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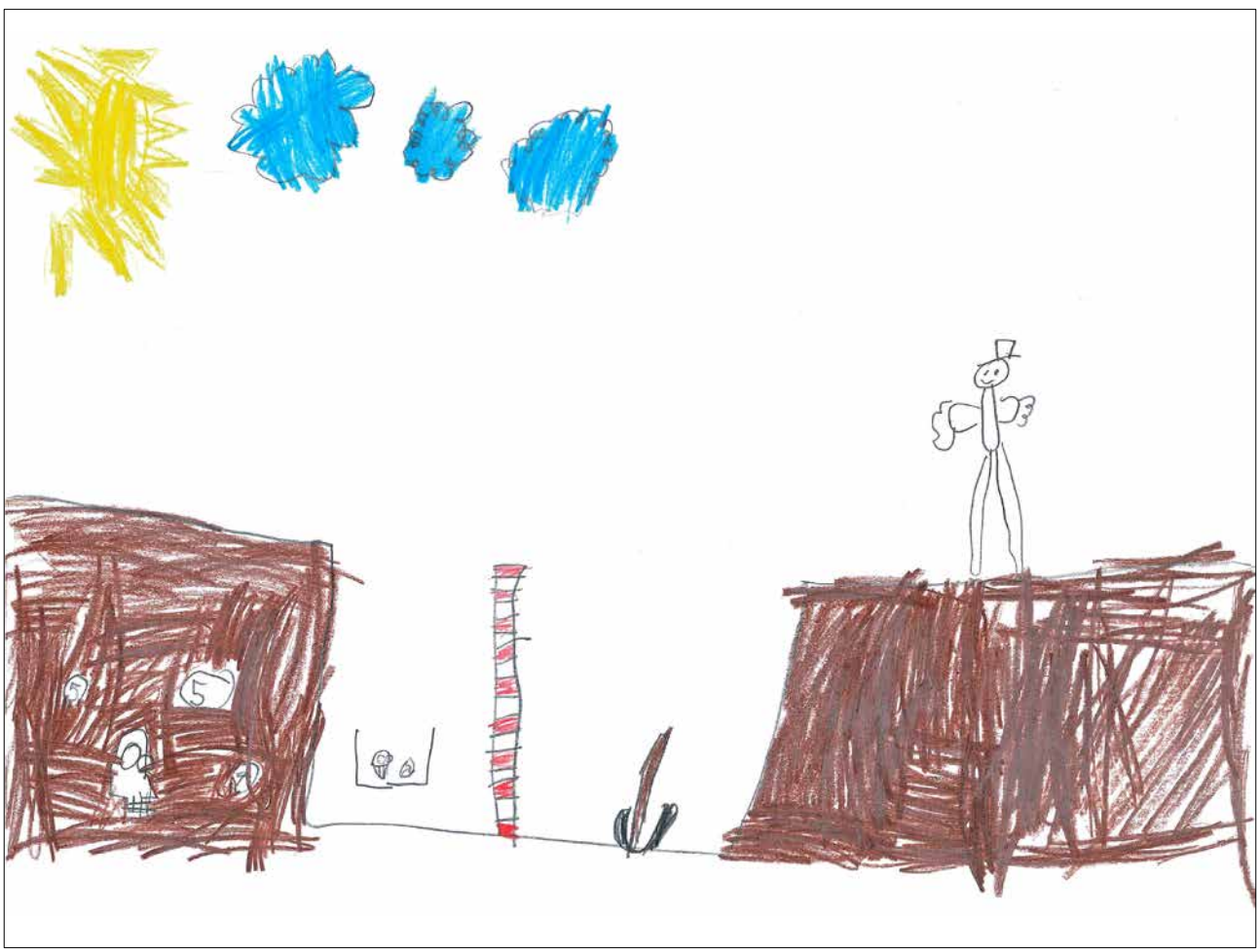
Scientific literacy at the school. An inquiry about *Archaeology in the classroom*

Scientific literacy at the school: improving strategies and building new practices of science teaching in early years education (SciLit)

2016-1-ES01-KA201-025282

Understanding the processes that shape the archaeological record (landscapes, sites, objects) converts archaeology into a time machine that allows us to see how life was hundreds or thousands of years ago, as if peering through a magic window to the past.

'To recognize that meaning does not just reside in the objects of the past but in the study of the past is to recognize that archaeology is a practice today'.
Shanks, M. and Tilley, C. *Reconstructing archeology: theory and method*. Cambridge. 1987, 66.



Archaeology as seen by a 6 year old boy.

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Scientific literacy at the school. An inquiriry about 'Archaeology in the classroom'.

http://www.csicenlaescuela.csic.es/scilit/scilit.html

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Image credits

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- Figure 51, photographs of the taller Buddha of Bamiyan. Authors: UNESCO/A. Lezine (left) & Carl Montgomery (right).

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INTRODUCTION

INTRODUCTION

This didactic guide has been prepared within the *Erasmus+ SciLit Scientific literacy in the school: improving strategies and building new practices of science teaching in early years education* project of the KA201 specialty (Strategic associations directed at the field of school education). This project has included the participation of scientists working in the CSIC and Spanish, Estonian, Italian, Lithuanian and Polish educators in different education centres, schools and a non-governmental organization. The work presented here is the result of their collaboration over the years that this project has lasted.

This work was based on the proposals made by CSIC at School for innovative methods of teaching science. CSIC at School (www.csicenlaescuela.csic.es) is developing a comprehensive programme whose main objective is to promote collaboration between scientists and school teachers to improve how science is taught, approaching it as a universal concept that includes the Human and Social sciences. Over the past few years CSIC at School has successfully incorporated archaeology into its programmes, as it is a field that offers many possibilities to teach science to early education students. Moreover, its relation with other subjects favours interdisciplinary perspectives, which helps overcome teaching challenges related to a multidimensional study programme.

People are generally very interested in the daily activity of archaeology and its role in researching history. However, like history, archaeology does not seem relevant in the majority of contemporary societies. In fact, its 'usefulness' is often questioned, which, unfortunately, is a common situation in Social and Human Sciences. The misconceptions, myths and half-truths that abound give rise to unrealistic images of the field, such as that of the scholarly archaeologist, far removed from the problems of today's society. Most often, archaeological activity is associated with excavation, discovery or the knowledge of ancient languages, when it is not mixed up with the study of dinosaurs or other elements outside of human history.

This guide seeks to help dispel these myths by proposing to use archaeology to teach science in the classroom. The project has demonstrated that updating the scientific training of teachers and searching for innovative teaching methods is becoming increasingly necessary. CSIC at School believes that introducing science in the earliest stages of education is essential for its later study, as long as an adequate method is established through experimental work.

In order to implement these innovative practices in education centres that have participated in the Erasmus+ SciLit, this work starts with the same three basic pillars as the guide *What is the world made of*:

A. Scientific training for teachers provided by CSIC at School, providing them basic scientific knowledge that will allow them to use the innovative practices in their classrooms.

B. Research into learning processes that allows us to analyse the ways in which kindergarten and primary school students carry out conceptual processes and create mental representations of the world. Teaching science in these early stages of education requires a highly precise understanding of the sequence of cognitive stages.

C. This guide is the result of the training and research process, designed to be a tool for teachers in the partner countries. In it science is represented as a problem solving method, facilitating the global development of the students while also being a building block in the scientific literacy of population.

Description of the *Archaeology in the Classroom* project

This guide presents a proposal directed at pre-school and primary education teachers to use archaeology to introduce science in the classroom. The objectives of our proposal are:

1. First of all, to make Social and Human Sciences more accessible to the general public by using the specific example of archaeology in the school system. The idea is to defend the role of archaeology and history as scientific disciplines within the Social and Human Sciences. Ultimately, the hope is to encourage children to develop scientific vocations in these areas starting from the earliest stages of education;

2. Second, to transmit how important the scientific method and critical thought are for understanding our current multicultural society; this will contribute to building a freer society that uses knowledge of the past to deal with the present and has the capacity to shape its future;

3. Third, to raise awareness about the importance of defending our entire historical and archaeological heritage, the monuments and the less visible elements of our cultural and historical heritage, in its geo-historical context. Ultimately, the goal is to provide tools that will allow students to understand their surroundings and encourage critical thinking so that they can become thoughtful members of society.

This work also includes the criteria of diversity in education, the presence of different cultures in the classrooms, as well as the development of a critical attitude in the children in their journey of learning about science. Issues related to gender have also been considered.

Finally, it should be highlighted that the programme proposed in this guide has been tested in various education centres participating in Erasmus +, as discussed in the second part of this guide, whose publication coincides with the commencement of the European Year of Cultural Heritage (https://europa.eu/cultural-heritage/node/2_en).

The educational values of archaeology

Various studies have been published examining the application of archaeology in classrooms, which have highlighted its pedagogical value from different perspectives. One Spanish language work that stands out is Professor Gonzalo Ruiz Zapatero's, 'The educational values of prehistory in compulsory education', published in the journal *MARQ Archaeology and*

Museums in 2010 ("Los valores educativos de la Prehistoria en la enseñanza obligatoria", *MARQ Arqueología y Museos*, 04, pages 161-179). In his study, Ruiz Zapatero underscores the educational values of prehistory, values that can be extrapolated to archaeology and history in general. Ruiz Zapatero makes the following claims about prehistory:

- Prehistory is the investigation of the human condition. It is an inquiry into the common origins of humanity and our existence over two million years on Earth.

- It is the study of human diversity. We should learn about and treasure the extraordinary and astonishing diversity of all the prehistoric societies that have ever existed, especially in a time in which globalization is creating a sadly uniform world.

- As a discipline, prehistory (like history) is diverse, with infinite branches (depending on the focus, the period, the language, the space, the country).

One of the lines of research that Ruiz Zapatero follows was set out by eminent figures, such as the English archaeologist Graham Clark, who in 1946 also highlighted the value of prehistory and archaeology (cited by Ruiz Zapatero, 2010). According to Clark, archaeology:

- Allows us to see history from a broader perspective and promotes human solidarity.

- Can be applied to the entire human experience, regardless of the civilization in which an individual has been raised, and without requiring prior book learning.

- Awakens interest in geography and cultural diversity.

- Studies not only the 'great monuments' but all of the remains; the 'rubbish' of every member of past societies is examined in a kind of 'democratization' of history.

- Provides evidence that reinforces the sense of belonging to a group.

- Provides educational entertainment for everyone, since it appeals to the basic curiosity of all human beings, which is important in an era that has an ever-growing amount of leisure.

Following Ruiz Zapatero's work, we believe that history and archaeology provide educational values that could be extremely useful for the classroom, because it:

1. Allows us to propose **comprehensive or combined learning** (and joint learning) of every field of knowledge. Indeed, its **interdisciplinary nature** makes it a useful way to teach material related to history, geography, maths, physics, language…).

2. Facilitates **the first-hand use of sources**. The nature of the information used by archaeologists allow them to employ all kinds of sources (objects, oral histories, written documentation, cartography…). As Graham Clark highlighted, archaeology does not only focus on 'great monuments' but on all the remains of the societies examined, including the 'rubbish' left behind by every member.

3. Promotes group and **cooperative learning**. Archaeology requires working in teams, in which every child can play a role. This will contribute to students developing the capacity to represent and communicate.

4. Helps to instil values such as **respect and understanding of cultural diversity**. Ultimately, archaeology promotes human solidarity because it allows us to view history from a broader perspective; it can be applied to everyone's experience, regardless of their upbringing; and it stimulates interest in geography and cultural diversity.

5. Finally, it allows us to approach education in a way that respects our cultural and natural heritage. In effect, archaeology raises awareness about the importance of our heritage, in a broad sense, overcoming the object-centric view of archaeology (as a treasure hunt) and allowing us to understand the landscape as a product of history. In addition, it provides evidence to reinforce the sense of belonging to a collective.

In addition, as we shall see, teaching archaeology in the classroom provides many opportunities to develop scientific thinking and reasoning, while promoting critical analysis.

Scientific knowledge for teachers

With these ideas in mind, this guide is presented as a training unit for early education teachers

EDUCATIONAL VALUES OF ARCHAEOLOGY		
Value	**Benefits for the teacher**	**Benefits for the student**
INTERDISCIPLINARY	A holistic and interdisciplinary means of learning	Provides a broad range of opportunities in every area of learning
USE OF ALL KINDS OF SOURCES	An instrument to study the consequences of human behaviour and decisions. A way to promote critical thinking	Learns to employ imagination, creativity and logic
WORKING IN GROUPS	A tool for cooperative learning and working in small groups	Develops abilities such as communication and representation. Working in groups
CULTURAL SENSITIVITY	Lays a groundwork to understanding multicultural perspectives	A way to understand our shared past
COMMITMENT TO OUR CULTURAL (AND NATURAL) HERITAGE	Teaches responsible and respectful attitudes toward heritage. Construction of our identity	Acquires an informed and respectful behaviour toward cultural resources, which are non-renewable

Figure 1. Archaeology workshop for children at the Roman archaeology site, Los Bañales (Zaragoza, Spain), during an open day.

EDUCATIONAL VALUES OF ARCHAEOLOGY - CAPABILITIES	
EDUCATIONAL LEVEL	**CURRICULAR ABILITIES THAT ARCHAEOLOGY CAN ADDRESS**
PRE-SCHOOL EDUCATION	Archaeology can contribute to every area of learning in the second cycle of pre-school education: • Understanding of self and personal independence • Understanding of surroundings • Languages: communication and representation
PRIMARY EDUCATION	It can also contribute to the development of key abilities in primary education: • Linguistic communication • Mathematical competence and basic abilities in science and technology • Digital aptitude • Learning to learn • Social skills and civic responsibilities • Initiative and an enterprising spirit • Cultural conscience and expressions

Figure 2. Archaeology in the classroom in Navarre (Spain). Simulation of an excavation carried out in the COMENIUS project, 'Discovering the world'.

that deals with theoretical and methodological aspects of archaeological research. The methodological proposal and the concepts upon which the guide is based were described in the first guide published through the SciLit project. However, we must point out some prior considerations regarding how it is structured.

The scientific knowledge is divided in two parts:

1. The first part presents archaeology as a scientific discipline focusing on the systematic recovery, description and study of the material culture of the past, providing insight into the societies that created them. Starting with the concept of 'historic time' and using simple activities and suitable questions, other concepts are gradually introduced, such as the 'archaeological record' or 'material culture'. For example, the formation of stratigraphic sequences is explained, with the goal of indicating the processes that shape the archaeological record and the way in which researchers carry out their work of obtaining data and building knowledge. Continuing along this line, we explain why the material remains of old societies are sometimes found underground. These observations then lead us to other aspects, such as the importance of context and the value of surveying as a form of archaeological analysis of our surroundings. One question leads to the next and soon we must give a reason why context is essential in archaeological investigation. We then discover that the landscapes, archaeological sites and the remains exhibited in museum are part of our past and we have an enormous responsibility for disseminating knowledge about them, as well as protecting and conserving them.

2. The second part of this guide will use a detailed presentation of various projects to show the way in which teachers in different countries have used this method of teaching science in their classrooms, after receiving the necessary training. The application of these projects reveals that archaeology offers an endless array of teaching possibilities in the educational study programme for pre and primary school in Europe.

Ultimately, this guide is meant to be a useful instrument that will assist any early education teacher to introduce science in their classroom.

FIRST PART

ARCHAEOLOGY IN THE CLASSROOM: SCIENTIFIC CONTENT AND METHODOLOGY

I. FIRST STEP: STIMULATE INTEREST IN ARCHAEOLOGY AND DISPEL MYTHS

During the second stage of early childhood education (from 3 to 6 or 7 years old) students should acquire a sense of self and personal independence, as well as develop an understanding of their environment. These aspects are the foundation upon which skills and knowledge are later developed in the first stage of primary education (from 6 or 7 to at least 10 years old), when the study of chronological time, the past and the present, is fundamentally associated with daily events and the experiences of their personal and family lives. Their knowledge about the environment during these years is basic and in large part gained through learning about the remains of the past of nearby areas (their town, city, municipality) and other spaces. Basically, they become aware of time and space, the past and the present, through their daily lives.

We have seen that archaeology offers many possibilities to teach these aspects to young children and introduce them to the research methods employed in the development of historical knowledge about people, society and the environment, as well as how such knowledge is structured. In addition, during their primary education students are introduced to scientific knowledge and how it is applied to different sciences, as well as to the study of Human and Social Sciences.

To help introduce students to the field of Human and Social Sciences we have developed a didactic guide that uses the proposals made by CSIC at School for Natural Sciences as a reference. It encourages students to observe their immediate surroundings and introduces them to scientific inquiry by teaching them how researchers observe, analyse and build knowledge about past societies.

The daily activity of archaeology and its role in researching past societies leave few people indifferent. Some studies show that people have grown increasingly attracted to archaeology and consider it useful. Unfortunately, this interest does not compensate for a general lack of knowledge about the nature of the discipline, how it is carried out and what it is based on. During the Erasmus+ project the drawings students made in our classrooms revealed that they are profoundly ignorant of the true nature of the field and are unable to describe what archaeologists study. When asked, 'what do archaeologists do?', students were unable to draw a clear representation (this can be seen clearly in the drawings made by the students of P34, in Bydgoszcz, Poland, which showed 'archaeologists' playing football; other answers included, 'plant flowers', 'take care of dogs' or 'take care of people's teeth'...).

Figure 3. Archaeologists play football. Drawing made by the students of P34 Preschool in Bydgoszcz, Poland.

Many drawings, by both students and teachers, linked archaeological activity to the study of dinosaurs.

Figure 4. Archaeology and dinosaurs. Drawing made by the students of P34 Preschool, in Bydgoszcz, Poland.

Of course there were exceptions. Some students drew buried objects and, in general, the teachers were able to properly identify what archaeologists do. However, the results reveal that on the whole their knowledge is based on numerous myths and half-truths. One of the most common was the perception of an archaeologist (normally a man) as a scholar dedicated to the study of past societies through the examination and classification of objects. The work was associated with excavation, discovery and the knowledge of ancient languages (and often, as mentioned earlier, mixed with the study of dinosaurs and other elements removed from the history of humanity). A good illustration of this is the drawing made by a teacher in Gijon, Spain, during a training course, in which archaeology is represented through ancient ruins (Egypt, Mexico) and a dinosaur (Figure 5).

These myths about archaeology are largely derived from Hollywood movies (the adventures of Indiana Jones, Lara Croft) or cartoons (The Flintstones, Arlo), in which humans and dinosaurs co-exist in the same setting. The association with Indiana Jones, very common among teachers (and rare among students), can be observed perfectly in this drawing done during the training course in Gijón (Spain) (Figure 6).

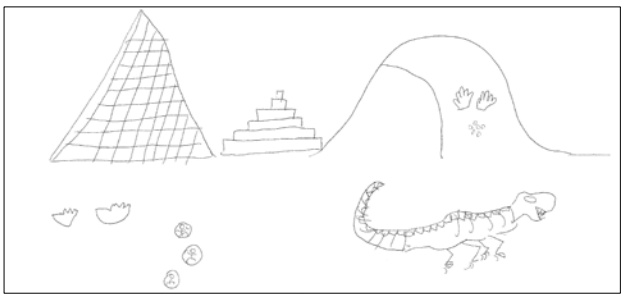


Figure 5. Archaeology is related to pyramids, ancient remains and dinosaurs. Drawing made during the teacher training course in Gijón, Spain.

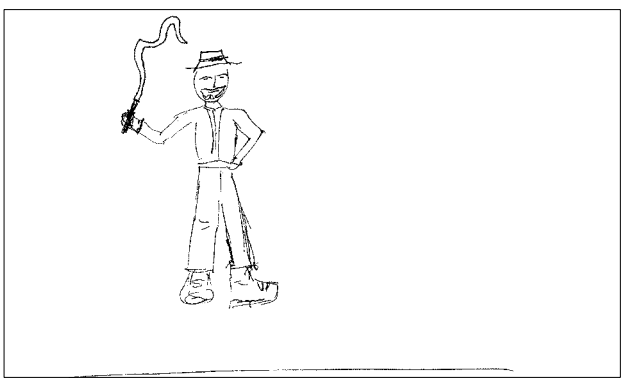


Figure 6. Indiana Jones. Drawing made during the teacher training course in Gijón, Spain.

It is important to keep these mistakes in mind when developing an archaeological activity or project, in order to avoid trivializing or simplifying the true enterprise of this discipline. If care is not taken, what is truly important is overlooked: that the objective of archaeology is to study human societies and their relations. There are many accessible references to archaeology that can be useful for the classroom. The references section contains these and other useful resources for those who wish to delve deeper into the main topics related to archaeology.

So then, what is archaeology?

The word 'archaeology' is derived from the Greek *arkhaiologia*, 'discourse on ancient things'. However, modern archaeology is a very young science that emerged at the end of the 19th Century, although some authors consider the 1960s to be when this discipline truly commenced.

Today archaeology is defined as the systematic recovery, description and analysis of the material culture of the past, as a way to understand the societies that built them (Fernández Martínez, 1989). First of all, the term 'past' must by defined here: archaeology does not study rocks or dinosaurs; these are the domains of geology and palaeontology. The work of archaeology starts with the appearance of the first recognizable tools and spans all the time between then and the present: from the study of the earliest hunter-gatherer societies to the contemporary world (for example, archaeology of the major wars of the 20th Century, or industrial archaeology).

Figure 7. Spanish Civil War position at the front known as 'Frente del Agua' (Paredes de Buitrago, Madrid, Spain).

