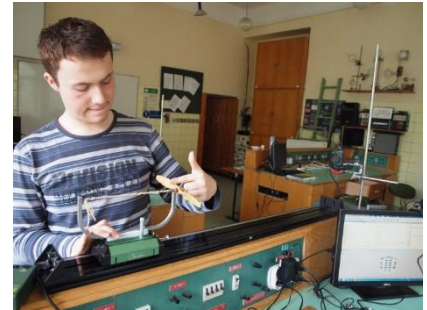
The Opponent challenges the Reporter for the problem	1
The Reporter accepts or rejects the challenge	1
Preparation of the Reporter	5
<b>Presentation of the report</b>	<b>12</b>
<b>Questions of the Opponent to the Reporter and answers of the Reporter</b>	<b>2</b>
Preparation of the Opponent	3
<b>Discussion between the Reporter and the Opponent</b>	<b>14</b>
<b>The Opponent summarizes the discussion</b>	<b>1</b>
<b>Questions of the Reviewer to the Reporter and the Opponent and answers to the questions</b>	<b>3</b>
Preparation of the Reviewer	2
<b>The Reviewer takes the floor</b>	<b>4</b>
<b>Concluding remarks of the Reporter</b>	<b>2</b>
Questions of the Jury	5





# ... why do we still enjoy it?

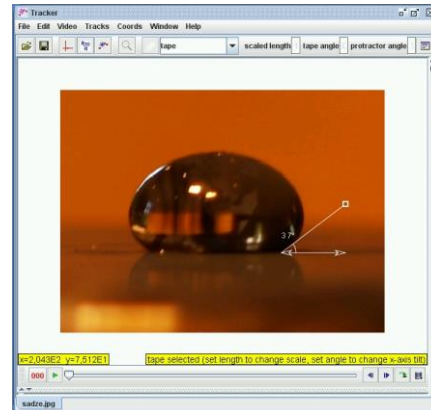
- working with passionate students
- increasing interest in physics study
- own professional development
- topics for university education
- cooperation with schools
- teacher training
- involvement of students - future teachers





# Challenges hidden in the tournament

- What strategy of task solution to implement?
- How to manage team preparation?
- What we know today that our students do not know, and perhaps we do not know either 😊
- How to get inquiry approach into teaching physics?







# Challenges hidden in the tournament

## What strategy of task solution to implement?

### How we understood the assignment

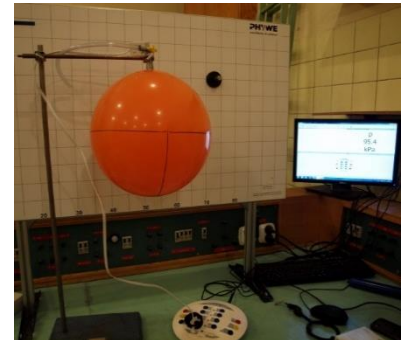
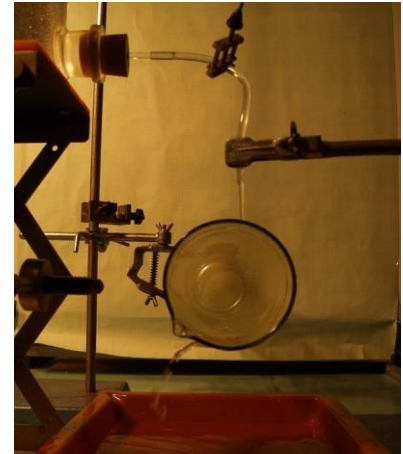
- meaning of all terms
- what we see as part of the possible solution

### Physical principle of task

- basic terms and their explanation
- physical relations, explanation of quantities
- description of physical processes
- theoretical approach.

