



Chemistry and Industry for Teachers in European Schools

FORENSIC CHEMISTRY

Criminal riddle

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Education and Culture

Socrates
Comenius

CITIES (*Chemistry and Industry for Teachers in European Schools*) is a COMENIUS project that produces educational materials to help teachers to make their chemistry lessons more appealing by seeing the subject in the context of the chemical industry and their daily lives.

The CITIES project is partnered by the following institutions:

- Goethe-Universität Frankfurt, Germany, <http://www.chemiedidaktik.uni-frankfurt.de>
- Czech Chemical Society, Prague, Czech Republic, <http://www.csch.cz/>
- Jagiellonian University, Kraków, Poland, http://www.chemia.uj.edu.pl/index_en.html
- Hochschule Fresenius, Idstein, Germany, <http://www.fh-fresenius.de>
- European Chemical Employers Group (ECEG), Brussels, Belgium, <http://www.eceg.org>
- Royal Society of Chemistry, London, United Kingdom, <http://www.rsc.org/>
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- Nottingham Trent University, Nottingham, United Kingdom, <http://www.ntu.ac.uk>
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- Institut Químic de Sarrià, Universitat Ramon Llull, Barcelona, Spain, <http://www.iqs.url.edu>

Other institutions associated to the CITIES project are:

- Newcastle-under-Lyme School, Staffordshire, United Kingdom
- Masaryk Secondary School of Chemistry, Prague, Czech Republic
- Astyle linguistic competence, Vienna, Austria
- Charles University in Prague, Prague, Czech Republic



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CRIMINAL RIDDLE

Teaching Method

A group of students is sitting in a circle. They should be able to see and hear each another. The teacher gives each student a strip of paper containing a single clue – all of the strips contain different information. The task for the group is to find the solution to a problem (criminal riddle) i.e. answers to the questions: **Who has stolen a gold medal? When did it happen? Where was the medal hidden?**

Exchange of information and discussion between students is necessary to solve the problem. Some of the information given to the students will help them to find the solution, some of the information will prove useless. The method chosen to organize the discussion depends on the group.

The aim of the exercise: to develop communication skills (oral communication) and problem solving, how to cope/deal with surplus information.

SINGLE INFORMATION

- (1) At 1.40 p.m. the police received a call from a Dr Malinowski who represented Cobalt Research Laboratory Ltd. He informed them that a gold medal had been stolen during the lunch break. The medal belonged to Prof. X. Dr Malinowski said that when he returned to the laboratory at 1.35 he noticed: opened window, blue crystals scattered on a window-sill and floor and an open glass case (where the medal was kept).
- (2) Police Inspector Kowalski arrived at the scene of crime at 2.30 p.m. He noticed: the opened window, scattered pink crystals.
- (3) The day was cold and rainy.
- (4) A barmaid saw Dr Malinowski eating his lunch in the canteen during the lunch break (1.00-1.30 p.m.)
- (5) The barmaid has not seen Dr Nowak in the canteen today
- (6) Inspector Kowalski noticed a yellow stain on Dr Malinowski's hand
- (7) Inspector Kowalski noticed a black stain on Dr Nowak's hand
- (8) Metal detectors situated on the door and window to the department of Prof. X did not record any attempt to take away a piece of metal.
- (9) Policemen didn't find any gold metal either in the premises of the department or in the personal belongings of the staff.
- (10) Cobalt Research Laboratory Ltd. has basic inorganic substances: oxides, acids, bases, salts
- (11) Conc. HNO_3 fumes - produces brown nitrogen oxide, NO_2 , reacts with proteins (xantoprotein reaction)
- (12) Gold - density $19,3 \text{ g/cm}^3$, resistant to atmospheric agents and almost all acids, dissolves in mercury/ quicksilver (forming an amalgam) and aqua regia
- (13) Aqua regia is a mixture of two different mineral acids:
 Conc. HCl – about 37%, density $1,19 \text{ g/cm}^3$, pungent odour, corrosive
 Conc. HNO_3 – about 69%, density $1,415 \text{ g/cm}^3$, pungent odour, corrosive
- (14) Conc. H_2SO_4 – about 96%, density $1,82 \text{ g/cm}^3$, (with water exothermic process/produces large amounts of heat), no odour, corrosive
- (15) Dr Malinowski suggests that a thief has stolen the medal at the beginning of the lunch break, because when Dr Malinowski came in after the lunch break, the temperature in the room was about 15°C
- (16) The laboratory is situated on the ground floor
- (17) Round the corner of the building is the crowded Krolewska Street
- (18) Professor Y lives at Krolewska Street
- (19) Professor Y is jealous of Professor X's scientific successes
- (20) Professor Y said that he was working at home all the day
- (21) The air condition in the laboratory was set at 20°C and low humidity
- (22) Dr Nowak said that he had been busy all the time making copies and destroying old documents. He didn't hear any noises from the laboratory.
- (23) The copying machine has many different containers for paper, toner/ink, some empty space, where anybody can hide small objects
- (24) It is quite easy to hide something in the container of the shredder
- (25) Dr Nowak said that he has stopped gambling



(26) Dr Malinowski has debts

If the group doesn't possess enough knowledge before they start to solve a riddle the teacher can give them extra tips.