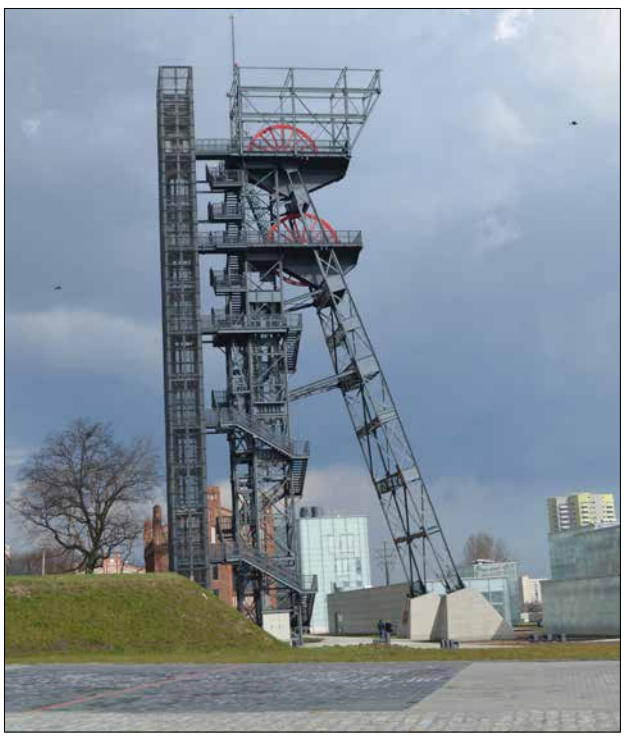


Figure 8. Example of industrial archaeology: Silesian Museum in Katowice (Poland).

Archaeology is the science that studies the relationship between societies and their pasts. Its objective is to create a body of knowledge using specific methods to investigate the past. It is unique among Social Sciences and Humanities in that it studies the human past through material remains. In addition, it produces and spreads knowledge about the past.

Palaeontology is the science that studies life in the past and its inter-relation with the evolution of Earth. Fossils are the main subject of study, the palpable evidence of the living beings that have inhabited the Earth.

A good example is the figure 7, a military position of the Spanish Civil War on the 'Frente del Agua', Madrid: the structure has been excavated, restored and conditioned for visitors as part of the Civil War Route, in Paredes de Buitrago (Puentes Viejas, Madrid, Spain).

1.1. THE DRAW-AN-ARCHAEOLOGIST TEST (DART)

As an introduction to a project on archaeology we propose the first activity to be a DART test, which will serve as the first step to overturning myths and asking the right questions: What is archaeology? What does it do? What is it for? In this test students are asked describe what they think archaeologists do in a drawing.

The activity is based on the idea that everyone has developed some ideas about archaeology (thanks to family vacations, movies, television). The Draw-an-Archaeologist-Test (DART) is a way to discover those ideas. Its use in this project is based on the work of Puran Renoe (2003: "The Draw-an-Archaeologist Test: A Good Way to Get the Ball Rolling", *Science Activities: Classroom Projects and Curriculum Ideas*, 40:3, 31-36, DOI: 10.1080/00368120309601128), which, in turn, was inspired by the Draw-a-Scientist Test (DAST), which followed the Draw-a-Man Test created by Florence Goodenough (1926).

To carry out the test all that is needed is blank paper and graphite or coloured pencils.

The DART test has proven to be a very useful in our SciLit project, both as a starting point for a project on archaeology, as well as an evaluation tool (both starting and final). As mentioned, in this test the children are asked to draw their perception of archaeology. These drawings provide a baseline with which we can later evaluate the acquisition of knowledge and model changes. These drawings can also be used to start the first class discussion about the subject and outline the content.

Dart is an easy way to discover how students perceive archaeology. When it is used as the first activity of the archaeology project it provides a way to introduce the field and dispel the myths or misunderstandings surrounding it. The activity also can be used to ask questions about equality and differences in opportunities.

DART is an excellent way to introduce archaeology to students, as well as other concepts about science: for example, that science is for everyone, and that anybody can 'do' science. The children need to understand that science is a human endeavour, carried about by women and men from diverse social and ethnic backgrounds. DART can also be used to start a conversation about stereotypes and to discuss the human nature of science as a whole.

During the class discussion started by the students' drawings, it must be emphasized that

archaeology is a scientific discipline concerned with studying past societies. Remember that it is unique among Social Sciences and the Humanities because it studies the human past through material remains. It is considered a science because it creates a body of knowledge about the past using specific research methods and then disseminates that knowledge. Finally, as occurs in other sciences, not all archaeologists are involved in research: they also work in universities, museums, administrations, public and private companies or independently.

In this first stage, and throughout the activity, it is essential to dispel the myths about archaeology. For example, that it consists entirely in excavating remains. In reality, the work of an archaeologist begins much earlier, formulating questions about how the people in a certain era lived, what their natural surroundings were like and how they made use of them or how their society was organized. After developing a hypothesis, archaeologists have a set of sources and scientific methods that they can employ to test it. They then have to choose which of those methods is most appropriate to resolve their questions.

Figure 9. Archaeology focuses on the human past.

Another of the most widespread myths, or misunderstandings, is the belief that archaeologists study fossils or even dinosaurs. Archaeology does not study dinosaurs: it focuses on the time spanning from the appearance of the first human being to the time of our grandfathers.

Archaeologists mainly use information about the things that people made (artefacts) and where they left them (context) to reconstruct the history of groups of humans who lived in the past.

The DART test should be used to present students with the concept of archaeology, with two general teaching goals: at the end of the session or sessions the children should know that:

1. Archaeology is a science.
2. Archaeology is a science that studies human societies.

1.2. FOSSILS VERSUS ARTEFACTS OR HISTORIC TIME

At this point it is important to define what archaeology studies. Simply put, the object

Figure 10. Dinosaurs, rocks or fossils: this material is the subject of palaeontology and geology.

of archaeological study is the human past. Archaeologists do not study dinosaurs or rocks or fossils directly; such material is the subject of palaeontology and geology. Keep in mind that archaeology studies the human past and the dinosaurs went extinct tens of millions of years before the first humans ever evolved.

Archaeology examines the time period ranging from when the first recognizable human 'artefacts' (tools) appeared all the way up until today.

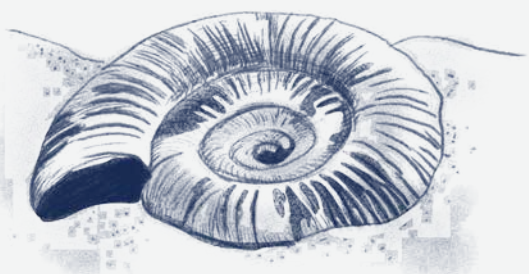
With the objective of helping students to develop a clear understanding of the concept and area of study, we can carry out a new activity in which they look at what differentiates animals from people.

The teacher should ask, if archaeology studies human societies, what elements does it examine? Or, what is the difference between animals and people? What remains of animals after they die and time passes? What remains of people after they die and time passes?

The objective of this activity is for them to understand two concepts clearly: the concept of 'fossil' and the concept of 'artefact' or 'object').

Both are usually found buried in the earth. It is important to understand the difference between an object (artefact) and a fossil, because archaeology does not study fossils. Archaeologists study objects, although not exclusively, because they are interested in all the material remains of human life (culture).

Fossils include the remains of dead plants and animals, or an impression left by their skeletons in rocks. In fossil remains, the original living tissue has been replaced by minerals. Normally, fossils are millions or even billions of years old



FOSSILS

The remains of living things (plants, animals), they are not objects that have been produced or manufactured.

OBJECTS (ARTEFACTS)

The remains of things made by humans, they are not the remains of living things.

(in this context it could be interesting to use the 'Discovering a Fossil' film made by CSIC at School: http://www.kids.csic.es/cuentos/cuento6a.html).

Artefacts are made by men, women, boys and girls. Artefacts found by archaeologists include coins, weapons, pottery. They can be thousands of years old.

Figure 11. Ancient objects: archaeological remains in the Museum of Navarra (Spain).

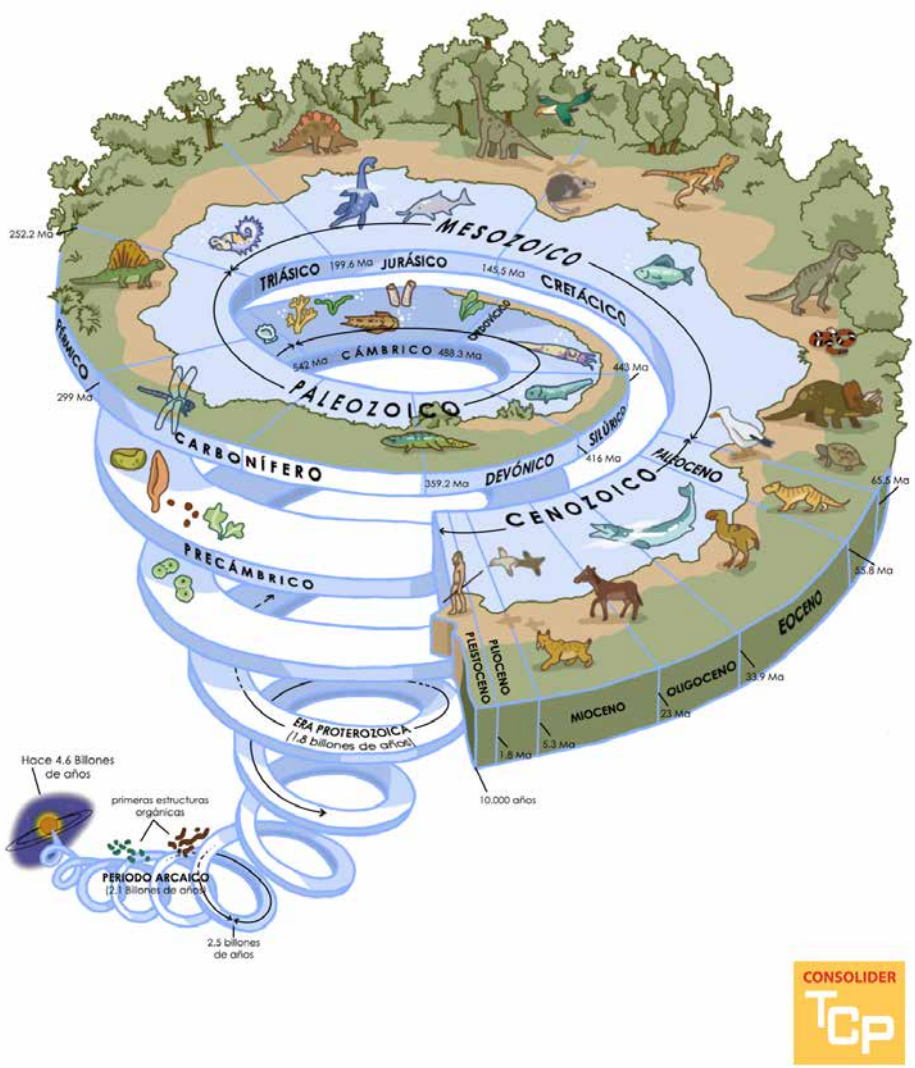


Figure 12. A spiral of time, image included in the materials developed by the Conservation and Revaluation of Cultural Heritage research programme (TCP) (CSD2007-0058) CONSOLIDER-INGENIO. Accessible at digital.csic: http://hdl.handle.net/10261/88717.

At this point the concept of 'historic time' can be introduced and the appearance of human beings explained (tailored to the educational level of the students).There are useful resources that can help explain human evolution and provide context for the presence of human beings in the history of Earth. Moreover, this would be a good time to explain and expand the scope and nature of the archaeological record.

2. BURIED ARCHIVES: THE CONCEPT OF THE ARCHAEOLOGICAL RECORD

Archaeology is concerned with the material remains of the past, in a broad sense. These material remains include different objects (such as a flint chips, a fragment of pottery), the remains of monuments (a house, an entire city), areas of human activity (burial sites, quarries, landfills, cropland) and also environmental elements (sedimentary records, landforms, scoria deposits). For example, environmental elements can be studied by analysing the chemical or physical properties of soil and sediment or of biological plant or animal remains, such as pollen, coal, bones).

In other words, we can refer to a visible archaeological record and another 'invisible' record, or better yet, an archaeological record that includes both perceptible remains and other remains that are imperceptible to plain sight.

Figure 13. A view of the excavation of an ancient agricultural terrace in Salamanca, Spain. Here we have a 'visible record' (the terrace, the layers that conform it and the visible soil properties) and an 'invisible record' (such as soil chemical properties, or microscopic remains from the ancient agricultural activity).

It is necessary to highlight the distinctive aspects of the kind of data employed by archaeology to infer the characteristics of the societies it studies (Luis Felipe Bate, *El proceso de investigación en Arqueología,* Crítica, 1998). First of all, archaeological data are related to the effects of activities that materially transform nature; that is, they are related to the intentional and non-intentional effects of human transformation of the natural environment. Second, it must be kept in mind that when they are recorded by archaeologists, these material effects and conditions are generally disassociated from the human activities and social relations that produced them, and the archaeologist must infer them. Finally, in addition to their disassociation from social relations and activities, these material elements have been affected by diverse, and sometimes complex, transformative processes (sedimentation, erosion, partial destruction). In other words, archaeology focuses on analysing in the present what is preserved in the present, remains that have undergone transformations in the past.

2.1. HOW AN ARCHAEOLOGICAL SITE IS FORMED

The study of the archaeological record is usually articulated around an archaeological site, which we can define as the 'unit of measure' employed to study cultures. The concept of an archaeological site allows us to delimit those different perceptible and imperceptible data and records (which are the effects, or the results, of human activity) and quantify, characterize and analyse them.

An archaeological site is a place containing material remains of any human activity in the past. To explain this concept, we can use the Flash animation created by CSIC at School (http://museovirtual.csic.es/salas/paisajes/medulas/imag_med/arq.html), which shows how a site is formed by presenting the history of a Roman house (the house was inspired by the Roman archaeological site in Las Pedreiras de Lago, in the Archaeological area of Las Médulas, Spain).

The following images will help to illustrate what is showed in the Flash animation cited. The first drawing shows a similar house in its occupation moment. At this point the newly built house was inhabited, so a woman is shown standing in one of the rooms, containing two amphorae that were most likely filled with wine. The room just to the left of the woman is a place for worship containing an altar or table; farther left is a third room. The structure of the house is simple. The stone base is built on foundations dug into the ground and adobe or rammed earth walls are built on the stone base (most likely made with mud and straw). The roof is made of wood.

Figure 14. An occupied house.

The animation shows an example image taken from the internet of the archaeological site in Numancia, Soria. It shows a house from the Roman era, although in this case the walls are made of stone and it has a straw roof.

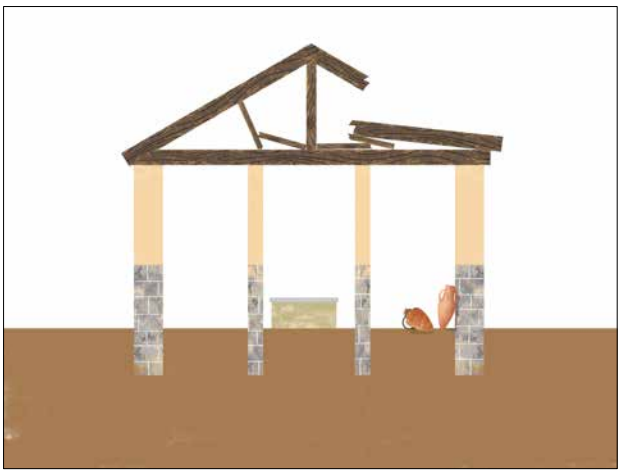


Figure 15. The house in the first stages of abandonment.

Figure 16. Reconstruction of a Roman house at the Numantia archaeological site (Soria, Spain).

The second drawing shows the phase of abandonment of the house. The family that inhabited it decides to leave and take their things with them. Drawings show a model of the deterioration of the structure after it was abandoned, a process that has been documented repeatedly in archaeology. Once the roof falls, the collapse of the structure is imminent. First the walls erode and fall, covering the roof structure and filling the area falling on top of the stone base. In the lower part are the remains of the objects the family did not take, because they were less valuable, such as the amphorae. Those amphorae –along with imperceptible material elements (small pieces of coal, pollen)– allow the structure to be dated in the future, when its remains are documented by researchers who study and analyse it. The example image of a house in ruins is taken from the area of El Cabaco (Salamanca). These are the ruins of a house built at the end of the 19th Century and abandoned in the 1970s.

Figure 17. Another example of a construction abandoned in a recent era. The photograph was taken in La Balouta (Leon, Spain).

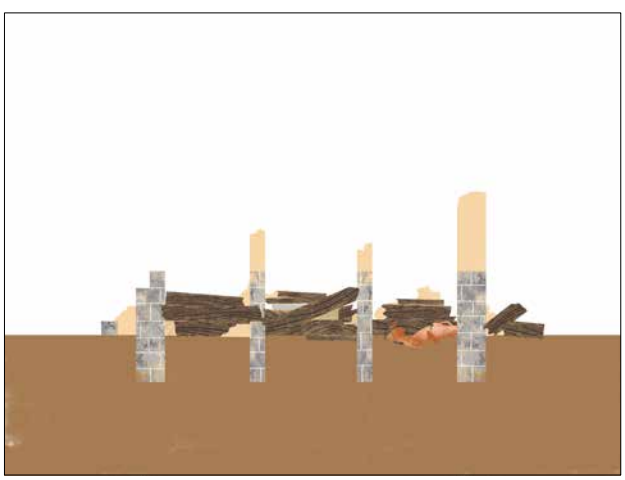


Figure 18. The house in an advanced stage of abandonment.

In a few years, the collapsed structure is covered by dirt and grass, as seen in the last drawing. Over time, different natural processes will completely bury the structure. Various images can be found on the internet that very clearly show how these processes work, and can be shown to the students in class.

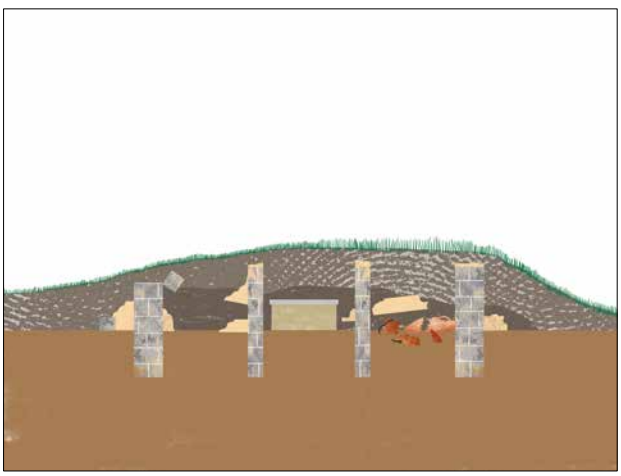


Figure 19. The house completely buried.

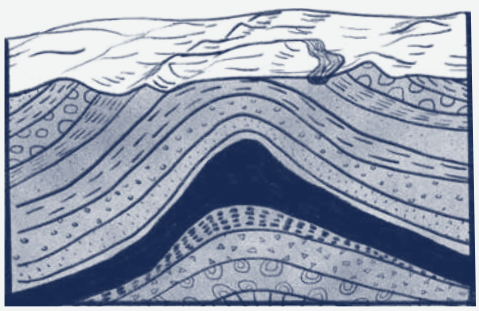
The Roman house animation –as the drawing series above– is very useful to explain two aspects:

- First, the processes that form the archaeological record and why in the majority of cases the data used by archaeology is buried.
- Second, it is a highly graphic way to explain the formation of strata and the superposition of layers.

As the Flash animation continues, it shows how the Roman house is later excavated layer by layer; the process of recording and analysing data (in the field and laboratory) and finally, how educational benefits are taken from the site (it shows a restored and protected site, with information panels). These slides would be very useful to deal with other aspects, such as laboratory work and the value of heritage.

2.2. THE PASSAGE OF TIME: STRATIGRAPHIC SEQUENCES

As we see in our Flash animation, when an area where human activity took place is abandoned, it is transformed by different processes. These include natural and artificial processes. If only nature intervenes, in a few weeks the area begins to be covered with vegetation that over time forms a stratum that covers it completely. Rain, wind and other natural processes contribute to the creation of these strata.



Stratum: A layer of soil that has been deposited over time on an area of land, formed by erosion, transportation and sedimentation. A stratum may or may not contain the remains of human activity.

It is very common for human beings to intervene in the formation of archaeological sites, returning to live in the same spot, destroying earlier constructions to build new things or covering the area with soil to grow crops.

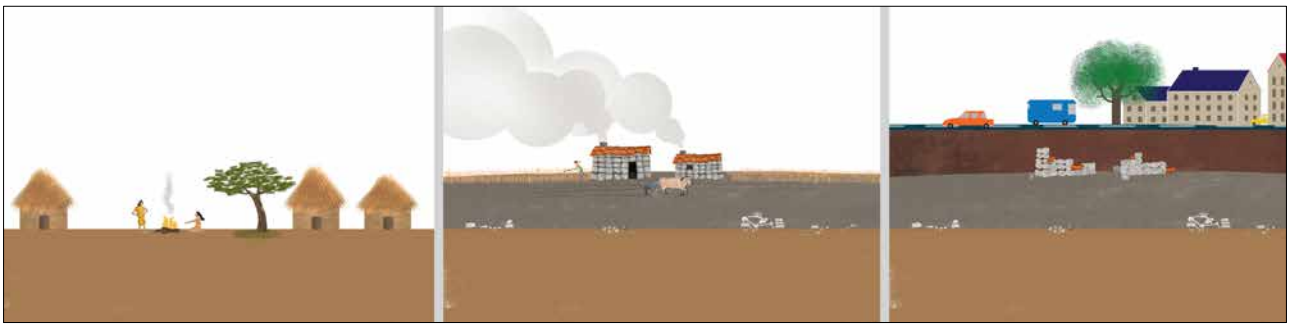


Figure 20. The process of formation of a stratigraphic sequence.

The **principle or law of superposition of strata** is based on observations of natural history and the foundational principle of sedimentary stratigraphy and other sciences based on geology: 'layers of sediments are deposited in a temporal sequence, in which the oldest are found below the more recent ones'.