### Demonstration of the experiment

- initial experiment
- video, photo documentation





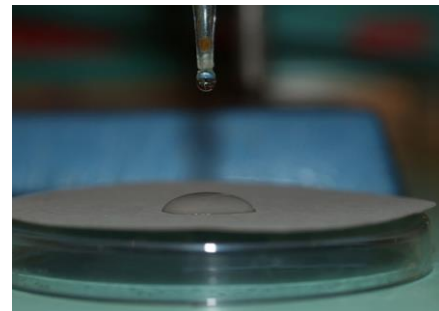
# Challenges hidden in the tournament

## Description of apparatus

- measurement principle
- basic instruments and their wiring
- measured quantities, measurement accuracy
- measurement errors
- outputs of recorded data

## Our realized measurements

- overview of measured dependencies
- data tables
- graphs
- photo, video, computer simulation





# Challenges hidden in the tournament

## Comparison of measurements with theory

- a brief reminder of the theory
- comparison of theoretical and experimental data
- conclusions - theory vs. experiment
- justification for deviations
- suggestions for possible improvements



## Interesting facts, use in practice

## Summary of results

## Preparation of the scientific debate

- formulation of questions,
- factual argumentation
- possible directions of discussion
- reporter, opponent, reviewer





# Challenges hidden in the tournament

## How to manage team preparation?

- Regional Initial meeting
- Work of school team
- Cooperation with university
- Regional tournament
- National tournament
- Open Austria tournament
- National selection camp
- Preparation of national team members
- International tournament





# Challenges hidden in the tournament

## How to manage team preparation?

- **Type of meetings**
- Tournament promotion and recruitment
- **Tournament regulations and task division**
- Training of newcomers
- **Initial brainstorming meeting**
- Active problem solving
- **Training Figth**
- Self evaluation of team members
- **Creation of representing team**
- Partnership with consultant

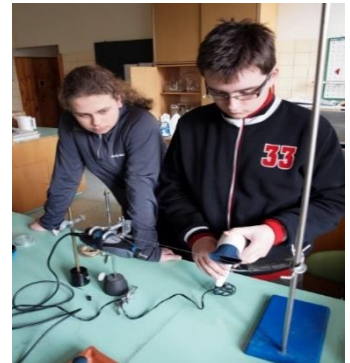




# Challenges hidden in the tournament

**What we know today that our students do not know,  
and perhaps we do not know either 😊**

- Ask questions that can be verified by experiment
- Propose an examination procedure
- To formulate a hypothesis
- Argue and hold a professional discussion
- Model and use models
- Solve new problems independently



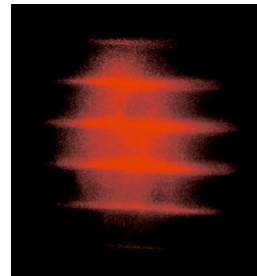
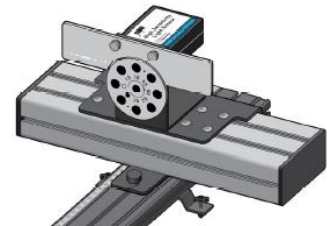
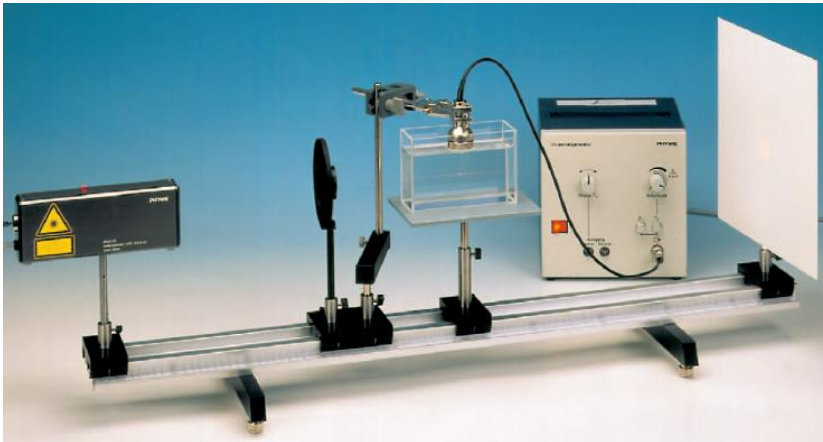


# Challenges hidden in the tournament

## How to get inquiry approach into teaching physics?



Use the **light** to measure the **speed of sound** in the **liquid**.





