Three easy pieces

Summary:

The activities propose experiments about classical physics.

Aims:

To understand and practice physics, to help teachers develop their role as facilitators of students' learning, to support diffusion of IBSE in school.

Main activities:

lab experiments about heat, falls and bounces

Narrative:

This course explore three themes of classical physics in a practical and funny way:

- Bounces: is it easy to bounce a ping pong ball and to centre a glass with this ball? Starting from this experiment teachers discuss and investigate on which are the key elements in a bounce.
- Falls: "In the absence of air every body falls with an constant acceleration equal to g". What happens if there is the air? Which are the characteristic of the fall?
- Heat boxes: Is it possible put the sun heat in a box to use it when the sun is not there? The teachers investigate an important component of the solar radiation: the infrared rays.

These are some of the questions used by the trainer to explore scientific topics. Teachers develop experiments to answer these questions and develop new questions.

The course is inspired by the work of the physicist Richard Feynman, the approach to scientific knowledge adopted by Feynman is proposed to teachers and discuss as a way to raise the interest of students in physics.

Methods of learning/training:
inquiry, experimentation, collaborative learning, scientific method, discussion

End user:
in-service secondary school teachers

Involved actors:
teachers

Location:
National Museum of Science and Technology Leonardo da Vinci

Languages available:
Italian

Where to find the application:
www.museoscienza.org/scuole/corsiFormazione.asp

Evaluation parameters:
discussion with teachers. This best practice has been certified by the internal evaluation of the Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci"

Duration:
3 days, 9 hours

Optimum number of participants:
20

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	x
3	Multidisciplinary	x
4	knowledge of contemporary science	x
5	variety of (especially student-centred) instructional strategies	x
6	lifelong learning	x
7	self-reflection	x
8	teaching/ learning processes within the domain	x
9	using laboratories, experiments, projects	x
10	common sense knowledge and learning difficulties	
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	

Mapping best practices with main principles

PATHWAY

1. Building interest in natural science phenomena and explanations:

The training course is built on a scientific topic and its applications. Through exploration, experimentation, observation, collection of data, development of hypotheses , through first hand involvement of the teachers, the course aims to raise interest in science and technology. Discussion in group aims at developing explanation of the phenomena observed.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

Participants are called to understand their own contribution as citizens, the importance of their own participation and critical opinion and how their own choices create an impact on how science and technology are perceived and integrated within society. Moreover, in the course scientific evidence is discussed in connection with ethical, social and legal issues.

3. Develop multiple goals:

- understanding big ideas in science including ideas of science, and ideas about science
- scientific capabilities concerned with gathering and using evidence
- scientific attitudes

Teachers investigate scientific phenomena with interactive activities. They are able to explore notions, phenomena, principles and transformations; they also use the different phases of the scientific method. This allows them to deepen into the science process which means build a scientific knowledge about a range of topics, but understand also how science works and what scientific research means.

4. Understanding students' concepts and learning style about of science phenomena:

The courses aim on the development of knowledge and skills in teachers but concentrate also on a metacognitive reflection, focusing on teachers as learners. On this basis, teachers are also invited to examine their own students' learning and involvement in science as well as problems they might face with the students.

5. Relevance of the content to daily life of students:

The choice of the topic is based not only on its scientific importance but also on its relevance with daily life. Also, the educational methodology adopted by the Museum in the training course (as well as in its education programmes) puts at the centre the personal experience and knowledge of each individual. This means that everyday life experience of students is one of the main tools on which training builds. . Moreover, the problem solving activities require teachers to use their background knowledge and consequently think of the students' own background.

6. Understanding science as a process not as stable facts. Using up to date information of science and education:

Understanding science as an on-going, not consolidated process emerges from the very activity of experimenting and testing carried out by teachers during the course. On this basis teachers are also encouraged to consider the process they chose to use in order to solve the problem and to collect data in order to confirm or not their hypotheses.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

The training course is based on a mix of activities which aim to develop subject-knowledge and skills in science and technology also through the use of interaction, confrontation, enjoThe course explores a specific topic not only in terms of its scientific and technological dimensions but also in relation to society, to everyday life and to individuals. yment and the use of emotions. We know that the personal and emotional involvement of participants in the learning experience maximizes the probability for effective learning.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

The activities start with an open scientific question posed by the museum trainer. The teachers conduct experiments to explore different answers following observation, data collection and interpretation, development of prediction and discussion of scientific ideas. The scientific method is the basis of all the work done.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

The museum is an informal environment of learning and has a role which is complementary to that of the school. Consequently, visitors' learning is not assessed like in schools. We do not use structured tools or processes for assessing the learning experience of our visitors (schools in this case) as this is not part of our education priorities Informal, personalised, meaningful experiences for each person in a different way is the priority of our education programmes. At the same time, we run self-reflection sessions among education staff in order to analyse how our programmes are developed (education methodologies) and how interaction with the public takes place. The formative and summative assessment are left to the teachers.

10. Cooperation among teachers and with experts:

The training course builds close collaboration between museum experts and teachers as well as collaboration between teachers themselves. This collaboration continues also after the end of the course through update of training or distance support. Moreover, professionals from companies or universities with expertise in different fields are involved in the training. The teachers appreciate very much the discussion with the different experts.