Human beings leave evidence of their activity in the natural environment and transform the landscape over time. These transformations and the diverse occupations of a space over time are recorded as layers in the stratigraphy.

The formation of a stratigraphic sequence (which is the superposition of various strata, one on top of the other) can occur over a short period of time or over a very long time scale. It is important for the study of the site to understand the processes that take part in its formation and in its later transformations.

Archaeologists use the principles of geology to interpret these strata. One of the basic principles to study a site (and essential when excavating it), is the law of superposition, which, in its plainest form, states that the oldest strata will be at the bottom of the sequence and the youngest will be closest to the surface. Furthermore, the accumulation of strata or layers tends to be horizontal. All the layers of a site together are referred to as a stratigraphy.

There are different ways to explain the formation of sequences of strata. These formations can be represented in various ways, but one of the most graphic is to compare it to a layered cake: in the stratigraphic sequence the layers are deposited from bottom up, just like with a layered cake.

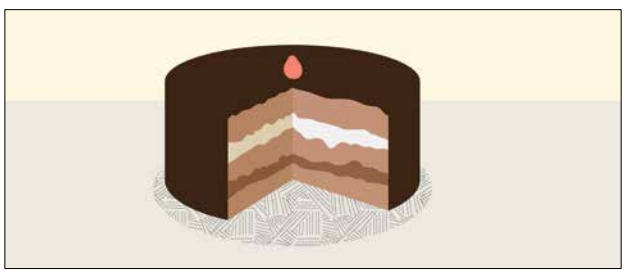


Figure 21. Stratigraphy can be compared to a layered cake.

The cake image is also useful for introducing other topics, such as the damage done by looters and people who use metal detectors to discover archaeological sites (and other aspects related to protecting and respecting archaeological

heritage, which is a non-renewable resource). When a hole is dug in the ground to unearth objects, the stratigraphic sequence is broken, the damage can be compared to what happens if someone sticks their finger in a cake to find out what it is made of (instead of making a clean slice).

Figure 22. The destruction of the stratigraphic sequence entails the loss of a great deal of information about the site's past.

2.3. WORKING WITH STRATIGRAPHIES: THE TIME BOX

Using the principles of stratigraphy and the superposition of layers, students can be introduced to the idea of how to measure time, as well as how to establish chronologically relative sequences. Students will gain a better understanding of the foundations of scientific reasoning in archaeology when they learn how archaeologists construct the temporal framework of the societies they study (Ruiz Zapatero, 2010, article cited above).

Explaining how strata and the archaeological record are formed can be approached using a 'time box' (original idea taken from Ruiz Zapatero, 2010). A transparent plastic box (like a quadrangular fish tank) is filled with different levels of soil, or coloured sands (or sands with different textures, such as those used in construction). A house can be modelled with play dough, or any other material, and then the processes of the structure's collapse and burial can be simulated so that the students can understand the nature of archaeological sites.

Figure 23. Picture of the 'Time Box' made by students at IES Maria Rodrigo (Vallecas, Madrid, Spain) in CSIC's 'Neighbourhood Science' project.

This activity will help students to understand why archaeologists excavate a site by layers, without mixing them. The soil in one stratum is removed in uniform layers. Everything found in a stratum is stored together, separate from the other strata, with a tag identifying where it came from. We know that we have changed stratum because the colour and texture of the soil is different and the elements that form that stratum and its consistency will also change.

We also distinguish the soil that is inside a structure (a grave or a pit, a room) from that which is outside of it.

Explaining the concept of a soil layer (stratum or stratigraphic unit) to students can be broadened by using other kinds of activities (see ahead) or by visiting places outside the school (in the city or countryside): take advantage of nature walks to make observations of the cuts in the paths (example) and to distinguish between different ground layers; in the city, use construction or earthmoving sites, sewer repair, or any circumstance that exposes the subsoil.

Figure 24. Old Market Square in Bydgoszcz (Stary Rynek), Poland, during development works.

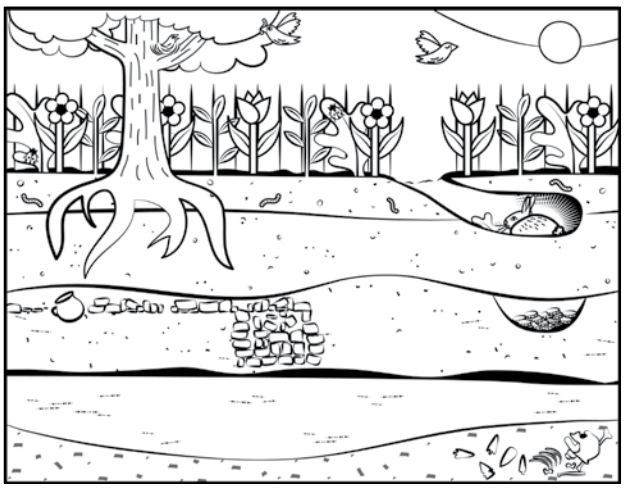
An archaeological site can also be reproduced in the school playground (or the 'time box' can be built out in the open, on the playground) so that the collapse of the house, or the burial of its remains can occur naturally (over the course of weeks with rain, wind…) and strata can be formed.

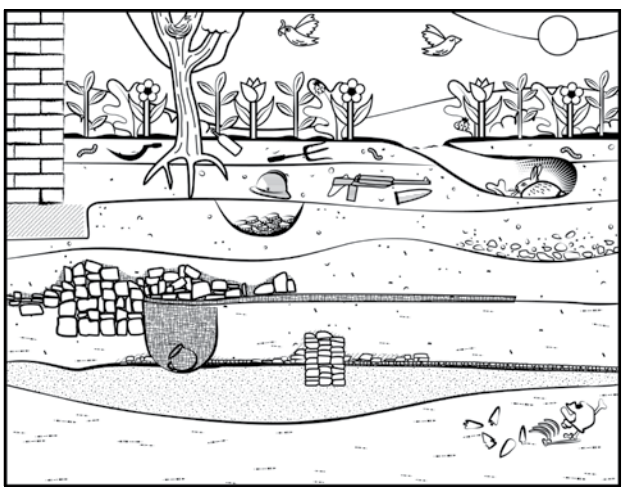
The 'time box' can be built in one or various sessions and, as mentioned, accompanied by other activities. We suggest two complementary activities:

1. The rubbish bin: after explaining the concept of ground layers and how they are formed, for a week or two, using the class rubbish bin or a transparent plastic rubbish bin, deposit the waste from the activities carried out in class. After this time, the bin can be 'excavated' in a way that the different remains from the classroom activities (clippings, the remains of magazines) can be used to create a record of what had been done during those weeks.

Figure 25. The rubbish bin.

2. Colour a stratigraphy: CSIC at School proposes two stratigraphies, with different degrees of difficulty. The students colour the ground layers with the help of the teacher.





Figures 26 and 27. Stratigraphies proposed by CSIC at School, with different degrees of difficulty (easier, above). These can be downloaded at the CSIC at School web site.

During this activity students can be asked the following questions: How many ground layers can you identify? Why were you able to identify those layers? The layers can be numbered –just as is done in archaeology– from top to bottom, in this way working on mathematical concepts. Once the drawing is completed, the activity can be concluded by having the children make up a story or historical narrative about the sequence in the drawing (Figures 26 and 27).

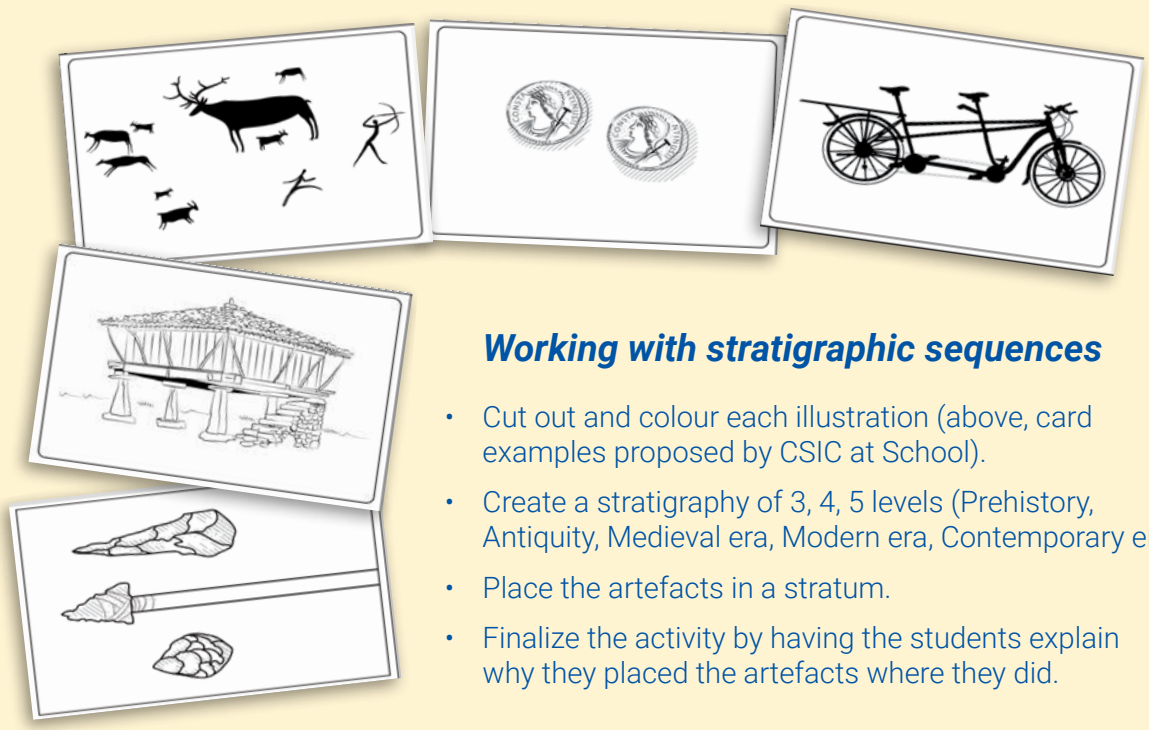
Older students (in the 4th year of primary education, 9 years old and up), can work on the concept of stratigraphy using real elements in their surroundings. Students can be asked to draw their own ground profile, imagining an archaeological site (this work should be done in groups, drawing, for example, various generic layers on a poster board: prehistory, Antiquity, modern era, contemporary era). Afterwards, the students must include the artefacts that represent the history of the site chosen (CSIC at School has cards with diverse artefacts that can be used for this activity.

In summary, the 'time box' and the activity on stratigraphic sequences enables students to:

- Organize, classify and sequence information, like real scientists.
- Understand the importance of identifying strata during archaeological research.
- Understand the processes that form a site and, by extension, its surroundings.
- Value the importance of respecting archaeological heritage, which is a non-renewable resource. Each site, and every superposition of strata, is unique. Its context is just as important as the object recovered, the layer in which it was recorded.
- Understand that archaeology does not search for treasure, but rather to understand the history of our societies and how they have shaped our surroundings.

The following charts and figure 28 summarize these ideas:

Figure 28. Stratigraphy created by four teachers from Santo Domingo (Dominican Republic) during a training course.



Working with stratigraphic sequences

- Cut out and colour each illustration (above, card examples proposed by CSIC at School).
- Create a stratigraphy of 3, 4, 5 levels (Prehistory, Antiquity, Medieval era, Modern era, Contemporary era).
- Place the artefacts in a stratum.
- Finalize the activity by having the students explain why they placed the artefacts where they did.

Understanding time. Working with stratigraphies

Working with archaeological stratigraphies allows students to:

- Understand how the passage of times affects an area of land.
- Comprehend the formation of strata and the laws of stratigraphic superposition.
- Analyse different strata.
- Distinguish the oldest strata from the youngest.

After completing the activity the students should know that:

- The passing of time leaves a mark on areas of land.
- Those marks can be seen and studied.
- They can recognize basic stratigraphic sequences in any cut in the terrain they can find in their surroundings.

3. THE IMPORTANCE OF CONTEXT

In this section we are going to see that archaeology is like everyday life: evidence must be studied in its original archaeological context or, at least, in the context in which it is found. The objective of this section is to show how students can use games and discussion to understand and transmit how important it is to examine artefacts in their context to learn about past societies. Ultimately the goal is for students to know that:

1. Archaeology is a science of 'context'.

2. Context is essential for archaeological research: artefacts must be studied in their context to learn about people from the past.

3. Understanding the importance of context helps raise awareness about respecting the integrity of archaeological sites and the consequences of intruding on them (for example, when metal detectors are used to trespass on sites, it upsets the integrity of underground or surface archaeological deposits and modifies the original context of the artefacts, thereby eliminating information essential to archaeological research).

Indeed, 'context' is a key concept to understand the process of archaeological research. Context provides meaning to the elements

that are registered and analysed; in fact, how the elements that are registered (artefacts and other remains of the past) are interpreted depends in large part to the context. Moreover, in many cases context makes it possible to date things (some of the methods used to discover the age of the sites will be discussed later).

Context can be defined as how artefacts are related to each other and the position in which they are found, either on the surface or in a stratigraphic sequence. Although, in reality, context involves more than just the artefacts; a more precise definition would be a collection of artefacts, elements and material conditions that interact through human activity. These elements, artefacts and material conditions participating in a context can be referred to as 'components'.

The functions of the components of a context are revealed by their attributes and their relative position in the contextual composition.

A simple example can be used to illustrate the importance of context, for instance, the position of a ceramic object, a pot. That pot will have a different meaning if it is found, for example, in a funeral context (a tomb, as part of a funeral dowry) or in a domestic context (in a kitchen, for example). That pot can also be found decontextualized, due to the earth being moved or even through the unscrupulous actions of looters searching for treasure with a metal detector. The decontextualization of this pot means that we lose all the information provided by its context, which would make it useless to archaeological research.

Figure 29. Ceramics in a funerary context. Reconstruction of the tomb of the Lord of Sipán in Huaca Rajada, Peru.

Figure 30. Ceramics in a domestic context. Ancient Greek amphoras, Khersones, Sevastopol.

Figure 31. Decontextualized ceramics. Exposed ceramic remains in a plundered archaeological site.

Ultimately, archaeology is like daily life: the evidence must be studied in its original archaeological context or, at least, in the context in which it is found.

3.1. THE CONTEXT GAME. INTRODUCTION

As mentioned earlier, students can use games and discussion to discover the importance of finding artefacts in their context to learn about past societies. The goal is for the students to learn through experience that archaeology is not about searching for buried treasure and decontextualized material is of no interest: archaeology is the science of 'context'. The proposed activity will help them to understand its importance for archaeological investigation. Artefacts must be studied in their context to learn about people from the past.

To kick off the activity we can start by explaining, for example, that the things people own tell us something about what those people are like. Indeed, the things chosen by a child, for example, can indicate age, sex, gender, etc. For example, a Betis shirt and a football in a bedroom would suggest that the owner likes football. Various posters of animals and a collection of books about dogs would suggest that the person likes animals.

However, these objects (artefacts) can only tell a more or less complete story if they are found together, where their owners left them, in other words, in their context.

Figure 32. Field work. Collection of data and information about the terrain.

Figure 33. Field work. Archaeologists collecting samples for a chemical and physical soil analysis.

Figure 34. Field work. Collection of data and information about the terrain.

Just as the things we own say something about us, archaeologists use things made by humans groups in the past (**artefacts**) and where they left them (**context**) to piece together their story.

Archaeologists preserve the context of artefacts that they collect from sites by recording the position of everything they find. When the context is lost, the information is lost (the artefact + its context provide more information than the artefact alone).

In order to introduce the game, the students can be asked the following questions:

- If I didn't know you and walked into your room, what could I find out about you by looking at your things? Could I tell if you were a boy or a girl? Could I tell what you like? Could I tell if you shared the room?

  Think of something in your room, an object that is special to you. What does that object say about you, along with something else in your room? Altogether, all your things reveal things about you because they are in context. You have chosen certain things and those things say a lot about you when they are found together.

- Now imagine that your special object was taken away and found in a park. How would this change what we know about you? When it is taken out of your room, the object by itself doesn't tell us anything. And, what's worse, your room is now missing an important piece of information about you!

The context has been changed and part of the information about you has been lost.

3.2. PLAYING THE GAME

The game is based on the resources created by the Society for American Archaeology and can be downloaded from their website www.saa.org/publicftp/PUBLIC/home/home.html (last accessed April 19 2018). The resources created for the Erasmus+ SciLit project that accompany this guide can be downloaded at www.csicenlaescuela.csic.es.

Tell the children that they are going to play a game that requires them to think like archaeologists. Divide the class in groups of 5 or 6 and assign each group a different number.

Then assign each group a room or type of building (for example, a hospital, school, restaurant, hair salon, hotel).

Each place is associated with various objects (artefacts) that define them (you will find these files or cards in the link to CSIC at School, shared above). The students can colour the cards. It is important that each card is marked with a key (if we decide that the restaurant is number 1, all the restaurant object cards will also be marked with a number 1 on the back). The drawing shows an example of the type of cards that can be used (the student can colour them or cut them out before the game starts).

The game starts when each group passes their cards to the next group (in clockwise order, for example). Every group has to see each set of cards and try to infer the function of each place. For the game to work, it is very important that two cards are removed right before passing the sets on. These cards are set aside, so that they do not get mixed with other sets of cards.

To start with, each group will have 10 cards related to a context; however, the first time they receive a set of cards from another group

The context game

it will only have 8 cards, as two have been removed from the set; then 6, then 4 and finally, 2 cards.

Each time a group receives a set of cards they will write down what place they think the cards represent on a piece of paper (the drawing shows a model that can be downloaded - as well as the set of cards- at CSIC at School website, see Figure 35).

The teacher will check the answers given by each group, and will show how many groups correctly guessed the functions of each place. Is it possible to know the function of a place if they do not have all the cards? Is an object out of context capable of providing us as clear an idea as all of the objects together in their original context?

The activity demonstrates that when artefacts are removed from a site, they are taken out of their context (that are decontextualized) making it more difficult to obtain a complete understanding of people from the past through them.

The way the game is played can be modified in accordance with the time available or the objectives of the teacher: the teacher can opt to give each group two cards at first, then three…

In the Erasmus+ SciLit project we have carried out this activity with groups of teachers and students. Normally groups were able guess the context with 8 and 6 cards. The groups that received the school, or the hair salon, for example, were incapable of guessing what they were with 4 and 2 cards.

To conclude the activity, ask the students to explain how the components of a context are the basis of understanding people, even people from the distant past.

Have them imagine what would happen if archaeologists found their classroom 1,000 years from now and discuss as a group how the objects that would be found could help them learn things about the class.

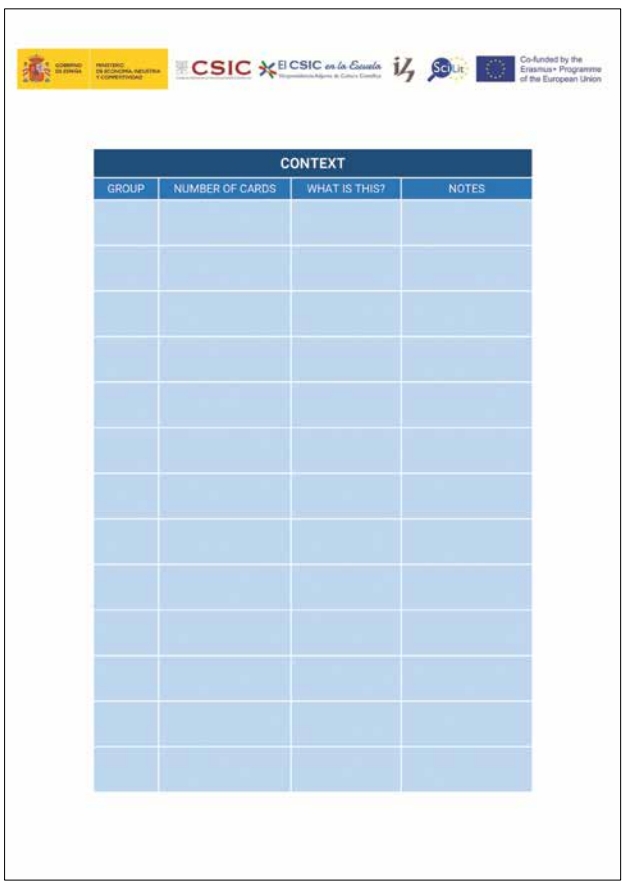


Figure 35. The context game.

3.3. SOME OBSERVATIONS ABOUT DATING ARCHAEOLOGICAL SITES

One of the most important questions to ask when an archaeological site is found is how old it is. For the research is it very important to place it in time: not only its age (when it came into existence, when it was founded), but also how long it was in use. Without this information it is impossible to come up with a good interpretation of what happened there.

In archaeology there are various ways of discovering the age of a site. Normally more than one dating method is used: archaeologists will decide what methods are most appropriate, depending on the objectives of their research, the characteristics of the site or the resources they have available to them. Dating methods can be divided into two groups: relative dating methods and absolute dating methods.

Relative dating methods are unable to determine the absolute age of objects, but can determine what is older and what is more modern. This kind of dating is carried out through the stratigraphy and the characteristics of the materials that are found.

We have seen that stratigraphy is essential to understanding how a site was created. Over time, various layers of earth are formed by erosion, sedimentation and human activity that are differentiated by colour, composition or texture. The strata or layers are deposited one on top of the other, more or less horizontally.

This stratigraphy allows sites to be relatively dated because lower strata are older than upper strata and, moreover, everything contained in a single stratum has the same age (objects, coals, structures…). Identifying the materials can also provide relative dating. The way objects are made, their shapes and decoration, change over time, and by studying these changes they can also provide dating information. For example, if we find a metal object we know that it must have been made after the discovery of how to work with that metal.

In contrast to relative dating, absolute dating provides an exact date, that is, it allows us to affirm that a specific element is 'a certain number of years old'. There are different absolute dating methods used on archaeological material: Carbon-14, thermoluminescence, potassium-argon, uranium-thorium, dendrochronology, etc.