# Astroblaster - Bouncing balls

## How to get inquiry approach into teaching physics?

### Bouncing balls

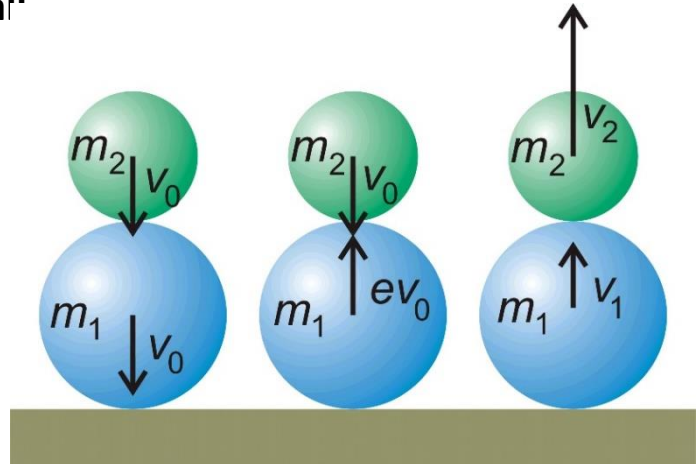
When a **large ball** is dropped, with a **smaller one stacked on top** of it, onto a hard surface, the **smaller ball** will often **rise much higher** than it would if dropped onto the same surface by itself.

Astroblaster—a fascinating game of multi-ball collisions

Marián Kireš

Physics Education, Volume 44, Issue 2.

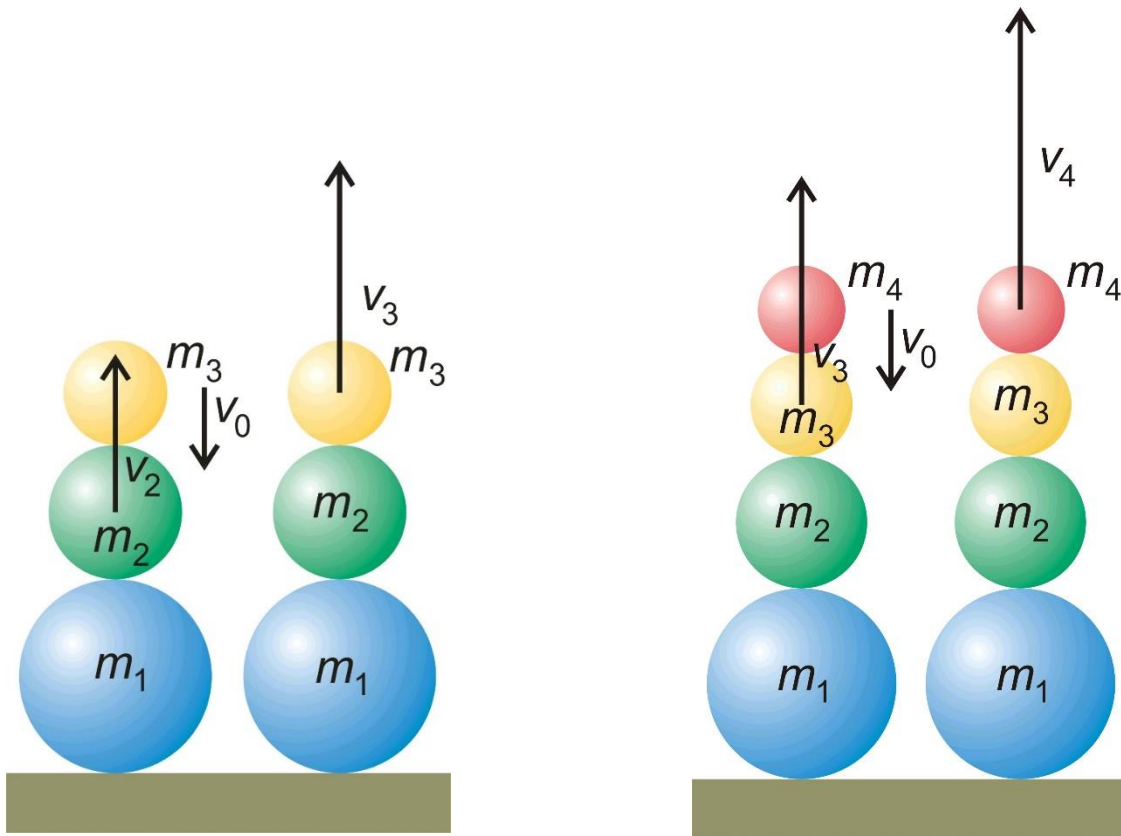
[DOI:10.1088/0031-9120/44/2/007](https://doi.org/10.1088/0031-9120/44/2/007)





