1.19	Forensic Science

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Short Description:

Using the context of forensic science, learners discover the basic idea of genetics as well as basic analysis techniques in (bio)chemistry

Aims:

The main aim is to teach how systematic investigation leads to detailed insights. Moreover the aim is to teach the principles of genetics and inheritance.

Fostered Skills:

According to the chosen topic, to the analysis of the curricula of each country, and to the analysis of misconceptions and knowledge gaps of the mission domains, a list of learning goals has been drawn up.

General science, social and presentation skills

- I can extract, organize and critically evaluate information on a definite subject
- I can follow an experimental process to answer a research question by formulating hypotheses, by justifying some parts of the procedure that will be used, by designing and carrying out experiments related to expressed hypotheses, and by using ICT to express and exploit my results: tables, graphical representation.
- I can take account of scientific, ethical and moral standpoints when forming an opinion on one or more personal and/or societal issues

Learning goals - Biology

- I can describe the structure of DNA (using the concepts of nitrogen bases, sugar and phosphate backbone, double helix and hydrogen bonding).

- I can link the concepts of DNA, chromosome, gene, allele and genotype
- I can explain the universality of the molecule DNA and the specificity of each living organism
- I can explain the role of DNA as a coding biopolymer for proteins.
- I can explain the differences between coding and non-coding DNA.
- I can evaluate the role of hereditary and environmental factors on an organism‘s phenotype.
- I can explain why sexual reproduction leads to similar genetic profiles in family members.
- I can assess information about scientific, legal and ethical problems related to the application of gene technology.
- I have acquired an overview of science disciplines and professions related to genetics and gene technology.

Experimental techniques – Biology

- I can describe how the following techniques work: DNA isolation, PCR, gel-electrophoresis, DNA-fingerprinting with restriction enzymes.

Learning goals - Mathematics

- I can calculate the frequency of a specific DNA-profile in a given population.

Learning goals - Chemistry

- I can relate the solubility of a substance in a solvent to its migration on a static phase with this solvent as the mobile phase.
- I can explain why thin layer chromatography (TLC) is a good technique to analyse inks.
- I can list different techniques of separation and identification of chemical substances.

Experimental techniques - Chemistry

- I can explain how the technique of TLC works.
- I can calculate retention factors (Rf) in TLC.

Connection to the curriculum:

In order to achieve a higher relevance of this mission for schools, we made an analysis of curricula of all countries engaged in the mission development (France, Netherlands, Estonia and Norway). (see appendix 4.6). Based on this analysis, a list of learning goals was outlined and each country selected the most relevant learning goals according to their curricula. The final list of learning goals was selected based on the four-country selection made to make sure that the mission content could fit at least in these 4 countries.

Implementation of the Demonstrator:

1. Information
   Student will use this LAS at the beginning of the mission to get familiar with the phenomena they have to investigate, and can revisit this LAS during mission work to look for specific resources.
2. Orientation
   Students identify the means and goal of their investigation.
3. Design
   This is the central activity of the scenario. Here students design their experimental

procedure.

4. Experiment
   Students use their experimental procedure to conduct experiments. The goal of these investigations is twofold: to evaluate the experimental procedure and to retrieve data to answer the research question that was posed during "Orientation".
5. Analysis
   Students analyse their data, draw inferences, and relate these to their hypotheses.
6. Reporting
   Students write a report to describe the final version of their experimental procedure.

Domain:	**Big Idea of Science:**	**Age group:**	**Time needed:**
Chemistry, Biology, Forensic science	9, 10	15-18	The duration of the complete mission is approximately 15 hours but can be reduced by excluding some of the optional modules (chemistry and mathematics).
Languages available:	**Equipment needed**	**Involved actors**	**Used eTool and link:**
English	Computers running JAVA. DNA chromatography kits for the students. Camera (can be in phone).	Teacher, students	scy mapper, scy experimental design, www.scy-net.eu

Quality Characteristics of the Demonstrator

Characteristic I
how Demonstrator follows an **inquiry based approach**

The inquiry-based approach is clear from the sequence of activities presented

Characteristic II
how Demonstrator integrates **eLearning element**

eLearning elements in the Forensic science mission are the tools for data collection and concept mapping.

Characteristic III

how Demonstrator follows a **Big Idea of Science**

The basic Big Idea that is fostered is the idea of genetic inheritance.

Characteristic IV
how Demonstrator is connected to a **real world problem**

Forensic science has become essential in solving crimes, based on DNA. For that, knowledge about the way DNA is unique to everybody, and insight into the methods of DNA fingerprinting is very relevant.

Experiences with the Demonstrator?

From DIX.4: SCY Summative evaluation report
This mission is modeled by "experimental design." It involved two domains: biology and chemistry. The results showed that the mission map in the SCY-Lab forensic mission was sufficiently balanced as structures, giving agency to students. The mission map provided an overview of the tasks and gave students opportunities to move back and forth between tasks. Specifically, the analysis of student routes through this SCY mission showed that the students moved back and forth in the experimental procedures and in the different aspects of data collection.
Previous studies of laboratory experiments show that students have a strong tendency to follow the "scripted route" (e.g., Lunetta et al. 2007). To a certain degree, this pattern also occurs in all our studies. However, in the forensic mission, the students used the procedures as resources to conduct conceptual work. This work was a part of the reflective processes that take place when performing the procedure, and the results were written up. Here, the students involved themselves in the interpretation of data. Therefore, learning object can be understood as objects that increased the potential for communication between students and teachers, as the objects produced became familiar and transparent products for the teachers. In this way, the structure and support for learning object production by learners as well as the intersecting trajectories of the students and student–teacher communication seem to be based on the design features that can stimulate a close connection between procedural (doing inquiry and bringing content forward) and conceptual development and change.