4. THE SURFACE ARCHAEOLOGICAL RECORD: LOOKING AT THE GROUND

One of the activities we proposed for teachers to apply archaeology in the classroom during Erasmus+ centred on one of its most important work methods, the field survey. The objective of this exercise is to shift attention away from archaeological excavation, which is often identified as the exclusive work of archaeology, and to broaden the students' perspective and teach them to observe their surroundings in a new way, thereby expanding their understanding of our archaeological heritage.

At the suggestion of various teachers in Seville (Spain), we have named this activity 'Science on the Surface (looking at the ground)'. The idea is to simulate an archaeological field survey in order to, first of all, identify and employ basic archaeological procedures. Second, to determine how sites and artefacts, recorded in

their context, provide information about human behaviour. Third, to analyse the survey data in the laboratory and make inferences about human behaviour. Fourth, to compare this research with the study of archaeology.

Upon completing the activity the children will know that the objects, artefacts, elements and recorded material conditions found in a site provide information about human activity and they will also gain a better understanding of how archaeologists work and, more concretely, the importance of documentation and recording information obtained from fieldwork and the basic procedures of laboratory work.

In other words, the activity implements all the knowledge the teachers acquired during their initial training and teaches the students that archaeology deals with human behaviour, and that this does not necessarily require excavating sites.

During the teacher's course we saw that archaeology does not work exclusively with excavation. For example, if we go to a doctor because our arm hurts they don't immediately put it in a cast or take us into surgery. They first carry out a series of diagnostic tests to understand the problem and deal with it in the most effective way. Similarly, the work of an archaeologist starts well before it is decided to excavate: the archaeologist first asks certain questions about the people who lived in a certain time period, what their surrounding environment was like, how they took advantage of it, how their society was organized, etc. Once they identify the scientific problem to be resolved and develop a working hypothesis, they have a set of scientific methods and sources to explore it. The archaeologist has to choose which of those methods is most appropriate to resolve the question.

Archaeological fieldwork primarily revolves around a site. We have seen that an archaeological site is a place that contains the material remains of any human activity in the past. In order to explain it to students, teachers can again turn to the Flash animation that was used to talk about stratigraphy, in which the formation of a site is described.

Figure 36. Screen shot of CSIC at School's virtual museum website.

The material remains that are documented in a site can include all kinds of artefacts (ceramic objects, remains of seeds, inscriptions, etc.) or structures (walls of buildings, paths, agricultural terraces, cave paintings), in other words, the remains of any human activity.

4.1. ARCHAEOLOGICAL DATA (THE ARCHAEOLOGICAL RECORD)

Archaeological data are the material remains of human activity in the past. These data, what archaeologists refer to as the archaeological record, are hidden away, varied and have multiple meanings; in the words of Victor Fernandez (1989), they are 'hard to sink your teeth into'. Following Fernandez, we can say that archaeology has to use all of its abilities to obtain, analyse and incorporate data into an interpretation.

Archaeological data is highly varied and to obtain them it is necessary to employ different recovery procedures, and to study them, various analysis techniques.

Broadly speaking, we can differentiate two large sets of data: perceptible and imperceptible data; that is, we differentiate between a visible archaeological record and an invisible one. The first group contains data linked to living areas, such as construction elements (walls, rocks, columns, bricks, roof tiles), movable objects (whole or fragments), such as ceramics, coins, glass, etc. The table lists various examples. The second group contains data not visible to the naked eye, but that also provide a great deal of information: the soil in the layers of the site, organic remains, microscopic bone fragments, fossilized pollen, etc.

ARCHAEOLOGICAL RECORD	
VISIBLE RECORD	• Composition and colour of soil layers (or changes in the terrain's surface) • Seeds and nuts / coals • Bone remains (fauna and micro-fauna) • Tools and man-made materials (stone, ceramics, glass, metal...) • Structures (remains of buildings and other human activities such as silos, walls, homes, mines...) • Artistic representations, inscriptions
INVISIBLE RECORD	• Microscopic remains (mites, pollen) • Chemical elements (phosphorous, potassium) • Physical characteristics (texture, granulometry)
Quantifiable	

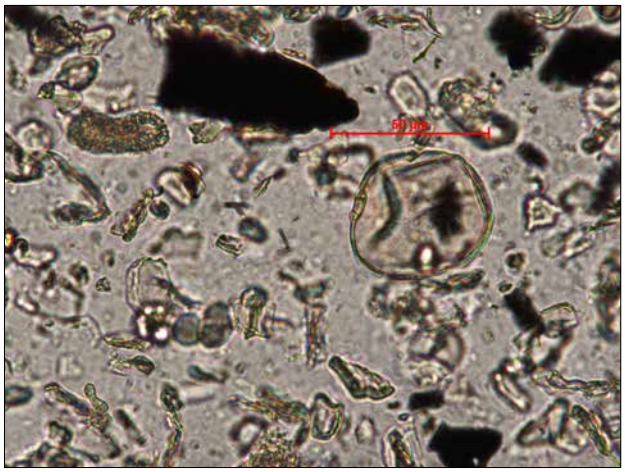


Figure 37. Example of invisible record: Ancient grain pollen seen through a microscope.

4.2. ARCHAEOLOGICAL SURVEYS

The term archaeological survey refers to fieldwork and laboratory work that focuses on studying a geographic area with the objective of discovering any archaeological sites it may contain. There are various reasons to carry out surveys today: for example, the need to document the maximum number of sites possible in an area before the construction of a highway, to analyse the archaeological impact it will have on a territory. From the point of view of researching an area within an archaeological project, surveys allow us to understand past human behaviour on a larger spatial scale than that of a site.

Indeed, through field surveys –which involve studying the surface of a terrain –archaeologists can learn where human groups settled and how they used the land.

An archaeologist's work during a survey is very important, because all visible information on the surface of the terrain must be meticulously recorded so that none of it is lost forever and we can understand and reconstruct our past.

Surveys usually consist of two parts (Fernández, 1989): prior analysis (bibliographic and laboratory) and fieldwork. The former consists in examining all existing information about the area of interest and the latter is involves studying the terrain in search of sites. The background information is found distributed among various sources (topographic maps, aerial photographs, written descriptions and bibliography).

Survey fieldwork consists in studying the surface of a terrain to find and record sites in a specific area. When a site is found, its borders are marked and mapped and then it is described in as much detail as possible, collecting the maximum amount of information, including mapping and recording all the artefacts located within its boundaries. In the real world these artefacts are only collected if they are necessary for the study or if the site is going to be destroyed due to urban development, road construction, digging a quarry, etc.

Environmental-ecological information about the site must also be collected. In addition to recording its topographic location, its approximate extension and making sketches, the natural setting must also be analysed. For instance, the surrounding geology, the area's relief, the climate, soil, hydric resources and usable raw material (rocks, minerals, clays), the vegetation, the type of fauna, the distance from connecting routes (paths, rivers, glens), the visibility of nearby areas from the site (Fernández, 2000). The use of a standard worksheet to describe all the information facilitates collecting as much data as possible.

Figure 38. Archaeological survey is the systematic exploration of the land surface.

The next step would be to analyse maps and all the information collected in the laboratory.

A useful resource for older students, in 6th grade of Spanish Primary Education (11-12 years old), is 'Search for a human footprint' developed by the CSIC and Zazúar School (it can be downloaded from Digital CSIC: http://hdl.handle.net/10261/81855). It contains very useful images (the image below was created using various images from this resource).

An ancient landscape

1. What we see at surface.
2. What we see when we dig.

Montage made with images included in the material developed in the Conservation and Revaluation of Cultural Heritage research programme (TCP) (CSD2007-0058) CONSOLIDER-INGENIO. Accessible at digital.csic: http://hdl.handle.net/10261/88713

An archaeological survey would allow for all the anomalies in image to be documented. If we wanted to learn more about the site, the following step would be to start excavating.

4.3. LOOKING AT THE GROUND… A SURVEY OF OUR SURROUNDINGS

Just like we study archaeological sites and the artefacts they contain to learn about past human behaviour, we are going to study the surroundings of our school to learn about recent human behaviour.

There are various areas in the school (the parking lot, back garden, side garden, playground, entrance, etc.). The artefacts that are documented in each of these areas (swing set, planters, waste baskets, cigarettes, paper…) can indicate what the people did there.

These areas are going to be our 'sites' in this project. The objective is to recognize and analyse different activity areas in our surroundings to learn about contemporary human behaviour. The study areas can be different parts of the school grounds: the parking lot, the playground, the entrance area, a side garden… or a nearby (and safe) place: a park, a pedestrian street…

Figure 39. Teacher and Resources Centre of Gijón (Spain) in a Google Maps image.

The procedures that we are going to follow are the same as in a real archaeological survey.

1. Select an area to work on in the school or its surroundings and various outdoor areas within it: parking lot, school entrance, the playground for the younger students, the playground for older children, workshop area…

2. Draw the students a map. It is recommended to work with an aerial photograph (google maps) and a simple map (this will depend on the age of the students), so that they learn to see things from another perspective and in their context.

3. At the playground divide the students into groups to explore the selected areas (they can also go to each area as a single group). This will depend on the age of the students and the teacher's preference.

4. Observe the surface of the terrain and describe the characteristics of the site (boundaries, extension, structures, ground, vegetation). Also record all artefacts found on the ground or any anomalies that are observed. Objects that are considered to be representative will be collected (in bags, by

Figure 40. Teachers simulating an archaeological survey during a CSIC at School training course in Santo Domingo (Dominican Republic).

type), noting down the area in which they are found (the bags will be well marked and tagged so that nothing is lost).

5. Sketch a map that shows what is observed on the surface of the terrain.

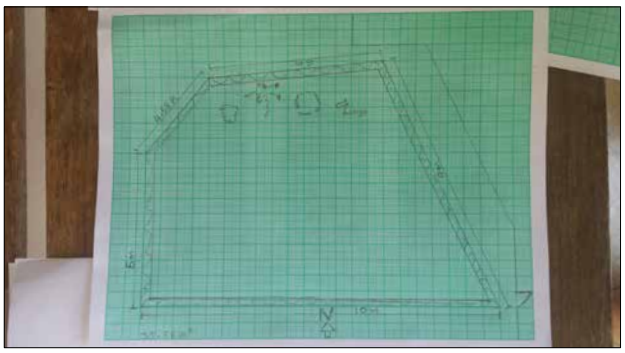


Figure 41. Sketch of an area surveyed, carried out by teachers during a CSIC at School training course in Santo Domingo (Dominican Republic).

6. Return to the classroom. In the same session or in various consecutive sessions, carry out the laboratory work in order to deepen the analysis:

   - Clean the material (if it is ceramic, with water and nailbrushes).
   - Dry the material.
   - Number the material (each material should be numbered, ceramics and other kinds of material can be marked with a permanent marker).
   - Classify the material.

   It is not recommended to work with organic refuse or with sharp pieces of glass or ceramics. The students should collect bottle caps, pieces of plastic, paper... but be careful with cigarette butts. Explain to the students that you are not going to collect all materials, only those that provide information about the study area.

   As mentioned the laboratory work starts with washing the material that has been collected (with water and nailbrushes), as seen in the photographs.

Figure 42. Field work at Santa Barbara Primary school schoolyard (Bembibre, León, Spain).

Figure 43. Laboratory work. Cleaning material during a CSIC at School training course in Santo Domingo (Dominican Republic).

Figure 44. Drying the material after washing.

The material is then air-dried in the classroom, on newspaper. It is necessary to be very organized, so the material must always be accompanied by labels that identify them, so that you can always remember where they came from.

Once washed and numbered, the most representative material can be drawn and described.

7. Describe all the evidence documented in the site (artefacts, elements, material conditions of the area explored…).

8. Interpretation and narration (final report).

Figure 45. Drawing of material.

Figure 46. Drawing of material.

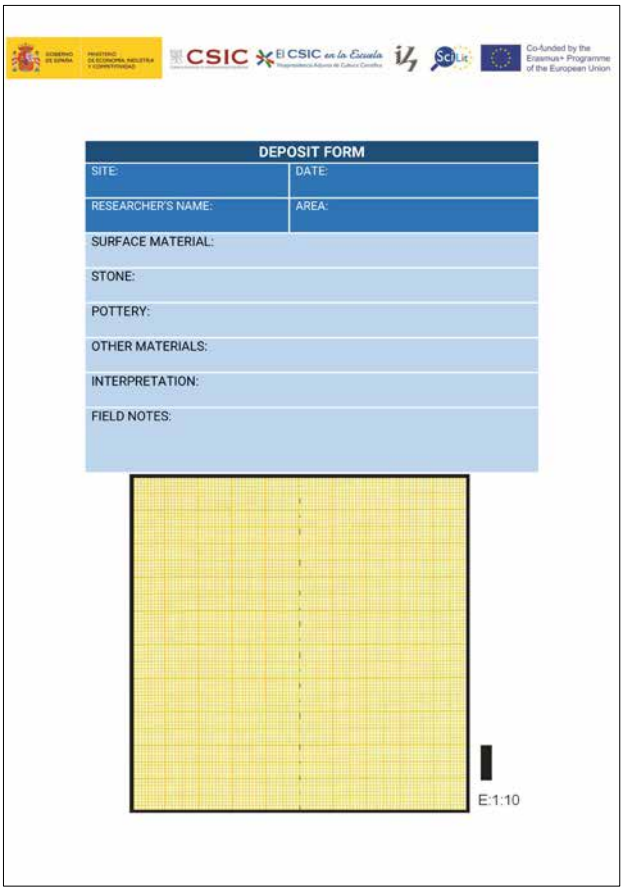


Figure 47. Example of a site record.

9. Conclusions:

To conclude the activity the documented objects can be displayed and a presentation can be given, written on pieces of cardboard or in Power Point. In their presentation to the other groups the students should include:

- The name of the site.
- Justification (aim): why this site was chosen.
- Methods employed in the study.
- A summary of the data collected

with descriptions of them (objects, observations, oral testimony, interviews…).

- An interpretation of how the site was used based on the objects present there, how they are related to each other, anomalies.

- A list of other sources of information (evidence) that supports their interpretation (interviews, bibliography).

Finally, based on the objects present in the site and their relation with each other (their 'context'), what inferences can be made about the activities taking place in this site?

10. To end the activity. The children can present their conclusions in class (or in a presentation for their parents). This presentation can be completed with an exposition of the material and documentation that was generated (maps, drawings).

The materials necessary to carry out this activity are:

- Site record sheet. It is a good idea to write down all the observations made by the class in a field journal. This journal can be used during all the activities related to archaeology.
- Graph paper (to sketch a map, to draw archaeological material).
- Compass.
- Measuring tape.
- Pencils, rubbers, coloured pencils.
- Plastic freezer bags.
- White labels.

Figure 48. Kids observing the site records after field work (Primary School Santa Barbara, Bembibre, León, Spain).

5. THE VALUE OF THE PAST

In earlier chapters we have seen that our surroundings, the landscapes, archaeological sites, the remains exhibited and stored in museums... represent the tangible and visible past, part of our collective memory. Archaeology has the enormous responsibility to protect and preserve that memory.

This chapter will discuss why the 'past' is important, and demonstrate in detail why our historical memory (in a broad sense) and archaeological, historical and cultural heritage are important, because they belong to everyone. To do so we will use the proposals made by CSIC at School to gradually teach why it is important to study the past and recognize the difference between different pasts and the present. The first step is to gather information about our own past (our grandparent's time).

This activity was designed for different purposes. The idea is for the students to:

1. Understand and be able to explain why researching the past is important.

2. Learn about the different ways we can get to know the past, including analysing written documentation, material elements, sources of oral history, etc.

3. Better comprehend the value of our archaeological heritage.

Ultimately, this activity introduces students to the study of **time** and how it relates to everyday events and their personal and family lives. The objective is to teach them the concept of the '**past**' and explain to them why it is important.

There are various classroom activities in this proposal that take advantage of a basic resource to reconstruct the past: the personal and family lives of the students.

Just like the activities carried out during our Erasmus+ SciLit programme, this chapter emphasizes the work methods employed in archaeology, in order to develop a foundation for the scientific reasoning of Human and Social Sciences in the classroom.

We have already seen that the **archaeological record** allows us to reconstruct the past. The careful and detailed study of remains buried underground or visible on the surface allows us to recompose images of history that we would never discover otherwise. That is why **it is imperative to respect and preserve our archaeological heritage**. If we allow it to be destroyed those fragments of our history will be lost forever.

A warmup activity that can be carried out with the students is to ask them about current threats to our archaeological heritage. The following image can be used to help set the tone.

It would also be useful to revisit the following concepts:

- **Archaeological site**: A site containing the material remains of human activity carried out in the past.
- **Archaeology**: A scientific discipline that uses specific methods for studying past cultures and analysing the material evidence they left behind (artefacts, sites, remains, sediments, etc.).
- **Artefact**: Any object made or used by humans.

5.1. WHY IS THE PAST IMPORTANT?

This activity can be also be used an introduction to the study of our archaeological heritage. Students will use a personal object in order to:

- Share the importance of their past.
- Connect the importance of their personal past with the reasons why the human past is important.

To start the activity, ask the students to bring an object to class, a photograph or drawing that represents their past.

Figure 49. Old family photograph taken at Samil beach (Vigo, Spain).

We have seen that archaeological sites and objects (or artefacts in general) can be messengers of the past. If we know how to read their messages, material remains can tell us

about the people who made or used them and left them behind. Although the owners of these objects and the inhabitants of the sites lived hundreds or even thousands of years ago, they undoubtedly had the same needs and concerns, hopes and fears, joys and sorrows that we have today (which does not mean that we can make direct comparisons: this is a complex subject that has to do with theoretical problems in history studies and the issue of the similarities and differences between the past and present, to read more on this subject see Domingo Plácido's book: *Introducción al mundo antiguo: problemas teóricos y metodológicos* (Síntesis, 1993, pp. 24 and 25).

Figure 50. Fragment of Ara Pacis (Rome). The child to the right is Germanicus, with his father, Druso, and mother, Antonia.

These messengers from the past belong to everyone. And we all have the fundamental right to know how the world became what it is today and our place in it.

Material remains and their context also provide cultural continuity and perspective to present day societies. In the words of Salvatore Settis (*Italia S.p.A. L'assalto al patrimonio culturale*, Einaudi, 2007): Our cultural heritage is not a foreign entity, arrived out of nowhere, but something that we have created over time and with whom we have lived for generations and generations, for centuries and centuries; our memory, our soul. It is this connection that makes the whole of our heritage priceless, including in that it is the image and value of our country. Our most precious cultural asset is context, the continuum between monuments, cities, citizens; and this context includes not only monuments and museums, but also the culture of conservation that has allowed it to reach us.

Material remains link the past, present and future with the experience of any human generation. This is one of the key reasons why the archaeological past plays such an important role in creating, destroying or even annulling identities. An extreme example are the recent attacks on archaeological sites in northern Iraq, which has been referred to as an archaeological 'jihad' perpetrated by the Islamic State that has led to the loss of ancient cities such as Nimrud, Hatra and Dur Sharrukin.

Figure 51. Another extreme example. Buddha of Bamiyan before and after destruction by Talibans in 2001.

Objects are linked to the past through scientific analysis, but also thanks to the traditional value placed on archaeological sites and objects.

For example, the Campa Torres site in Gijón (Asturias, Spain) is valued by the population because it provides a tangible link to the ancient history of Asturias. A scientific examination of the buildings, objects and material extracted from the excavation of such places also provides scientific information about the lives of their past inhabitants.

Figure 52. La Campa Torres archaeological site (Gijón, Spain).

Similarly, some prehistoric (or ancient or medieval) sites in Poland, Lithuania, Estonia or Italy represent the heritage of their populations and are valued accordingly. A paradigmatic example is the Biskupin site in Poland, seen in the photograph.

Figure 53. Biskupin archaeological site (Kujawsko-Pomorskie, Poland).

Campa Torres, Biskupin, and many other sites also provide scientific information about the prehistory and history of a region.

We propose the following approach to this activity. As mentioned earlier, we believe this activity will allow students to discover why we study the past. And this can be related to how we study the past.

Ask the students to being an object or photograph from home that says something about their own past (or their family's past). If the object can't be brought to class, a drawing or description is sufficient.

Next, working in groups of 3 or 4, have the children tell each other what the object says about their past.

In an assembly (or class discussion), in the same or different session, the teacher can ask the following questions:

- Is knowing about your past important to you? Why or why not?
- Is it important to know about humanity's past? Why or why not?
- Humans have lived in Europe for at least 100,000 years. Is it important to know about their lives? Why or why or not?
- What can we learn from the past? (Some examples: how humans lived in the past and how and why human cultures have changed over time.)

To close the session the students can be asked: if your personal past is important to you, what conclusion can you make about the importance of the past in general?

You can carry out this activity at the start of your work with archaeology, but also at

the end, to demonstrate how the students have broadened their knowledge and comprehension of archaeology and the past.

The activity can be completed by visiting a nearby archaeological museum or a site. It is important to prepare the visit well, limiting it to a defined period or museum room and focusing on the questions we have seen in the training: They need to understand that there is a connection between these apparently decontextualized **objects** and **societies of the past**.

5.2. THE TRUNK OF MEMORIES

The goal of this activity is to encourage studying our archaeological heritage, specifically, the meaning of objects and how to interpret them. This is a simple exercise that will demonstrate how much information can be learned about a society by studying a single object.

However, in accordance with what we have seen during training and in earlier chapters, it is important to transcend the meaning of isolated objects and emphasize the importance of interpreting objects in their context.

For this activity we need an old trunk or suitcase and various old objects (clothes, coins, books, newspapers, bottles, old family photos, canned food, etc.).

Once the objects are collected, place them inside the suitcase.

Tell the children that yesterday the old suitcase filled with things was found in the attic of somebody's grandparents or an old house and that they are going to use those objects to find out who the owner was and what kind of life they led.