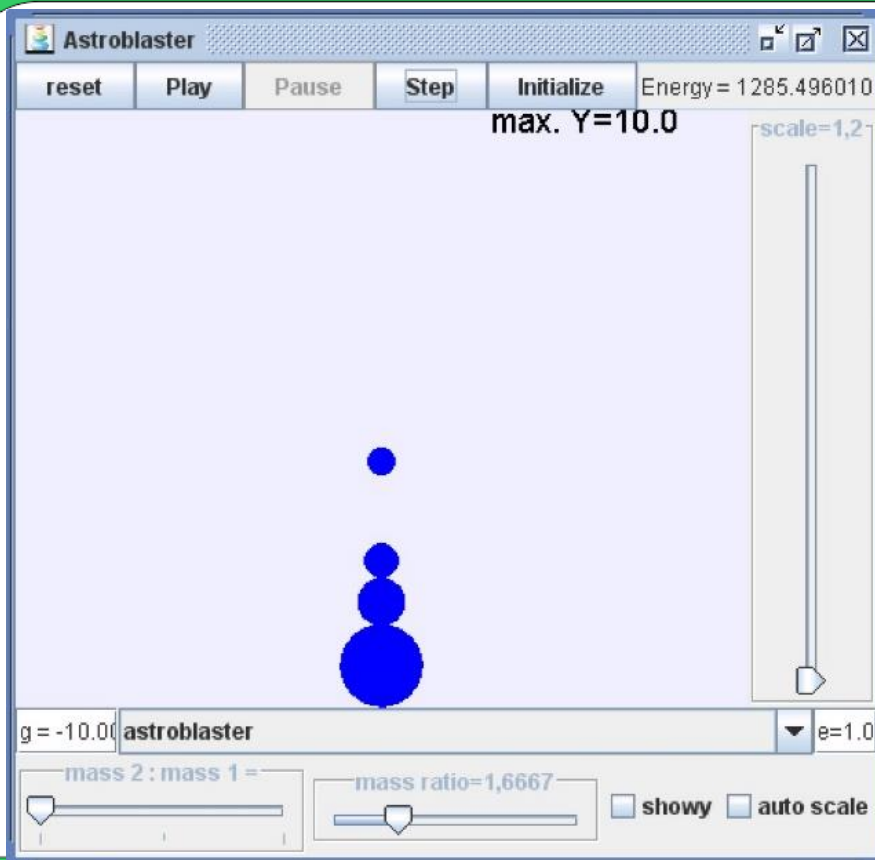


# Astroblaster - Bouncing balls





# Astroblaster - Bouncing balls



$$m_1 = 3m_2$$

$$m_3 = \frac{1}{2}m_2$$

$$m_4 = \frac{3}{5}m_3$$

$$h_4 = 16h_0$$



# Challenges hidden in the tournament

## How to get inquiry approach into teaching physics?

### Presentation and argumentation skills training

### Young non-physicists' tournament

#### Topics from everyday life

#### Simplified rules

#### Fights

#### Designer clothes

High-quality branded clothing is more expensive than quality but non-branded goods. At the cost of designer clothing, it is possible to obtain several pieces of similar clothing. Recommend students branded or unbranded goods.

#### Rush time

Why don't we have time for anything and do everything in a hurry? Arrange time-stealing factors by performance.