- (a) Cobalt salts have two forms: anhydrous and hydrated. These have different colours.
- (b) The anhydrous form of cobalt salts is blue, hydrated forms are pink.
- (c) Cobalt salts adsorb water/moisture from the air.
- (d) As a result of the xantoprotein reaction of protein and nitric acid, the protein becomes yellow
- (e) Aqua regia: a mixture of nitric acid and hydrochloric acid in a ratio: 1:3

METHODICAL HINTS

The method and effectiveness of classes work should be discussed, whether the pupils have solved the problem on time or not (informing the pupils of the time limit make them decide faster). It means that:

- the pupils' solution should be compared with the right one.
- ask the pupils: what made the problem easier to solve and what made it more difficult? What helped and what made the discussion difficult? How to organize the discussion, in order to make it the most efficient (moderator, rules and principles)?

In the end it should be mentioned that pupils in their lives will deal with the situations, when there is too much information of not well defined reliability.

There is a course of action presented hereafter, which should lead the pupils to the solution of riddle. If the class is not active enough or the discussion leads to the false conclusions the teacher can suggest the pupils preparing the table, and then the scheme.

COURSE OF ACTION

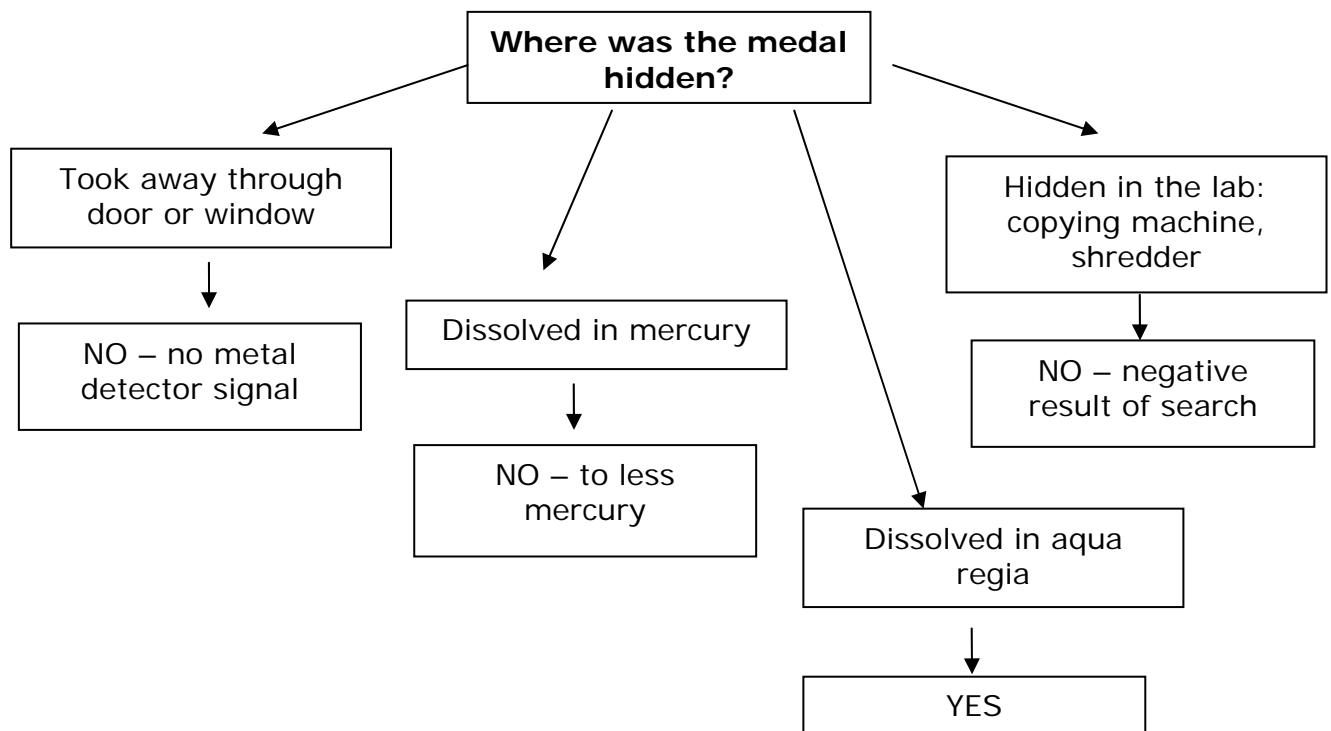
Who stole the medal?

Who?	Presumptive evidence	Evidence	Reasons	Conclusion
Prof. Y	lives nearby,	lack	jealousy	NO
Dr Nowak	black stain on hand	lack	debts (?)	NO
Dr Malinowski	he was in the laboratory	yellow stain on hand	debts	YES

When the medal was stolen?

- at the beginning of lunch break – impossible, after half an hour (at the end of the break when dr Malinowski called the police) in the moist air the crystals of CoCl_2 should have changed colour from blue to rose.
- at the end of lunch break – YES, Dr Malinowski made a phonecall right away after he had jostled a container with CoCl_2 in order to point out at the probable way out of the thief. Dr Malinowski lied when he said, that after he entered the lab everything indicated, that the window had been opened from the beginning of lunch break.

Where was the medal hidden?





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