Questions you can ask to the students:

- Are you able to point out some traits of the person who owned this suitcase?
- Can you tell us when they lived? Approximately how old they were? What were their living conditions? How did they think?

If we are working with younger children, in kindergarten, the questions can be even simpler: How many years did this person live? Is it a man or a woman? How old was this person? Or talk about and ask them questions about the personal circumstances of the trunk's owner (family, work, etc.).

Some things that can be placed into the trunk:

- Old newspapers
- Old books
- Clothes
- Canned food
- Old family photos
- Bottle of liquor or wine
- Pack of cards
- Coins
- Train ticket

In this way:

1. The newspaper and the publishing dates of the books can tell us when the person lived, their personal tastes and political leaning.

2. The characteristics of the people in a photo or the clothes can also indicate the time period, the family environment or where they may have lived (where they were from).

3. The clothes and personal objects can tell us whether they belonged to a man or a woman, if they had served in the army or worked in an office or factory.

4. The type of clothes can also give us clues: if they are simple and well worn, or elegant and well cared for, it could indicate (along with the photo) the social class of their owner. If we find a picture of someone in uniform, it could indicate that our protagonist served in the military, and we may even be able to figure out if they served in combat (World War II, Cuba, the Philippines, etc.).

5. Books could indicate they had a good education, that they know how to read or that they were interested in social or cultural subjects.

6. A coin can tell us the society in which they lived and what that society was like: system of government, if the country was affiliated with a system of states (European Union), past symbols of the country, etc.

To conclude, we can remind the students that the material remains of a culture offer us varied information about the people who used those materials, who they were, when they lived, their economic and social level and even what they thought.

SECOND PART

FROM TRAINING TO THE CLASSROOM: PRACTICAL APPLICATION

1. INTRODUCTION

The second part of the guide, *Scientific literacy at the school. An inquiriry about 'Archaeology in the classroom*', presents the practical experiences of the schools involved in the project. These experiments were based on the content of the initial training and proposals developed by CSIC at School that are presented in the first part of the guide. But first, we shall offer a few general thoughts regarding how the common methodology was applied in the classrooms and the overall results of the research.

All the archaeology projects were carried out following the experimental path proposed by CSIC at School, which was adapted to human and social sciences from a method that had been employed in earlier projects involving experimental sciences. For example, in the guide about *What is the world made of?*, the classroom work started with a few simple experiments, which started the students down the path of inquiry into observable facts that allowed them to construct theories and models to explain the world surrounding them. The archaeology projects have also followed the experimental path, placing a great deal of importance on the initial 'DART test' as a motivational experiment that introduces the subject. This activity, in which the children express their ideas on archaeology by drawing a picture, starts them down the path of investigation. As occurred in the experimental sciences project, the students played an active role throughout the entire process of exploring the material manifestations of past cultures.

The first step of this research project was the training course that the teachers from partner institutions attended at the start, the basic content of which is included in the first part of this guide. After the initial training, CSIC at School sent various materials with specific proposals (itineraries) to work on archaeology in the classroom. The experiences that make up the second part of this guide reflect the pedagogical criteria of the teachers who adapted these materials to their classrooms and the cognitive capacity of the students.

Six specific experiences are presented here in the following order:

1. San Francisco Public School (Pamplona, Spain). 'IN SEARCH OF THE LOST ARCHAEOLOGY'. The general objective of the project carried out by this school was based on the questions:

   - What is archaeology?
   - What does it do?
   - What is it for?

   The activities carried out guided the students step by step through an introduction to the concept of archaeology and its role as a social science, as well as its relevance for investigating our past and the sustainable management of our surroundings.

2. Asunduse Lasteaed Preschool (Tallin, Estonia): 'WORKING WITH ARCHAEOLOGY'. The objective of this project, which revolved around four independent activities, was

to introduce the children to the scientific discipline of archaeology and the basic aspects of the work of archaeologists.

3. Kedainiu Lopselis-Darzelis 'Zilvitis' (Kėdainiai, Lithuania): 'ARCHAEOLOGY IN PRESCHOOL'. The general objective of this research project was to discover what archaeology is and why it is important for our society. The project had the invaluable help of an important local archaeologist, Algirdas Juknevičius, from the Regional Museum of Kėdainiai. His participation in every stage of the project, coupled with the excellent work of the teachers, allowed the students to experience every step of a genuine archaeological investigation, using authentic sources first hand.

4. 'Little Explorers' Preschool P34 (Bydgoszcz, Poland): 'ARCHAEOLOGY IS FOR KIDS TOO'. The general objective of this research project was to teach the children about archaeology, a scientific discipline they were unfamiliar with. In this context, the activities focused on the connections between archaeology and other similar sciences, particularly palaeontology and anthropology, as well as on the concept of the archaeological record, by helping them understand the formation of strata and introducing them to how scientific reasoning is used in archaeology.

5. Two schools associated with the Gijón-Oriente Teacher Training and Resource Centre (Gijón, Spain) also participated:

- Antonio Machado Public School carried out a project called 'THIS IS ABOUT ARCHAEOLOGY' whose objective was to teach students about the methodology of archaeology, as part of a broader project on Prehistory that was being carried out by the school.

- The Begoña Public School's 'ARCHAEOLOGY IN THE CLASSROOM' project was highly original, revolving around two key concepts: comprehending processes of social change (and how these changes materialize in the sequential formation of the archaeological record) and the process of archaeological investigation.

To present a description of their projects each school used a general template provided by the project coordinator. Because it was mandatory to use this template to present projects, all of the teachers involved in 'Archaeology in the classroom' and also 'What is the world made of?' compiled the material produced during the scientific research carried out in their classrooms in the same way. This template is described below.

2. TEMPLATE TO BE USED IN ALL DOCUMENTS DESCRIBING CLASSROOM ACTIVITIES

Each document must contain the following sections:

1. TITLE OF THE RESEARCH PROJECT

Example: 'Archaeology is for kids too'.

2. DESCRIPTION OF THE ACTIVITY

This should include the total number of hours spent on the project, the school where it was carried out, the number and characteristics of the teachers involved, the resources used, the methodology used, the literature consulted, a description of the groups of students, and so on.

Below is an example of the information required for describing the group of students:

Number of students (boys and girls), age range, specific conditions and any other information describing the characteristics of the group.

3. PURPOSE OF THE RESEARCH PROJECT

The objective of the research should always include scientific content, the experimental methods followed and the structure of the scientific knowledge. The objective can be specific (discovering stratigraphic laws) or more general (What is archaeology? What does it do? What is it for?).

4. DEVELOPMENT AND PREPARATION OF THE RESEARCH ACTIVITIES

Describing how the students carried out the activity or activities.

4.1 *Assessment of the state of knowledge*

of the students before starting the activity, considering both the content and structure of scientific knowledge (NOS). DART test.

4.2 *Description of the methodology used*.

To clarify this, we have provided an example of how to describe the methodology involved:

a) The first task is an analysis of the ontology (set of concepts) needed in the application, organized as a Novak map.

b) Next, the corresponding **concept map** should be drawn.

In the concept map, the top (or final) level contains the concepts needed to describe the process that is the objective of the application, using scientific magnitudes. The lowest (or starting) level must reflect the concepts that are meaningful to the students *ab initio* (Ausubel level). In order to meet the requirements of meaningful learning, the teacher should design a constructive path between the Ausubel level and the final level.

If the age of the students permits, the teacher can explicitly specify how a concept becomes a magnitude: measurement process, units, and so on.

In the case of archaeology, these aspects can be related to some of the content in the school curriculum; for example, in primary school, learning how to measure time. The concept map can be complemented by other aspects, such as timelines or mind maps. The specific vocabulary is also part of this point.

c) The importance of inquiry in the research work: The Nature of Scientific Inquiry (NOSI)

To begin with, the teacher should choose a challenging experiment that serves both to awaken the interest of the students and to assess any prior knowledge they may have on the subject.

After performing the experiment, the students should be asked to describe the process in their own words, answering standard questions, such as What happened? How did it happen? Why did it happen? Which in the case of archaeology could be accompanied by questions such as: Where? When? How? How did they live, eat, dress, organize their society, bury their dead? How? Did they move around, cook, paint?

d) Uncovering the misconceptions and/or dismantling clichés

The teacher should use the answers given by the students to evaluate their prior knowledge, their Ausubel level and their capability of using language to precisely describe what they have seen while, at the same time, assessing the existence of misconceptions. These misconceptions must be deconstructed using classroom discussions, supported by suitable experiments or activities designed ad hoc.

e) The experimental path

The teacher, using the Socratic Method, must help the students design experiments that answer the standard questions, which will also be useful for them to construct the new concepts they will need, depending on their age. This experimental path, guided by the questions above, is what defines research work.

Throughout this educational process, experiments that are suitable as evaluation exercises will be introduced to check how well the students are assimilating new concepts. These exercises should be performed after presenting the most important or particularly difficult concepts. In the case of archaeology, these evaluations include the activity in section 1.2.3 (Working with stratigraphies, the time box) or section 1.4.3 (Looking at the ground … a survey of our surroundings).

5. FINAL ASSESSMENT OF THE ACTIVITY

In order to ensure that the learning process has yielded the expected results, at the end of the project the teacher must propose a new experiment, previously unknown to the students, the explanation for which requires the students to understand the top-level concepts on the Novak map. The students should not only identify the concepts but also apply the laws, models, and theories (as contemplated in the PISA proficiency tests) needed to theoretically explain why and how the process has taken place.

In the case of archaeology, an appropriate assessment could be to visit a museum or an archaeological site, an activity in which

Figures 1 and 2. Photographs taken during the initial training course on archaeology.

every concept is needed to understand what is happening. The assessment consists of comparing the level of knowledge gained by the students with their initial knowledge. No persistent misconceptions should be detected.

6. FINAL CONSIDERATIONS

Any drawings, photographs, graphs, or records made by the students during the development of the activity should be included in the report. All the graphic material must be accompanied by a corresponding descriptive text.

Each partner must ask for parental permission to publish the photos of their children.

3. RESULTS AND CONCLUSIONS FROM THE CLASSROOM EXPERIENCES IN ACCORDANCE WITH THE GENERAL PROPOSAL PRESENTED ABOVE

As stated in the introduction, the project partners put into practice the proposal made by the coordinator, basing their specific designs on the classroom training they received. The resulting experiences demonstrate that, no matter what EU member state they come from, and regardless of their economic and social conditions, their language, culture, religion, sex, etcetera, with good scientific training and an adequate methodology, the teachers can introduce science in the classroom from the earliest stages of education. And as also occurred in the 'What is the world made of?' project, it is the teachers' job to assess the level of knowledge they can teach their students, taking into consideration their cognitive state and Piaget's schemas (which can be consulted in the guide *Scientific literacy at school: a proposal for a new methodology*, along with recommendations for establishing common criteria for science education in the European Union).

It is significant that when the realities of the classrooms of the different partners are compared, and the results are observed, everyone reached similar conclusions, even though activities and itineraries may have differed.

The partners' work in the classroom suggest several conclusions that are presented below and which largely coincide with the evaluations made in the *What is the world made of* project.

1. A change in teachers' attitudes about science is acknowledged in their work. During the project they expressed the need to receive more training to teach science.

2. The teachers considered the proposal's use of Human and Social Sciences a positive approach. In the specific case of archaeology, the teachers recognized its enormous possibilities for pre and primary school education, because of its cross-disciplinary perspective and transversal nature, as well as its capacity to awaken the curiosity of the students.

3. Regarding the students, the teachers verified that these subjects can be addressed in classrooms and that children are very capable of building scientific models adapted to their educational level.

4. It is increasingly necessary to introduce science teaching beginning in early childhood education, as children tend to ask questions, solve problems, and question everything they observe. These archaeology projects have revealed that regardless of the context or the level of the students, this approach provides universally positive results.

5. Teaching science is inclusive, and its hands-on and visual nature facilitates integrating all children in the activities, even those with a low

level of oral comprehension. In classrooms with students of diverse nationalities it was confirmed that archaeology favours instilling them with values, including respecting and understanding cultural diversity.

6. The teachers report changes in the thought processes of the children when working with science. It is no longer 'magic', but 'science'. A myth is shattered: science is fun; learning it can be enjoyable and can be used to show students how to think and solve problems, in other words it involves changes in the way we think in order to construct knowledge. Moreover, teaching archaeology in early childhood education encourages critical thinking, which is essential for understanding our history and the foundation of any free society.

7. From the teachers' responses to the Lederman questionnaires, it is clear that they need to acquire a deeper understanding of the structure of science (Nature of Science). It is paramount to determine a nucleus of scientific content in European Union curricula for training non-university teachers.

8. Finally, it must be highlighted that both boys and girls respond in the same way and with the same interest in scientific learning, something that coincides with the results of the latest research.

We conclude this section with a reflection. Teachers are in a privileged position to influence society, as their role is to transmit to future citizens the knowledge and attitudes necessary for them to be able to live their lives in a technological and highly sophisticated society, in other words, to ensure their students acquire what Lederman and Charpak call *scientific culture*. In addition, because early stage education requires the active participation of families, the ways in which this stage of education is focused and the teaching philosophy it employs reach virtually every citizen of the European Union. Specific knowledge is structured around a mindset and values that are only acquired naturally at a young age, when students are socialized.

Salvatore Settis states that 'our cultural heritage is not a foreign entity, arrived out of nowhere, but something we have created over time and with which we have lived for generations and generations, centuries and centuries, our memory, our soul'. Archaeology, like history, provides the historical knowledge we need to understand it, while also working to protect our heritage. That is why the objective of this guide is to help children, guided by their teachers, to become interested in past societies and to understand that the past and the present shape the world around them.

4. RESEARCH CARRIED OUT BY PARTNERS

Female archaeologists (a mother and her daughter) visiting an ancient mine.
Drawing made by a 6 years old girl.

4.1. SAN FRANCISCO PUBLIC SCHOOL (PAMPLONA, SPAIN).

IN SEARCH OF THE LOST ARCHAEOLOGY

1. COORDINATOR'S INTRODUCTION

San Francisco Public School has been working on and researching models to teach Science in collaboration with CSIC at School for years. To date the centre has mainly been involved in projects related to Natural Sciences, so introducing archaeology in the classroom is their first time working in the area of Human and Social Sciences.

This research project focused on the concept of archaeology as a scientific discipline and how it can be important to the social surroundings of students, following a constructivist approach in which the children are the true protagonists. The proposals set forth by CSIC at School were followed, verifying that the activities and research work proposed by the teachers open a wide variety of teaching opportunities that the students were enthusiastic about, encouraged by their own curiosity.

The design and execution of this activity was possible thanks to the enthusiasm of the teachers involved, who had few resources available to them and very short deadlines to develop it. The training the teachers received was a key to carrying it out, both in the 'kick-off meeting' in the SciLit project, as well as in the three complementary sessions held in the school, which allowed the researchers and educators to exchange their opinions.

2. COMMON METHODOLOGY USED IN THE PROJECT

After receiving training, the teachers who carried out the activities guided the students through an introduction to the concept of archaeology and its role as a social science, as well as its relevance for investigating our past and the sustainable management of our surroundings.

Before initiating the research and throughout project, the teachers studied the primary education curriculum in order to discuss and identify the material and aspects best suited for teaching archaeology. In addition, a schedule was designed through questions marking the experimental path that was used to introduce the concepts according to the cognitive stage of the children involved in the project. The schedule gradually increased their exposure to archaeology:

- What is archaeology? Archaeology as a scientific discipline.
- The social and scientific relevance of archaeology.
- The material studied by archaeology: the material remains of past societies.
- Culture as a distinctive element of human societies.

- The continued existence of material remains over time.
- The Antiquity of cultural elements.
- The concept of cultural heritage.

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'IN SEARCH OF THE LOST ARCHAEOLOGY'

3.1. DESCRIPTION AND CHARACTERISTICS OF THE GROUP

CEIP San Francisco is a diverse public primary and preschool located in Pamplona's historic centre. It has 407 students, representing 21 different nationalities, distributed in three linguistic models: Model D teaches classes in Basque, with Spanish as a subject; Model G, teaches classes entirely in Spanish; and Model A, teaches classes in Spanish, with Basque as a subject.

Our school's educational approach seeks to incorporate active and inclusive methodologies into the classrooms that help improve consideration for diversity and success in school. In this sense, we feel that the training and work we carried out in collaboration with CSIC at School is completely in line with our general goals for improving the school, which is why we followed the programme's approach to teaching and learning science in the classroom.

Six classes, 3 levels and 3 linguistic models participated in this project. However, the results, the observations and all the photographs and images presented here belong to just one of those groups. This particular group was made up of nine Year 3 primary school students, aged 8 or 9. The majority of the pupils were of Romani (Gypsy or gitano) descent or immigrants. Not all of them were fluent in the working language (Spanish) and some were in the process of learning how to read and write. Their families had a low or very low socio-cultural level.

3.2. OBJECTIVE OF THE RESEARCH PROJECT.

a) General objective

In our case, the general objective of the work was based on the questions:

- What is archaeology?
- What does it do?
- What is it for?

Figure 1. What is archaeology?

b) Initial investigation of the primary education curriculum

One of the first issues we dealt with (which was carried out concurrently with the project, although here it is presented second) was to study the content of the Primary Education Curriculum for Navarre. The result was extremely positive, as we verified that archaeology is compatible with the official curriculum for these levels and that it could also be approached transversally.

Regarding scientific material, we highlighted the aspects of Year 3 Social Sciences in Primary Education that were most relevant to this research project. The curriculum indicates that:

1. Students are introduced to scientific knowledge and its application by studying Social Sciences.

2. They work on methods of **compiling information** about a topic, using different (direct and indirect) sources.

3. It is necessary to use communication and **information technologies** to search for and select information and present conclusions.

4. It is also necessary to promote the development of strategies to **organize, memorize and recover information** obtained through different methods and sources, as well as to use and read different **textual and graphic languages**.

5. Techniques to encourage reading **texts that divulge (social, geographic and historical) information about Social Sciences** are employed.

6. Strategies are employed to promote group cohesion and **working together**.

7. The correct use of the various materials they use is also promoted.

In addition to the aspects related to **Social Sciences**, the curriculum also contains other Social Science blocks that were worth including from the beginning of our project in archaeology:

1. **Cartography. Maps.** Elements and types of maps. Maps of local streets and areas. Reading and interpreting.

2. Human intervention in the landscape. **Respect, defence and improvement of the landscape**.

3. The study of historic time and its relation to different historical ages through the study of the history of a town and its surroundings. Historical heritage, historical remains and historical evolution of **specific objects**. Basic concepts about time.

As we shall see, all these aspects converge in the project that we are presenting. From the start we also contemplated including other scientific material related to other fields, specifically **mathematics and language**. In the area of **Mathematics**, the curriculum includes:

1. An approach to the scientific work method through the study of some of its characteristics and using it in simple situations.

2. Geometry. Elemental representation of known spaces: blueprints and mock-ups. Reading and interpreting simple maps.

3. Statistics and probability. Collection and representation of data in tables and graphics. Reading graphics and tables.

The subject of **Language** can also be perfectly approached using an archaeology project, specifically aspects such as:

1. **Strategies to identify different kinds of texts**: descriptive, argumentative, narrative, expository and instructional. **Strategies for reading comprehension of texts**: Title. Illustrations. Key words. Rereading. Anticipating the hypothesis. Text structure. **Using the library**.

2. **Producing different kinds of texts** according to their typology to **communicate experiences, needs and knowledge: narrations, descriptions, arguments, expositions and instructions**. Applying **spelling rules**. **Handwriting. Order and neatness.**

1. Acquiring **vocabulary** to facilitate and improve oral and written comprehension and expression.

c) Specific goals

Consistent with the aspects highlighted above, the specific goals of our project were to:

1. Collect information about the topic to be analysed, using different (indirect and direct) sources.

2. Obtain specific and relevant information about facts of previously delimited phenomena, using different (direct and indirect) sources.

3. Find, select and organize specific and relevant information, analyse it, obtain conclusions, reflect on the process followed and to communicate it orally and/or in written form.

4. Use information and communication technologies to obtain information, learn and express material related to Social Sciences.

5. Use information and communication technologies (Internet, blogs, social media…) to elaborate projects using **terminology related to the topics studied** (specific vocabulary).

6. Use information and communication technologies to find and select information and present conclusions.

7. Develop strategies to organize, memorize and recover information obtained using different methods and sources.

8. Use and read different textual and graphic languages.

These objectives correspond to the evaluation criteria of the first block of content of the primary school curriculum.

3.3. ELABORATION AND PREPARATION OF THE RESEARCH ACTIVITIES: DESCRIPTION OF THE ACTIVITY OR ACTIVITIES THAT THE STUDENTS HAVE CARRIED OUT

1st session. Evaluation of the students' level of understanding before starting the activity, considering both the content as well as the structure of scientific knowledge (NOS). DART test

The first session consisted in asking the students to make a drawing that expressed their idea of archaeological research. The results reveal that the students were generally ignorant about the field. Of a total of 9 drawings, 3 linked archaeology to caves ('archaeologists visit caves, because that's their job'). The rest of the drawings had nothing to do with archaeology at all (a flower, children playing, a truck filled with balls…).

Figure 2. 'Archaeologists visit caves because that's their job'.

2nd session. Research on archaeology

Given the lack of information that the students had about this topic, we took them to the computer room and searched for images on Google related to archaeology. They then wrote down in their notebooks the words suggested by the images found. The work was carried out in pairs.

Figure 3. Research on archaeology.
Figure 4. Searching on *Google*.

3rd session. Drawing in the classroom

Later they made a second drawing in which we came up with our **first hypotheses**:

- **What do archaeologists do?**
- **What is it for?**
- **Why is it important?**

To do so, we used the images we saw on the internet and the words they had written down in their notebooks. The following is literally transcribed from what they wrote on their drawings: 'People who work in that have to find skeletons to put in the museum'; 'they take old stuff out to sell it, because old stuff is worth a lot'; 'they are 'dugging' for water. They work a lot'; 'the 'sterologists' to look at the bodies of dead people so that they can take them to a museum so that people can look at them'; 'to discover important things because they are pretty'; 'to know what we have in all our body, because when we die they bury us and we become a skeleton'; 'esento' a tunnel and a head in the water. 'The 'chronology' is for making money'.