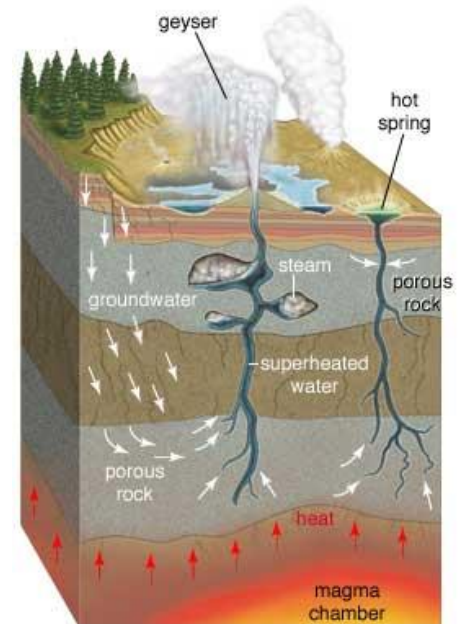
# Challenges hidden in the tournament

## How geyser works

Support a long, vertical tube containing water.

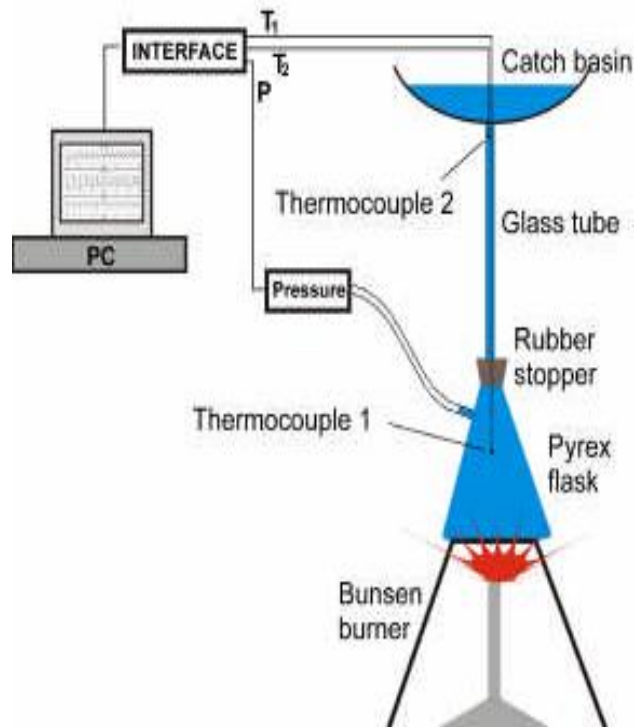
Heat the tube directly from the bottom and you will observe that the water erupts. Arrange for the water to drain back into the tube to allow repeated eruptions.

Investigate the parameters that affect the time dependence of the process.



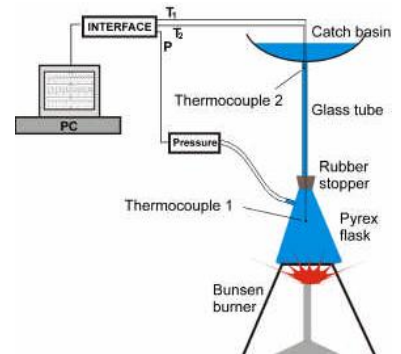
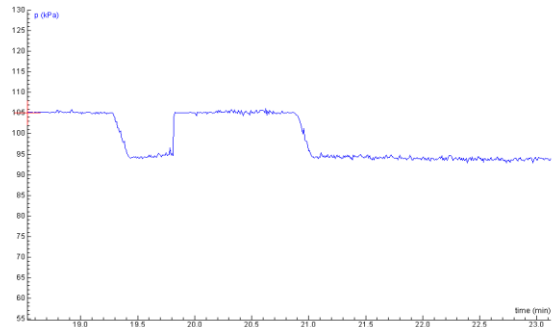
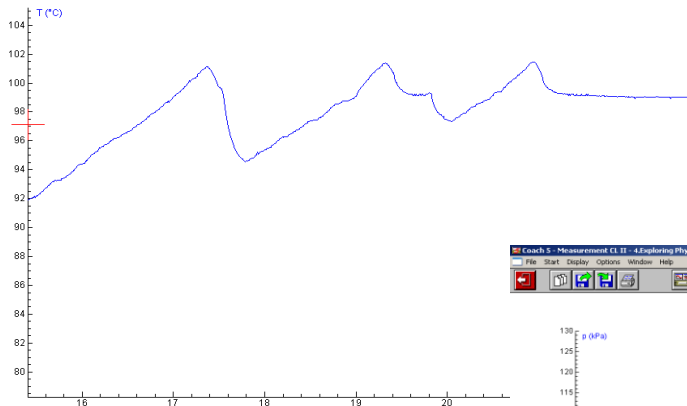