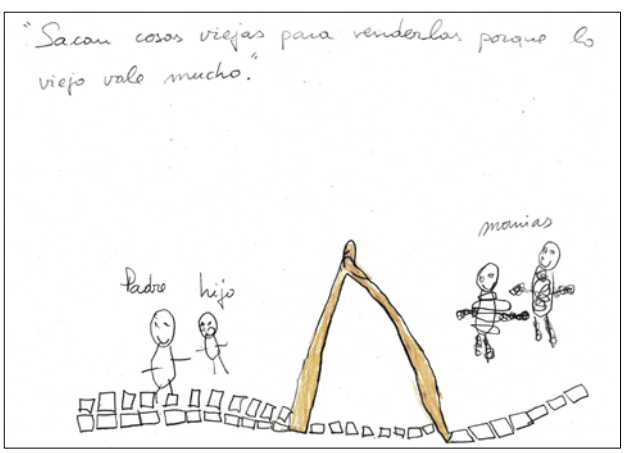


Figure 5. Archaeologists 'take old stuff out to sell it, because old stuff is worth a lot' (to the left, 'father', 'son', to the right, 'mummies').

As can be seen, a substantial qualitative change was observed between the first and third sessions. They began relating archaeology with aspects related to Antiquity: for example, the drawing that says archaeologists 'take old stuff out to sell it, because old stuff is worth a lot'; or the 5 who drew skeletons this time; or the student who linked archaeology with the discovery of 'important things because they're pretty'.

4th session. Discussion and work in the classroom

According to the Meaningful Learning theory, and following Ausubel's ideas, to learn meaningfully people must relate learned information with relevant concepts they already know. The new knowledge must interact with the structure of the student's knowledge. In this project, the children related their new knowledge about archaeology with a book that we had read in earlier sessions that dealt with speleology. We took advantage of that classroom reading to obtain concepts that would provide them background for the following sessions.

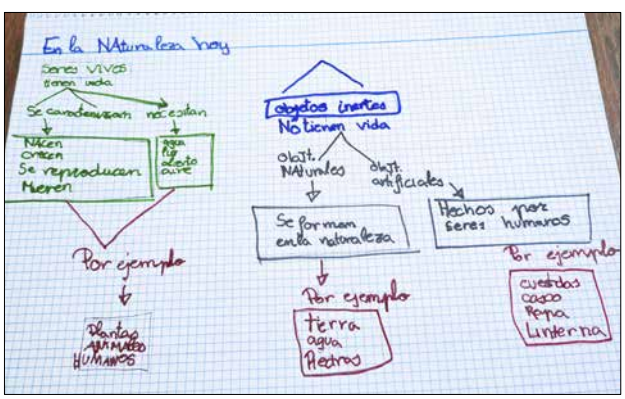


Figure 6. Relating learned information with relevant concepts they already know.

The image displays the result of the work: as can be observed in the coloured diagram, the notes highlight that, in nature there are: living things/alive (written in green)/inert objects/ lifeless (written in blue). The living creatures are born, grow, reproduce, die and need water, light, food, air. The inert object can be (written in black) natural (formed in nature) or artificial (made by humans). The children wrote their examples in red: plants/animals (living things), ropes, helmet, rope and torch (inert objects). The inert objects are clearly related to the book they read about speleology.

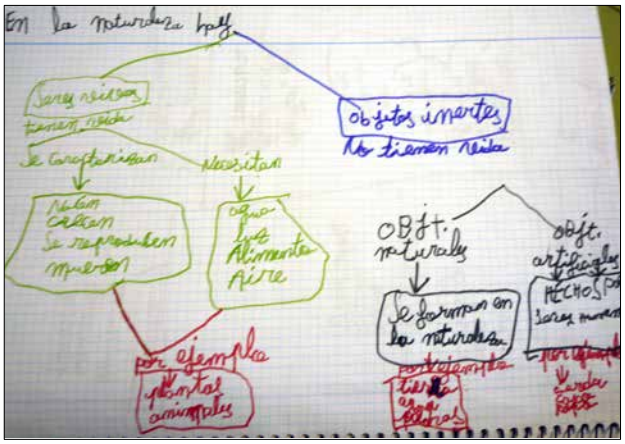


Figure 7. Another example of diagram.

In summary, from our perspective: the prior knowledge used to incorporate new information, would be the difference between living things and inert material.

The work continued with a new question: **What makes animals different than people?** We noted their answers in a Venn diagram and worked in a large group.

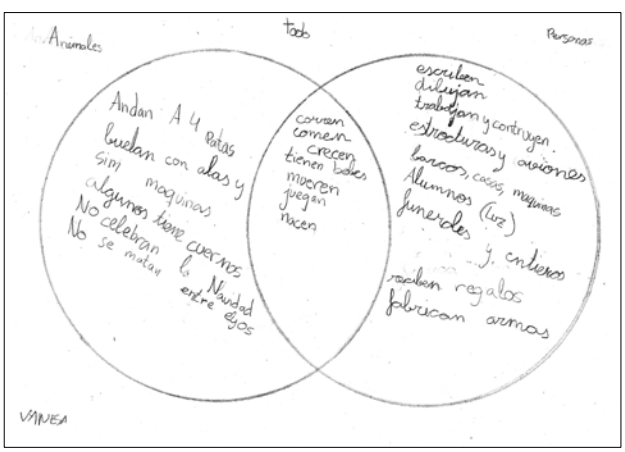


Figure 8. Example of Venn diagram.

The following are some of the observations:

- About ANIMALS: 'they walk on four legs'; 'they fly with wings and without machines'; 'some have horns'; 'they don't celebrate Christmas'; 'they don't kill each other'.
- About PEOPLE: 'they write'; 'they draw'; 'they work and build'; 'funerals and burials'; 'they receive gifts'.
- About BOTH: 'they run'; 'they eat'; 'they grow'; 'they have babies'; etc.

5th session. Discussion and classroom work

In the following session we asked:

- **What is left of animals after they die and time passes?**
- **What is left of people when they die and time passes?**

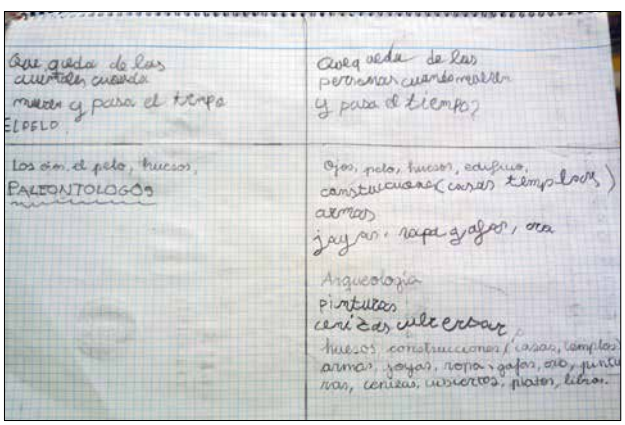


Figure 9. What is left...?

We wrote the answers in a table and we gave a name to the people who study the remains of living things or **fossils** (**palaeontologists**) and to the people who study the remains of things **that were produced by people, artefacts** (**archaeologists**). In addition we named the

sciences that study such material. We worked in small groups.

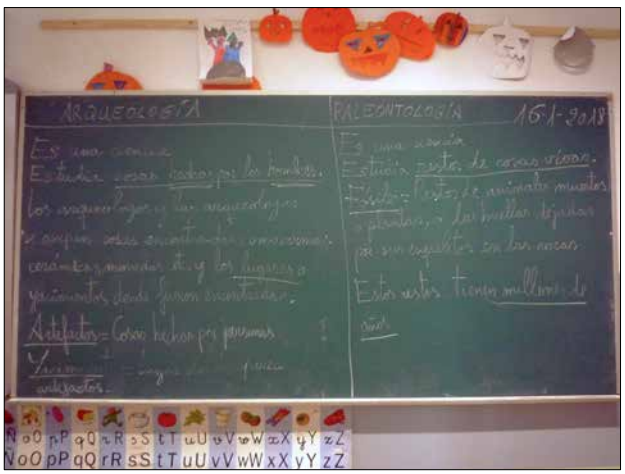


Figure 10. Archaeology versus palaeontology.
Figure 11. What is Archaeology? What is palaeontology?

6th session. Differentiation and classification

We arrived at the conclusion that fossils are the remains of living things, not created by humans. They can be millions of years old. Could there be one nearby?

Archaeologists investigate things, objects or artefacts made by humans. They can be thousands of years old. Could there be any nearby?

We went back to a project we had completed before this one (the municipality and the autonomous community) and we looked at the tourism pamphlets from our area. The teacher provided some material to show the difference and we started a preliminary classification. We worked in small groups on the tourism pamphlets.

Figures 12 and 13. Working on the tourism pamphlets.

7th session. Debate

The information collected allowed us to differentiate two sciences that are related to each other. But, **why are they important to us?**

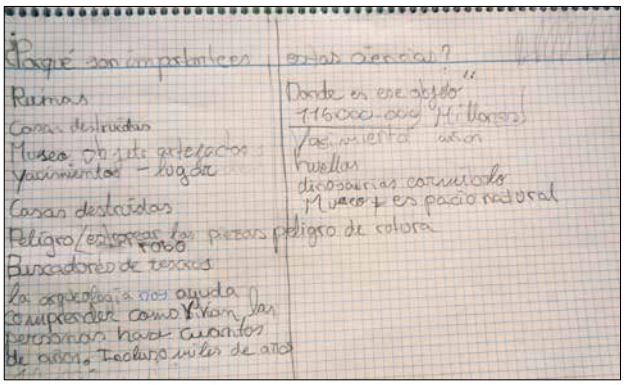


Figure 14. Why are these sciences important to us?

On the blackboard we wrote down the new concepts and what we thought was important. We worked in a large group from notebooks.

Conclusions of the debate:

- Palaeontology helps us understand how life arose on Earth. Archaeology helps us to understand how people lived and organized their societies in the past.
- Fossils can be millions of years old, archaeological remains can be thousands of years old.

And we returned to the question: **why are they important to us?**

Two newspaper articles allowed us to start an interesting debate. The headline of the first was 'A 115 million year old dinosaur footprint was destroyed by hammer blows'.

The second was 'A graffiti artist finds a Roman villa in Burgos using Google Maps'.


Diario de Noticias

Un grafitero halla una villa romana en Burgos a través de Google Maps

Destruyen a martillazos la huella de un dinosaurio de 115 millones de años

Figure 15. Newspaper articles.

These are some of the comments that arose during the debate: we transcribe them literally, made in a large group:

- 'Danger for the treasure hunters who come later…'
- 'What kind of danger?'
- 'They can fall in a hole. They can break everything. There could be a bear. There could be money that somebody dropped. They can steal what they find. What a mess he got into…'(the graffiti artist).
- And if they steal it, who are they stealing from? Who owns it?
- 'The museum, the town council, the person who found it, the archaeologists…'

With what we know we could clarify a few questions, but new ones arose: What is the difference between treasure and heritage? What is a 'natural space'? How is it different than an




Figures 16, 17, 18, 19. Showing what we had learned.

archaeological site? How can we represent hundreds of millions of years?

Indeed, reading the articles gave rise to **new concepts that we had to clarify and organize**: 'millions of years', 'scientific importance', 'archaeological site', 'natural space', 'treasure and heritage', etc.

Before dealing with these new questions it was better to review what had already been learned.

8th session. Showing what we had learned

We decided to make a mural with information to show our work in the gallery and to make a summary map with all the information we had collected so far.

We worked as a group and individually to make the mental map.

3.4. FINAL EVALUATION OF THE ACTIVITY

Because we had to finish other projects, this work could not begin until the second half of December 2017, with little extra time to carry out more activities for the final report. That is why we were unable to carry out the sessions in which the results are collected and presented to check how much the students had learned. In future sessions we will work on, for example, texts such as 'Roñita goes to school' (the story of a prehistoric girl with various modern and anachronic elements) in which the children can detect errors and relate concepts.

In any case, a preliminary evaluation can be carried out using the questions that arose during the session where the newspaper articles were read and debated: the observations made by the students allowed us to confirm what they had learned and also what needed further work. This information is also part of the evaluation.

Figure 20. Working on different materials.

Questions arose that can be taken up again later when working on other material such as textual typologies (news items, definitions), using a dictionary, etc.

We would like to note that regardless of the linguistic model and year of the participating students, our experience as a school in prior work on science is that this kind of approach has positive results for all students, whatever their starting point.

This proposal also allowed us to work with all the students without simplifying the information at all. We believe that it is completely inclusive and that, due to its visual and tactile nature it facilitates integrating children with lower levels of oral comprehension or who do not understand our language.

Figure 21. Working on different materials.

Finally, we would like to summarize some concepts that could be taken up again when we continue the project:

Figures 22, 23 and 24. Our final work. Summary of what we have learned.

- What is the difference between treasure and patrimony?
- What is a natural space?
- How is it different from an archaeological site?
- How can we represent 'hundreds of millions' of years?

4.2. 'ASUNDUSE LASTEAED' PRESCHOOL (TALLIN, ESTONIA).

WORKING WITH ARCHAEOLOGY

1. COORDINATOR'S INTRODUCTION

Tallinna Asunduse Lasteaed (Asunduse Lasteaed Preschool in Tallin), teaches children from one and a half to 7 years old. Some of the school groups include children with special needs in a primarily Estonian language environment, although some students are not native speakers and receive assistance from the teachers to help them adapt to the local setting and learn the language. Each group has at least one teacher and two assistants, or two teachers and one assistant.

Before participating in the SciLit project, the teachers of Asunduse Lasteaed had worked on the COMENIUS project titled, 'Discovering the world. Developing skills through experimentation and exploration' (013-1-PL1-COM06-38578 2), which dealt with some material related to archaeology in the classroom, with the assistance of CSIC at School.

However, this is the first time that an archaeology in the classroom project has been undertaken in this preschool. The research project was carried out through various activities that were treated like independent research projects. The teachers focused greatly on monitoring the acquisition of new concepts and the initial and final evaluation of each of the experiments or activities carried out by the children involved.

The work on archaeology in Asunduse Lasteaed revolved around helping the students understand archaeology as a scientific discipline and providing an initial approach to the work methods of archaeology. The topics taught were:

1. Activity 1: What is archaeology? Archaeology as a scientific discipline and the role of archaeologists (female and male) in studying the past.

2. Activity 2: What are archaeological discoveries? The material studied by archaeology: the material remains of ancient societies.

3. Activity 3: Underground strata: What is underground? The nature of the archaeological record and the stratigraphic principles of superposition.

4. Activity 4: What instruments does an archaeologist use? An initial approach to the work of archaeology and learning about our surroundings.

To carry out the activities the teachers used the knowledge obtained from the initial training received after the SciLit project's *kick off meeting* and diverse material created for the CSIC at School project.

2. COMMON METHODOLOGY USED IN THE PROJECT

After their initial training, the teachers guided the students through the activities that will be described shortly with a basic objective: to introduce archaeology as a scientific discipline and the daily activity of archaeologists. The activities also helped introduce the concept of archaeological stratigraphy (the principles of stratigraphic superposition) by having students observe their surroundings.

Before and during the research the teachers studied the topics that would be developed in each activity. All discussions held in the classroom with the students were based on the Socratic Method, understood as asking the children a series of apparently innocent questions that would lead them to a logical conclusion. This conclusion was always incompatible with the initial belief expressed by the children.

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'WORKING WITH ARCHAEOLOGY'

As we shall see, each of the four activities was approached independently, in reduced groups (around 12 students per activity) in ages from 5 to 7 years old. In every case two teachers directed the activities. For greater clarity, each activity will be described as if it were an independent research project.

ACTIVITY 1. WHAT IS AN ARCHAEOLOGIST?

Description and characteristics of the group

The activity took place in the school with a group of 12 children, 7 boys and 5 girls.

Purpose of the activity, methodology employed and preparation of the research activities

The general objective and starting point for the work on archaeology was the question: **Who is an archaeologist?**

This activity lasted for 24 hours distributed over three sessions (three days), including preparation, the acquisition of materials, carrying out the sessions with the children and the conclusion.

During the activity a concept map was made, as can be seen in the figure.

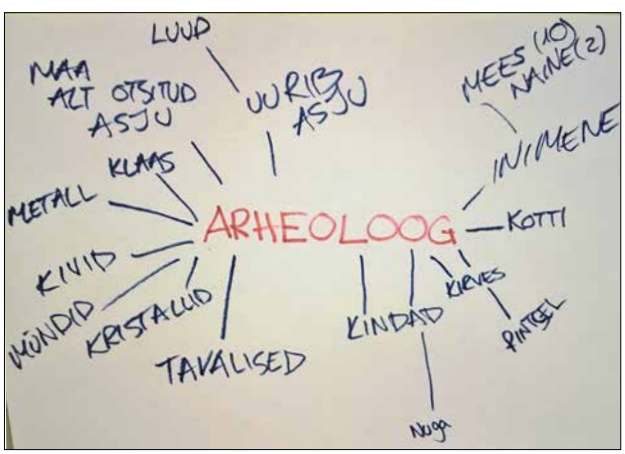


Figure 1. Concept map (original in Estonian language).

In the 1970s Novak and his research team developed the concept map technique as a way

to represent the emerging scientific knowledge of students.

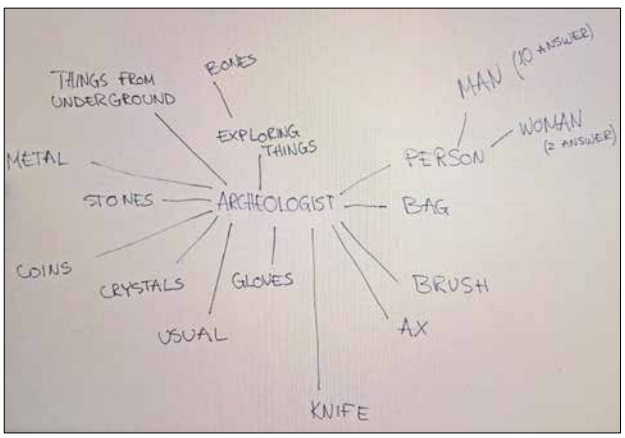


Figure 2. Concept map (English version).

Ausubel states that learning new knowledge is based on what one already knows. That is, the construction of knowledge starts with the observation and recognition of events and objects through concepts that we already have. We learn how to construct a concept map and add new information. Ausubel also emphasizes the importance of reception instead of learning by discovery, and meaningful learning more than memorizing. We kept all these considerations in mind while carrying out the activities.

Description of the activity or activities carried out by the students

The first step was for the teachers to study each topic. They took notes, consulted each other, planned the activities, searched for the necessary material and asked permission to carry out the planned activities.

One day before the activity (experiment), the teachers asked the children what they thought an archaeologist was: how they are, what they look like and what kind of work they do. The teachers asked the students to express their ideas in a drawing, working individually.

The children had never heard of archaeologists before the session. Some thought they did the same work as the police. As could be expected, their drawings reflected their ignorance of archaeology: they drew men and women indiscriminately carrying out various activities: for example, 'the archaeologist holds a balloon in the air'; 'in reality doctors and astronauts are archaeologists'; 'someone who does doctor things'; 'a person who explores lions'. Only one child linked the activity of archaeology with palaeontology and wrote down that an archaeologist is 'someone who looks for dinosaur bones'.

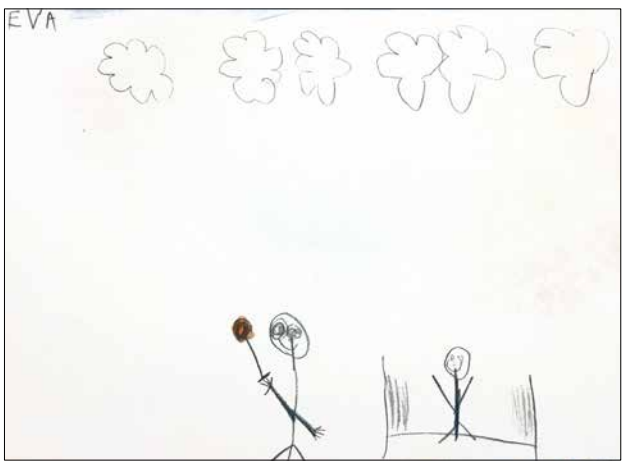


Figure 3. Eva (before): 'The archaeologist holds the balloon in the air.'

Next we held a group discussion about the topic: What is an archaeologist?

The children's answers were varied, in accordance with the ideas expressed in the drawings: 'they could be doctors'; 'police'; 'firefighter'; 'it's someone who looks for dinosaur bones'; 'human'; 'maybe schoolteachers'; 'but who built the pyramids?'; 'it is the type of person who saves other people'; 'it is a machine where you put cats in and when they come out they are dirt (see image).

Figures 4 and 5. Group discussion.

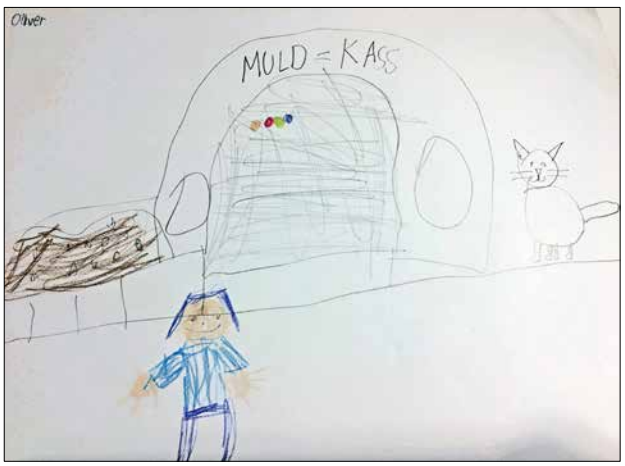


Figure 6. Oliver: 'It is a machine where you put cats...'.

Figure 7. Computer research.

After this session we encouraged students to do a computer search, in pairs. Using the word 'arheoloog' (archaeologist) the children obtained various images. After completing the search they spoke with their classmates about what they found.

We concluded that:

1. Archaeology is the scientific study of human life through the observation of artefacts, the human made objects that were left behind by people who lived long ago.

2. Archaeologists study human history, from the development of the earliest stone tools millions of years ago, to the past few decades.

3. Archaeology has various objectives ranging from understanding the history of culture to reconstructing the way people lived in the past and the documenting and explaining the changes in human societies over time.

4. The discipline involves surveying, excavating and finally, analysing the data collected to understand more about the past.

5. An archaeologist can be a man or a woman.

6. An archaeologist does not research dinosaurs.

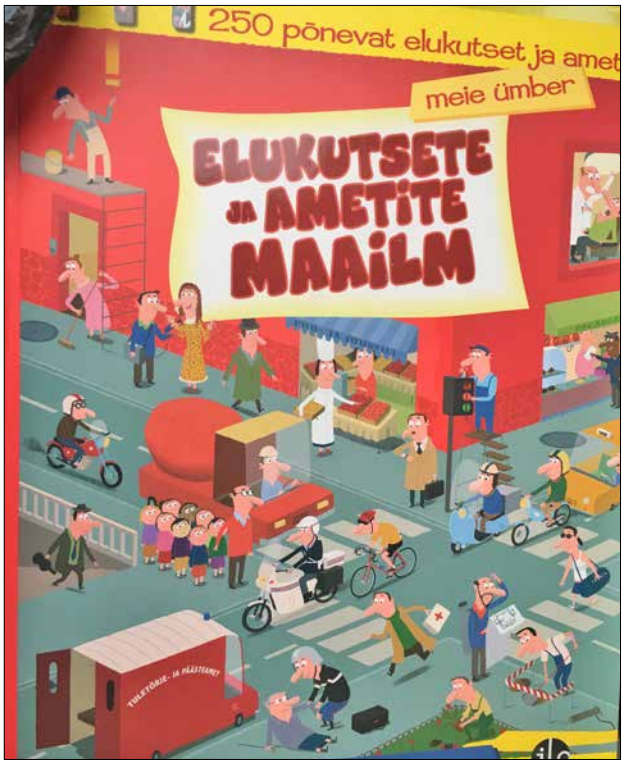


Figure 8. *Elukutsete ja ametite maailm*.

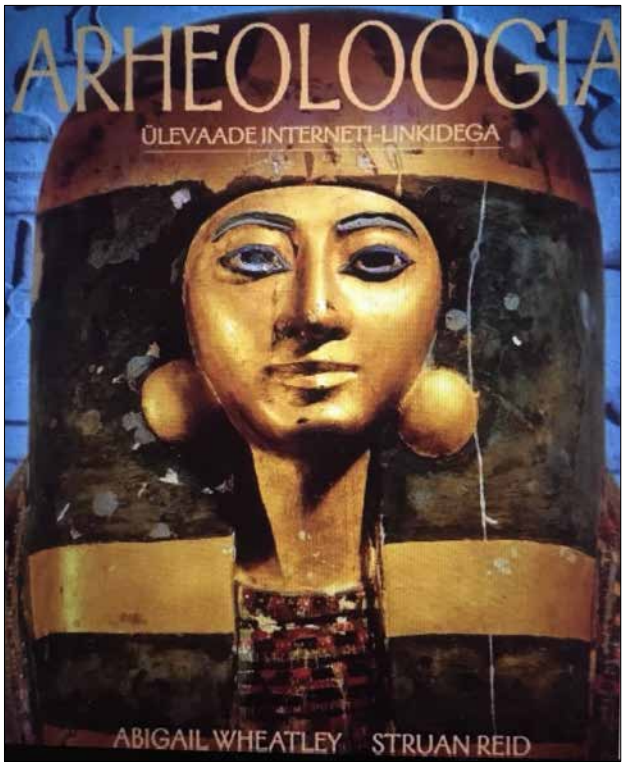


Figure 10. *Arheoloogia*.

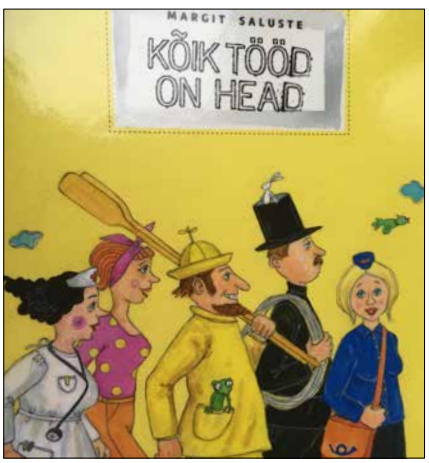


Figure 9. *Kõik tööd on head*.

Figure 11. Working with books.

Then we came up with our first **hypothesis**: 'An archaeologist studies different things to learn about something. About the Earth or people'.

Next we checked the hypothesis through a research project. Various books about different professions were used: 3 of the 8 books used had information about archaeology. The references used were: A. Wheatley, *Arheoloogia*, 2006; P. Holl, *Elukutsete ja ametite maailm*, 2011; and M. Saluste, *Kõik tööd on head*, 2016.

After this research another explanation was obtained for the hypothesis: 'An archaeologist is like a detective'; 'they have to study a lot'; 'they study the landscape'; 'a woman can also do this job'; 'they study our history'; 'they write a lot of books'; 'they know what happened before we were born'.

Figure 12. Books and archaeology.

Before finishing, we asked the children to ask their parents about archaeologists. The next day the teachers again asked the children to make a new drawing about what an archaeologist was and what kind of work they did.

Only 7 children attended school during the 3 days that the activity lasted (the first day they made the first drawing; the second they carried out the activities described; the third day they made the final drawing). All 7 children drew an archaeologist doing their work ('researching', 'finding something'). All 7 children understood that archaeologists do not look for dinosaurs.

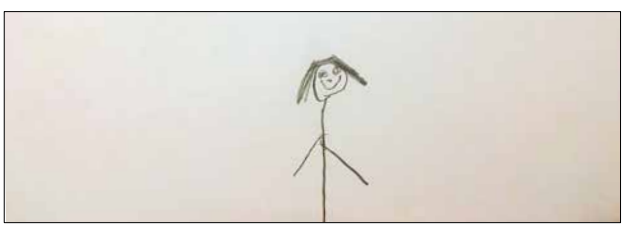


Figure 13. Eva (after): 'Woman, archaeologist. She looks around the yard'.

Two children said that the person in their drawing was a woman. A girl first thought that an archaeologist was a woman, but then drew a man.

Therefore, a substantial qualitative change was observed between the first and the third sessions. Two more drawings show another example of this evaluation: before, 'doing doctor things'; after, 'he also has a bag. He found something like that on the ground. I don't know what that is. He is still researching. In one hand is a knife, in the other a magnifying glass'.

Figures 14 and 15. Before, 'doing doctor things'. After, 'he also has a bag... He is still researching'.

ACTIVITY 2. WHAT ARE ARCHAEOLOGICAL DISCOVERIES?

Description and characteristics of the group

In this case the activity took place in the school and in the Estonian Archaeological Museum. A total of 14 children took part, 8 boys and 6 girls. The project was directed by the teachers Eneli and Kristel, and they were assisted by a guide from the archaeological museum during the visit.

Purpose of the activity, methodology used and preparation of the research activities

The purpose of this activity was to discover the kind of things that archaeologists find. Like the previous activity, the teachers studied the topic, took notes, consulted each other, planned the activities, searched for the material needed and asked for permission to carry out the planned activities.

As in the prior activity, the evaluation was again very important. So one day before the experiment the teachers asked the children about what they thought were archaeological discoveries. The children drew their ideas. Next, the teachers asked the students to bring in internet images that showed things that archaeologists have found. The word used for the search was 'arheoloogilised leiud' ('archaeological discovery).

The day of the activity the teachers arrived in the classroom earlier to prepare the students for their field trip to the museum. They were happy to get on the tram and discover the archaeological excavations of the old part of town on the way to the museum.

Description of the activity or activities carried out by the students

First of all, we observed and discussed the topic 'What kind of things do archaeologists find during their work day?' What information do they use for their research?'

The children's answers were varied: 'They can find anything.' 'They find money.' 'Some find garbage.' 'They find objects from space and dinosaur bones.' 'They find old things well.' 'Or something that somebody lost.'

After the Google search a group discussion was started. We concluded that:

1. Archaeologists work with stones, ceramics, glass, metals, bones, wood, leather, textiles, and weapons.

2. Archaeologists can find fossils and artefacts. Fossils are animal remains or dead plants, or the prints left behind by their skeletons in rocks and they are very old, they can be millions or billions of years old. The objects made by people are not as old, but they can be thousands of years old.

Figure 16. Waiting for the tram. **Figure 17.** On the tram!

All this led to a new hypothesis, expressed in the following way by the children: 'Archaeologists find all kinds of bones, money, jewellery and other old things'.

We then checked the hypothesis on a field trip to the Estonian Museum of Archaeology. During

Figures 18, 19, 20, 21 and 22. Field trip to the Estonian Museum of Archaeology.

the visit to the museum the children made the following observations: 'The clothes are made of fur'; 'they ate animals'; 'jewellery made out of teeth'; 'so many teeth… he must be rich'; 'these things all belonged to dead people'.

The explanation provided by the hypothesis was materialized in the following way: 'There were no dinosaurs in the museum'. 'The archaeologists have found so much money'.

When we returned to school, the group had a discussion about what they saw at the museum. The remembered that they saw pendants, amber, jewels, pistols, coins, urns and bowls. Of the 11 children who attended school during the 3 days this activity lasted, 8 said that archaeologists make money (coins, bills). All 11 children understood that archaeologists do not search for dinosaurs and 4 of them drew some kind of jewellery. Therefore, a qualitative change from their previous ideas of the children could be observed, although the visit to the museum should be completed with other kinds of activities that allow them to work with basic concepts, such as the pieces in the museum and local archaeological heritage.

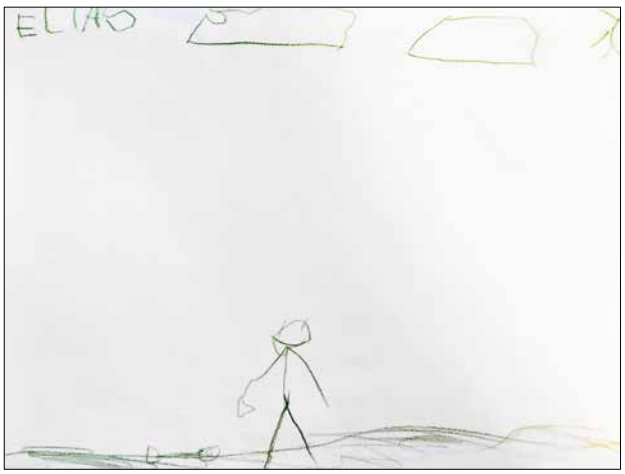


Figure 23. Elias (before): 'The archaeologist finds a showel'.

Figure 24. Elias (after): 'The archaeologist uses the shovel to excavate a skeleton'.

These drawings by Elias shows the advances made by the students. First 'the archaeologist finds a shovel'.

After, the shovel becomes a work tool and the 'archaeologist excavates a skeleton with the shovel'.

ACTIVITY 3. UNDERGROUND STRATA. WHAT IS UNDER THE GROUND?

Description and characteristics of the group

The experiment took place in the 'Asunduse' school, with a group of 11 children, 8 boys and 3 girls.

Purpose of the activity, methodology used and preparation of the research activities

The objective of the activity was to introduce the concept of 'stratification' and its relation to the objects in the prior activity. Ultimately, the idea was to introduce the concept of 'time' and transmit the importance of the integrity of the archaeological register.

Before the activity the children drew what they thought or imagined about the Earth's strata. This activity was carried out a day before the classroom work. The question the teachers asked before asking for the drawing was: 'What is underground?' After the activity the students worked in a group or in pairs with stratigraphic sequences, which the children coloured.

Figure 25. Colouring stratigraphic sequences.

After these actions, a group discussion was held on the topic: What levels, or strata, are underground? There were various answers: 'A stratum is like a really thick road'; 'underground there is sand'; 'dirt'; 'lava'.

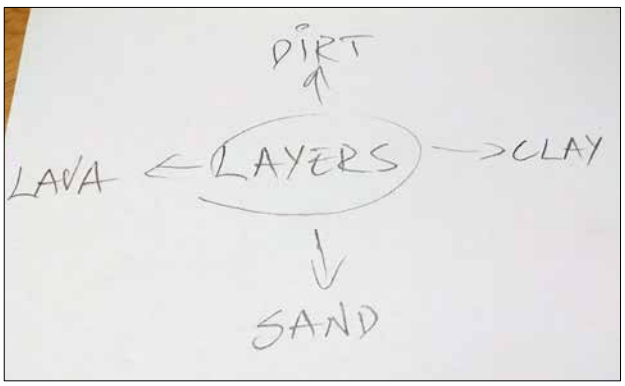


Figure 26. Diagram about layers.

Next we created a stratigraphy with diverse objects that we had prepared beforehand. We used a metal wastebasket to create different strata.

Figure 27. Creating our stratigraphy.

Each child placed an object in the container and since there were 11 children, a month was assigned to each of them, with the 12 month given to the teacher. The idea was to observe how the different stratigraphic units were formed over time (in this case months) and how they relate to the work of archaeologists.

Figure 28. Metal wastebasket containing our stratigraphy.

The comments were varied: 'January was a long time ago, December is now.' 'When December ends, everything starts over.' 'A ground has less than 12 layers.'

In total 6 children attended class during the 3 days that this activity lasted. Before the experiment, all the children thought there was lava underground; some said dirt, sand and roots. At the end of the activity they all said that the ground is made up of layers and we

Figure 29. Amelia (before): 'Grass'.

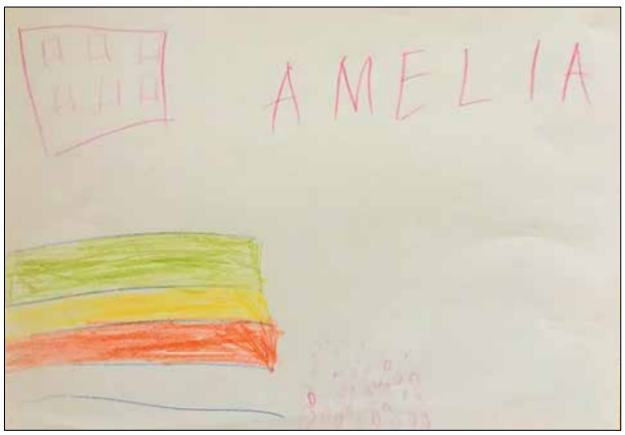


Figure 30. Amelia (after): 'Layers of earth, rocks where people died'.

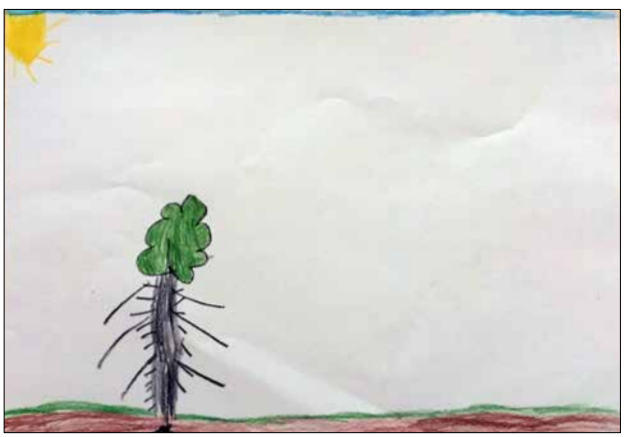


Figure 31. Eva, before.

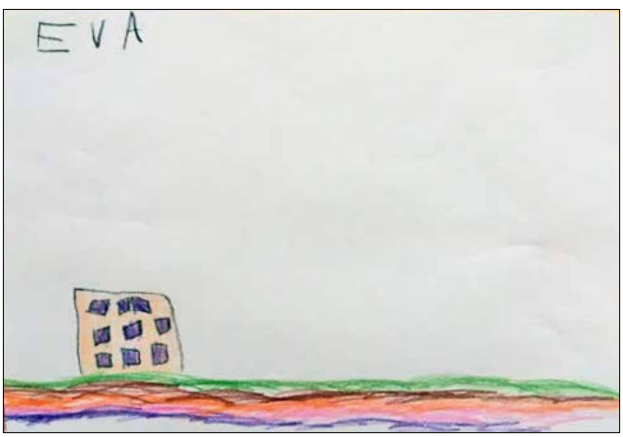


Figure 32. Eva, after.

could find old walls, skeletons and roots in those layers. The drawing we have chosen as an example shows that after the activity many of them were able to conceive of the horizontal stratification of the ground they walked on. This can be seen in Amelia's drawings.

Or Eva's drawings, in which before 'there is dirt and tree roots underground'.

After, there was still 'grass', but with strata also clearly marked under the building.

ACTIVITY 4. WHAT INSTRUMENTS DO ARCHAEOLOGISTS USE?

Description and characteristics of the group

The group for this activity was made up of 11 children, 8 boys and 3 girls.

Purpose of the activity, methodology used and preparation of the research activities

The purpose of the research was to highlight the work of archaeologists through the tools they use. This activity required more development:

the children had to take part in an excavation in the school playground, in order to talk about the material that archaeology studies and its fragility (the importance of following the stratigraphic layers during excavation; of using adequate tools that respect the characteristics of the archaeological heritage, etc.).

Before the activity different tools were selected.

Figure 33. Archaeologist's tools.

The activity lasted for a total of 24 hours, distributed over 3 days. As with the previous activities, the teachers prepared the topic beforehand. One day earlier the teachers asked the children to think about what tools archaeologists would use and they asked them to express their ideas through drawings.

Archaeologists use different kinds of tools depending on the kind of job they have to do. We are going to simulate an archaeological excavation: 'What kind of tools should we use?'

The group of students went out to the playground where a strip of land had been prepared, marked with elastic bands that divided it into a grid.

Figure 34. Fieldwork.

There were various reactions: 'Why is this area divided in squares?'; 'It's so nobody fights'; 'Adults don't fight'; 'With a brush'; 'You need the ruler to measure its length'; 'We need a magnifying glass to observe the ground better'; 'Archaeologists find dinosaurs'; 'They need a lot of time'; 'They clean it with a brush'…

The playground excavation was limited to the surface of the area. The students placed any discoveries they thought were important in plastic bags and they wrote down their location in a worksheet. Although we could not carry out this activity in greater depth, they concluded that the work of an archaeologist is exhaustive, and that everything had to be recorded carefully and in detail.




Figures 35, 36, 37 and 38. Documenting and recording artefacts.

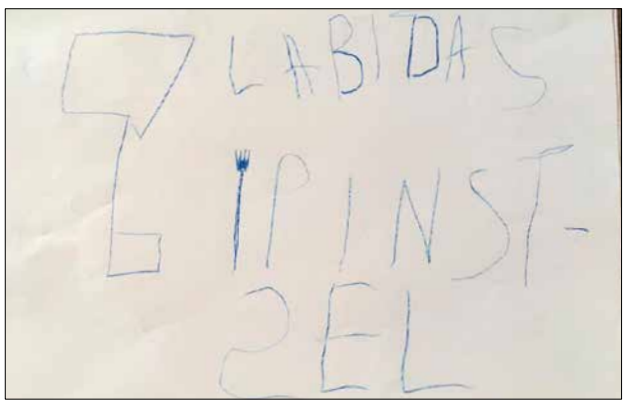



Figure 39. Sebastian (before): 'Found items were placed in to the machine and driven away'.
Figure 40. Sebastian (after): 'Trowel and brush'.

The drawings (before and after) reveal this change: before 'objects found are put in a machine and thrown away'; after: the work of an archaeologist is associated with the 'trowel and brush'.

IN CONCLUSION

The evaluation carried out over the four activities and recorded in the before and after drawings at the end of the activity, show that in this first contact with archaeology the students were able to conceptualize important aspects of their surroundings and broadened their understanding of the concept of the past. We also feel that it was important that they were able to extend their conception of scientific activity to other areas, such as Human and Social Sciences.

4.3. KEDAINIU LOPSELIS-DARZELIS 'ZILVITIS' (KĖDAINIAI, LITHUANIA). **ARCHAEOLOGY IN PRESCHOOL**

1. COORDINATOR'S INTRODUCTION

'Zilvitis' Preschool in Kėdainiai has a long tradition in educating children in the arts and plays a decisive role in transmitting the traditions and values of Lithuanian culture to its students. The collaboration between its teachers and CSIC at School began in the COMENIUS project titled 'Discovering the world. Developing skills through experimentation and exploration', in which some aspects of teaching archaeology in the classroom were introduced.

The research project carried out by the school had the invaluable help of an important local archaeologist, Algirdas Juknevičius, from the Regional Museum of Kėdainiai (www.kedainiumuziejus.lt). His participation in every stage of the project, coupled with the excellent work of the teachers, allowed the students to experience step by step a genuine archaeological investigation, using authentic sources first hand. It must also be highlighted that the project has greatly contributed to raising the awareness of the students and their families about how archaeological research helps us understand our local heritage and its role in the sustainable development of their immediate surroundings, providing elements that reinforce the sense of belonging to a local community. All of this without losing sight of the constructivist path proposed in the SciLit project, in which the students are the true protagonists.

2. COMMON METHODOLOGY USED IN THE PROJECT

After receiving training and the guidance of the archaeologist of the Regional Museum of Kėdainiai, the teachers who carried out the activities guided the students toward understanding their immediate surroundings and the role of archaeology in appreciating, valuing and protecting it.