# Challenges hidden in the tournament





# Challenges hidden in the tournament





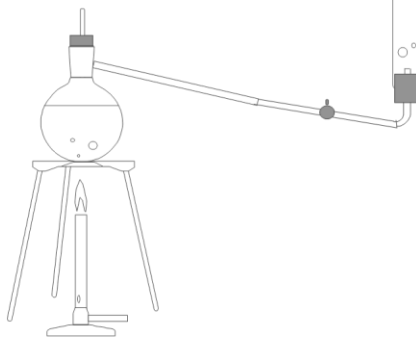
# Challenges hidden in the tournament

## Heat and temperature

A tube passes steam from a container of boiling water into a saturated aqueous salt solution.

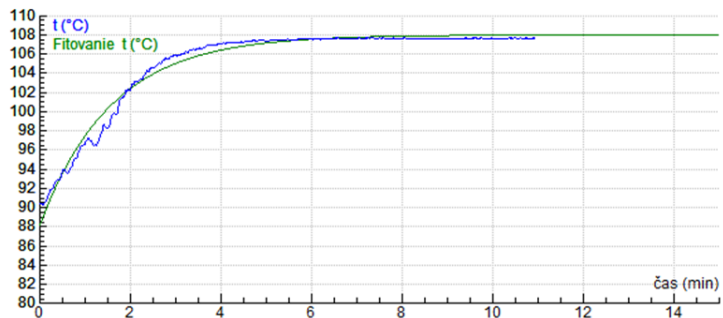
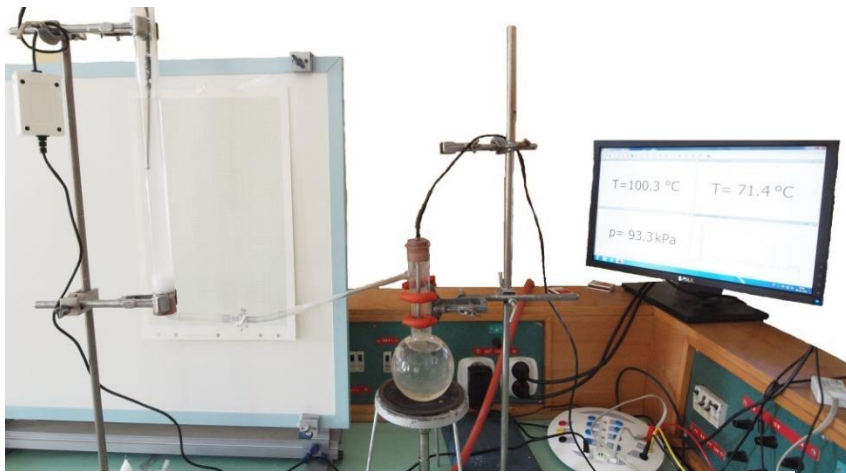
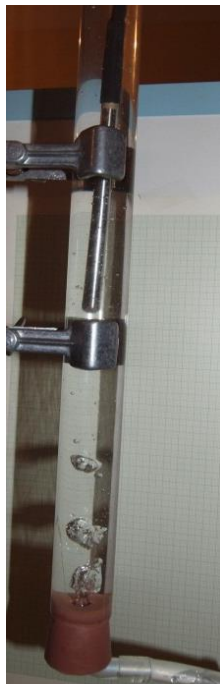
Can it be heated by the steam to a temperature greater than  $100^{\circ}\text{C}$ ?

Investigate the phenomenon.





# Challenges hidden in the tournament



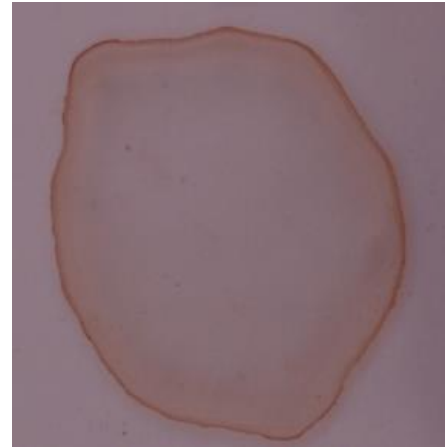




# Challenges hidden in the tournament

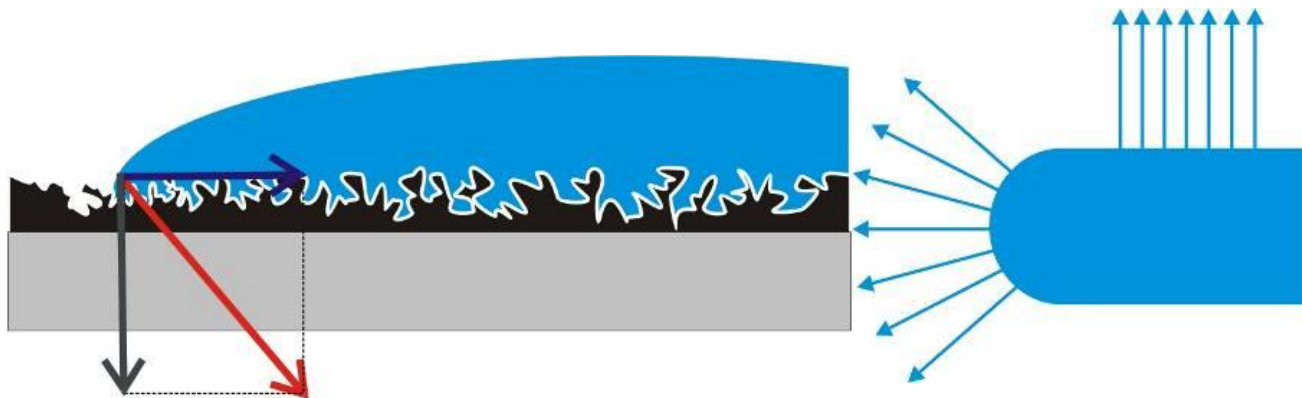
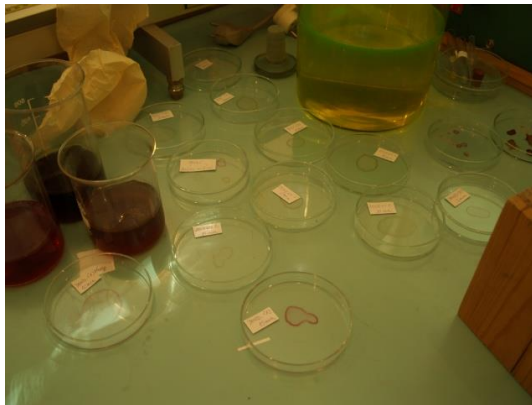
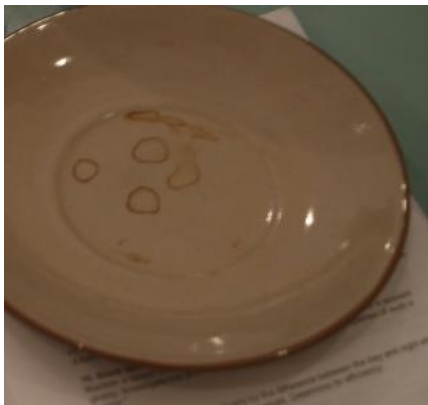
## Liquid stain

When a drop of liquid such as coffee dries on a smooth surface, the stain usually remains at the edge of the drop. Investigate why the stain forms at the edge and what parameters affect the characteristics of the stain.





# Challenges hidden in the tournament





# What secondary school students can solve

## Vacuum bazooka

A 'vacuum bazooka' can be built with a simple plastic pipe, a light projectile, and a vacuum cleaner.

Build such a device and maximise the muzzle velocity.





# Vacuum bazooka



$$v_n = \sqrt{\frac{2 \cdot ((p_a - p_i) \cdot S - m \cdot g \cdot f_s) \cdot d}{m}}$$



# Teacher professional development

## The teacher's role as an expert on:

- subject matter
- technical devices and apparatus
- designing of experiment
- planning observations
- collecting data
- data analysis and interpretation
- time management
- team coach
- competition strategy
- human resources
- ...

Why don't you join us?