The teachers combined the proposals of CSIC at School with suggestions made by the local archaeologist, using the following schedule:

1. What is archaeology?
2. Archaeology as a science that studies the past.
3. The work of archaeology.
4. How data is obtained: excavation.
5. The preservation of material remains over time.
6. Restoration.
7. Laboratory work.
8. The museum.
9. The local area's past (Kėdainiai).
10. Cultural heritage.

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'ARCHAEOLOGY IN PRESCHOOL'

3.1. DESCRIPTION AND CHARACTERISTICS OF THE GROUP

The research project was carried out over 2 days with the participation of 16 children aged 4 and 5. The project was structured in various steps, that alternated activities inside the school, outside (archaeological excavation) and in the Regional Museum of Kėdainiai.

3.2. OBJECTIVE OF THE RESEARCH PROJECT

a) General objective

The general objective of the project was to discover what archaeology is and why it is important for us.

b) Specific objectives

In accordance with this general objective we proposed to:

- Educate the children about the type of work archaeologists carry out.
- Develop practical activities related to archaeology in their immediate surroundings: collect and analyse information and learn a specific vocabulary.
- Help students achieve a better understanding of their environment.

3.3. ELABORATION AND PREPARATION OF THE RESEARCH ACTIVITIES: DESCRIPTION OF THE ACTIVITY OR ACTIVITIES THAT THE STUDENTS HAVE CARRIED OUT

1st step: What is archaeology?

The first step was to ask the question: What is archaeology? We discussed the topic in a group. Only one of the children said that archaeology was related with excavation. The majority did not know what to say.

After this discussion, we showed them the documentary 'How archaeological excavations take place: Bajorai 2012', available at the following link: www.youtube.com/watch?v=L-cA6_HnBeY (in Lithuanian language).

2nd step: Children's drawings and discussion

Next we asked the children to make a drawing where they came up with their first hypothesis: **What do archaeologists do?**

Figure 1. Female archaeologists at work.

Figures 2 and 3. Archaeologists working next to the systems used to sift on site.

Figure 4. Group of archaeologists.

What stood out was how faithful the drawings were to the scenes the children had seen in the video they were shown earlier: almost all of them reflected the systems used to sift through the dirt, as well as the presence of both men and women on the excavation team.

3rd step: Meeting with Algirdas Juknevičius, archaeologist and employee of the Regional Museum of Kėdainiai

Our project had the good fortune of having the collaboration of an archaeologist who works in the Regional Museum of Kėdainiai, Algirdas Juknevičius, who visited the school and met with the children.

Figure 5. Meeting with an archaeologist.

Figure 6. The archaeologist made a presentation about his work.

During his visit he used various slides to introduce excavation work and the most significant discoveries in the city of Kėdainiai.

Figure 7. The archaeologist made a presentation about his work.

4th step: Field trip to the Regional Museum of Kėdainiai

The Regional Museum of Kėdainiai is one of the oldest in Lithuania, founded in 1922.

During the visit to the museum, the archaeologist showed the students objects that had been documented in the area surrounding our city. He also told them how they were discovered and what the people who made them used them for.

5th step: Practical excavation work in Kėdainiai's Old Town, an old area occupied by taverns

A few days later the archaeologists suggested carrying out an excavation in a plot in the old part of our city.

Before starting the excavation work he explained to the children the rudiments of excavation (work procedures, the tools required).

The work was distributed to teams and the children carried out their excavations very carefully. They discovered copper coins, fragments of a clay jar and glass. During the excavation the children measured the depth at which they discovered the objects and recorded their discoveries. The archaeologist showed the children how to clean the copper coins and to glue the fragments of the jar.

Figures 8, 9 and 10. Visit to the museum.

Figures 11, 12, 13 and 14. Practical excavation work in Kėdainiai's Old Town.

6th step: The children visit Arnet House

Arnet House provides a unique look at the way the Scottish community lived in Kėdainiai in the 17th and 18th centuries, next to the Great Market Square, which was the main market at that time. It is an example of 17th and 18th Century urban residential architecture. Later, the Reformed Evangelical Church established a rectorate here. In 2015 it became the traditional crafts centre of Arnet House, run by the Regional Museum of Kėdainiai. Today it is a dynamic cultural centre offering workshops on knitting, ceramics, basket weaving, woodworking, etc. These workshops are taught by professional artisans and popular artists (www.kedainiutvic.lt/tourism/en/objects/traditional-craft-centre-arnet-s-house).

The visit focused on restoring the objects documented during the excavation and the information that they provided to the research. Part of the work was to familiarize the children with how to restore objects using the small fragments. The students could observe different elements and imagine the past settings in which these things could have been used and for what purpose.

Figure 15. Visit to Arnet House.

Figures 18, 19 and 20. Process of gluing several jar fragments.

Figures 16 and 17. Visit to Arnet House.

7th step: Restoring and cleaning the jar fragments and coins

Over several days, the children glued the jar fragments they had found during the excavation. Once glued, the fragments were deposited in a sand filled container to dry. The children had to carry out the task carefully, which allowed them to acquire better and more precise movements with their fingers and hands (development of fine motor skills). Everyone was pleased with the result: the jar was glued together.

The archaeologist showed us how to clean the copper coins in a very original way. We cut a tomato in half and placed the coins inside. After a while we washed them with gentle soap and a brush. This procedure greatly captured the interest of the children.

Figure 21. Cleaning copper coins.

Figures 22, 23 and 24. Cleaning copper coins.

3.4. FINAL EVALUATION OF THE ACTIVITY

During our project the children were able to learn that archaeology is a science that explores the daily life and culture of people. To be an archaeologist you have to acquire a great deal of knowledge, since it is a profession that requires special training.

Archaeological discoveries allow us to understand how people lived in the past. In this sense, the children linkened archaeology to the work of detectives.

The opportunity to work alongside an archaeologist of the Regional Museum of our city was excellent. For the children it has been a memorable experience that allowed them to come in contact with true archaeology.

The activity had a great impact on the school, on the students and their families, and on the city of Kėdainiai, as can be seen by the article published in the local newspaper and the time dedicated to our project on local TV.


Archeologiniai ir fizikiniai mažylių atradimai

Figures 25 and 26. Article in the local newspaper. Below, the director is interviewed during the excavation.

4.4. 'LITTLE EXPLORERS' PRESCHOOL P34 (BYDGOSZCZ, POLAND). **ARCHAEOLOGY IS FOR KIDS TOO**

1. COORDINATOR'S INTRODUCTION

The project carried out by Preschool P34 in Bydgoszcz took place over several weeks and involved all of the school's groups, around 90 children. As we shall see, the project was designed to apply all of the proposals that CSIC at School had transmitted to the teachers who participated in the initial training of the SciLit project. The teachers from Bydgoszcz also received a second training course (lasting two days) in February, 2017 in Bydgoszcz. The teachers took great advantage of the training they received; their comprehensive project allowed the children to acquire a broad understanding of archaeology as a field and of how archaeologists work today. The project was based on the notion that it is necessary to rethink some of the most deep-rooted ideas about archaeology as a scientific discipline and to integrate the teaching of archaeology in the daily lives of the students. The experiences of P34 can serve as an example of how archaeology can be integrated into a transversal educational approach and also provide interesting ideas for classroom work.

Figure 1. Children of kindergarten P34.

2. COMMON METHODOLOGY USED IN THE PROJECT

The resources created by CSIC at School for the SciLit project (the power point presentations that were sent to all the partners with instructions on how to carry out the projects) were used to carry out the activities described in this chapter. In addition, the teachers consulted the internet (Wikipedia) and put into practice the concepts they were taught during the training courses. They also consulted the following references:

1. *Archaeology. Theory, methods, practice* by Paul Bahn and Colin Renfrew (in its Polish Edition, Warsaw, 2002).

2. *Wstęp do archeologii*, by Dorota Ławecka (Warsaw, 2003).

3. *Nieinwazyjne rozwiązanie zasobów dziedzictwa archeologicznego: potencjal I możliwości*, edited by Michal Pawleta and Rafal Zaplata (Lublin 2015, accessible at: http://e-naukowiec.eu/wp-content/uploads/2016/06/ksiazka_maly_rozmiar_pliku.pdf).

Basic preschool teaching methods were employed to work with the children, for example:

1. The self-learning method: which encourages creativity in children, increases their practical knowledge and abilities, with the objective of developing a positive attitude toward discovering science.

2. Autonomy: the objective is to develop autonomy in the children, favouring individual resolution of problems.

3. The 'show and observe' method to develop the children's perception and enrich their knowledge.

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'ARCHAEOLOGY IS FOR KIDS TOO'

3.1. DESCRIPTION AND CHARACTERISTICS OF THE GROUP

'Little explorers' Preschool (number 34 in Bydgoszcz, Poland) is a public preschool attended by students from 3 to 7 years old. It is located in one of the most working-class neighbourhoods of Bydgoszcz, which is the eighth largest city in Poland. The student body is made up primarily of children of Polish nationality, although it also has children of other nationalities (currently there are children from Bulgaria, Spain, Estonia, Slovenia, Korea and Belarus).

Four teachers participated in the project with children from ages 4 to 7.

3.2. OBJECTIVE OF THE RESEARCH PROJECT

The general objective of the research project was to teach children a scientific discipline they were unfamiliar with: archaeology. This general objective was achieved by pursuing various specific goals:

- Describe what archaeology studies to the students.

- Explain to them how archaeology relates to similar sciences, in particular, how it differs from palaeontology and its connections to anthropology.

- Convey the concept of the archaeological record: introduce how strata are formed and the types of scientific reasoning used in archaeology to the children.

Why did we choose archaeology?

In a project carried out a few years ago (a COMENIUS project, titled 'Discovering the world') we became familiar with the work of archaeologists. During the activities carried out for that project the children discovered that archaeology is a scientific discipline, a topic that was of great interest to them and very useful for classroom work. Thanks to that experience, the teachers acquired new skills and broader knowledge. We participated in the SciLit project in order to continue acquiring training in this material and working along these lines with other children, so that they can understand why it is important to study the past and why the past is important for our understanding of the present.

3.3. ELABORATION AND PREPARATION OF THE RESEARCH ACTIVITIES: DESCRIPTION OF THE ACTIVITY OR ACTIVITIES THAT THE STUDENTS HAVE CARRIED OUT

Evaluation of the students' knowledge before starting the activity, considering both the content and structure of scientific knowledge (NOS)

The first activity was to evaluate the students' knowledge about archaeology. To do so, in each of the classes we asked, 'What is archaeology? And 'What do archaeologists do?'

We then asked the children to make a drawing that expressed what they thought archaeology is and what the people who work in archaeology do.

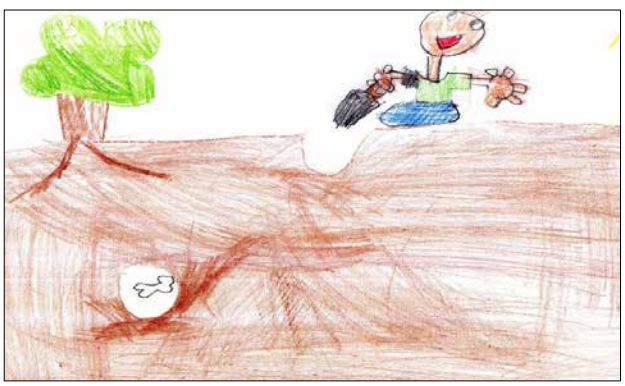


Figure 2. 'Archaeologists excavate bones'.

The ideas reflected in the drawings were very different. Some of the children had some notion about what archaeologists were (someone who excavates bones, for example, or dinosaur bones), but the majority expressed unrelated ideas, such as that archaeologists observed the stars; or played football; or that an archaeologist is someone who painted pretty pictures.

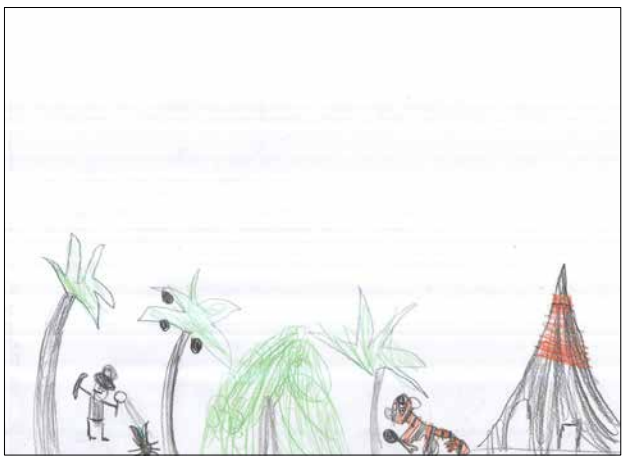


Figure 3. Kacper: 'Archaeologists take care of dogs'.
Figure 4. 'Archaeologist… he examines things in a jungle'.

We then created a concept map that reflected the ideas of the students.

Figure 5. Creating the concept map.

Figure 6. The concept map.

Analysis of the ontology (set of concepts) needed for the application of the activities in the classroom, organized in the form of a Novak map

From the start we understood the importance of questions in research work (following the tenets of 'Nature of science inquiry' (NOSI). When making the concept map about archaeology, the children asked the following questions: What? How? Why?

The drawings made by the students earlier were used to assess their prior understanding of archaeology and how it changed after taking part in the activities, thereby allowing us to evaluate the effectiveness of our classes.

At the same time, the teachers studied archaeology on their own and acquired the vocabulary presented in the graphic.

a) Discovering misunderstandings

The activities that we proposed were conceived of to answer the questions, What? How? and Why? Thanks to these questions the children were able to verify their prior misunderstandings regarding archaeology and archaeologists.

b) The experimental path

As we shall see, the teachers helped the students learn how to carry out archaeological research through various activities designed to provide them with the necessary concepts. This experimental path followed the methodology created by CSIC at School that the teachers had learned through various training courses (2015

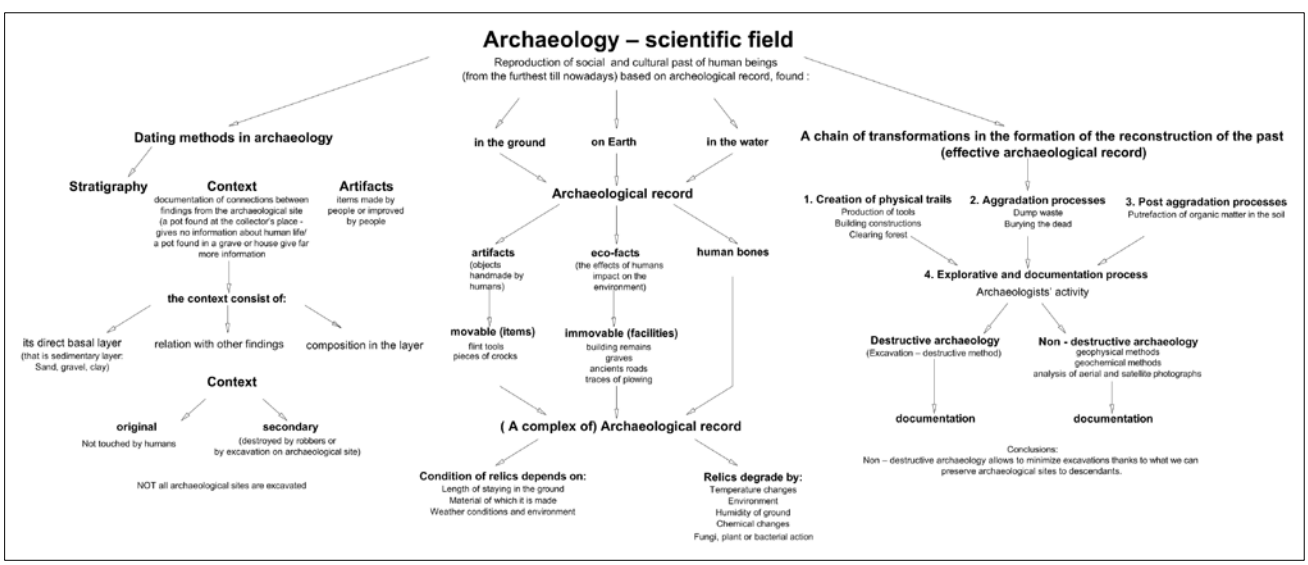


Figure 7. Nova's map: archaeology.

and 2016, Madrid; 2017, Bydgoszcz), which was adapted to the age of the students.

3.4. ACTIVITIES CARRIED OUT

3.4.1. *Activity: The passing of time*

The objective of this activity was for the children to recognize the passing of time.

We approached this activity by first talking about how we measure time: clocks, days of the week, months, the calendar. We also spoke about the chronology of the lives of our fathers and grandfathers, of the succession of events and how they shaped our history.

After these discussions, the children made a 'time box', which consisted in taking a container (in our case, a transparent plastic decanter) and placing different materials in it each day.

Figures 8, 9, 10, 11, 12 and 13. Building our time box.

Figures 14 and 15. Building our time box.

The first day we placed pieces of the edges of the concept map poster in the 'box'; the second day, things related to that day's activities (play dough, pieces of paper, etc.); and each day something different. This activity helped the children to understand and visualize that the different activities carried out in the past leave a footprint that we can observe: the different layers of the 'time box' are connected to a particular day. In this way we could measure the passage of time.

To visualize the differences between the children of today and those of the past, we watched an old video clip in which the children had to point out the objects that were used in the past that today have a completely different aspect (furniture, kitchenware, telephones, etc.).

To finalize the activity we showed the children old school yearbooks, illustrated with many photographs showing the changes the school had undergone, both in terms of the classroom furniture and in the way the people dressed.

Figure 16. Checking the old school diaries.

3.4.2. *Activity: The grandparents' trunk*

The previous activity was used to introduce the following activity in which we asked the children to identify who owned a trunk that we found filled with various objects.

Before starting the activity we asked the children several questions: Is it important to know our past? Why or why not? Is it important to know about the past of people? Why or why not? People have lived in Europe for at least 100,000 years, is it important to know about their lives?

All the children agreed that knowing our past or the past of people in general is important, interesting and fascinating; knowing about them provides us information about ourselves.

Next the teacher showed them an old trunk that she had 'found the day before, in her grandparents' attic'. She showed them the objects contained in the trunk one by one, while asking the children different questions:

- What can we say about the owner of these items?
- Who used them?
- Was it a man or a woman?
- When did they live?
- What did they do?

Answering these questions introduced the children to the idea that we can obtain information about people through the objects they used; objects provide information about the people and societies that produce and use them.

Each group in our preschool had its own trunk containing different objects characteristic of a person (a doorman, a tailor, a watchmaker, a war journalist, a blacksmith, a firefighter). Later, the children visited each of the groups to observe the other objects.

To conclude the activity we asked the children to bring some of their grandparents' belongings, and to tell us a story linked to each of those objects; we also put together a 'grandparents' corner'.

Figures 17, 18 and 19. The grandparent's old trunk.

3.4.3. *Activity: Field trip to the museum of soap and history of dirt*

The Museum of Soap and History of Dirt is located in downtown Bydgoszcz (http://www.muzeummydla.pl). The museum was inaugurated in 2012 and it is undoubtedly the first of its kind. The museum's exhibits deal with the healthy past of the city of Bydgoszcz and its long tradition of manufacturing high quality soap (from the oldest types, made from lamb fat and olive oil, to the most modern soaps to wash clothes, like Persil).

During the visit, the children had the opportunity to observe items used in the past and to identify how they differed from modern items; they also noted that some museums try to present the items in their exhibits in the context of the past to accurately display what the past was like. This allowed us to link this activity with the following one on the importance of context.

3.4.4. *Activity: The context game*

The objective of this activity was for the children to understand the importance of context. When objects are contextualized they provide meaning to each other; on the contrary, decontextualized objects lose a great deal of the information that they could provide us.

We showed the children the ground plan of a house with 4 rooms: a bedroom, bathroom, kitchen and game room; we also gave them a set of objects connected to these rooms. The first thing they had to do was to link each object with the correct room.

The next step was to completely cover the ground plan: the only thing left visible were the outer walls, so that the children knew it was a building. We covered each room with 3 sand-coloured sheets of paper. The first layer, on the top, had one hole; the second, underneath the first, had 2-3 holes; the third, 3-5 holes). Next, the children had to uncover the images, layer by layer, trying to guess which room it was. The objects they had seen earlier gave them an idea of the type of room, despite only being able to see a small part of it.

After expressing their hypotheses about which room they thought it was, the entire image was revealed to check if they were correct.

This activity was very useful to demonstrate that although the information we have about a society may be partial, the context can help us to understand things about the way of life of other people.

3.4.5. *Activity: Observing the ground*

Once the children discovered that we can obtain information from objects (the grandparents' trunk, the context game), we went outside to explore the park next to the school.

First we chose an area to explore and then we spoke about the area with the help of a map and an aerial photograph: in this way the children gained a different perspective of the place and grew more familiar with it.

Then we started exploring. To do so, we gave each child a small flag that they could use to mark any object that they found. They were instructed not to touch what they found, but rather to just place the flag next to the item.

Later, as a group we marked the objects on a map.

Figures 20 and 21. A first look at the area.

Figures 22 and 23. We marked our findings with a flag.

Figure 24. Looking at the ground with the help of aerial photograph.

3.4.6. *Activity: Formulating hypotheses*

Once all the elements were marked on our maps, the children tried to explain their meaning in the place they were found.

For example:

- A girl was playing on the playground and lost her headband (headband on the ground).
- Some children passed by our school and ate candy (candy wrappers on the ground).

3.4.7. *Activity: Ground strata*

The 'time box' activity is the perfect introduction to ground strata. From this example we showed the children other 'time boxes', made from rubbish. We explained how in the same way we added layers to our 'time box', in nature the ground is built up layer by layer (only it takes much more time).

With the help of an image on the formation of layers (stratification), provided by CSIC at School, we spoke about how the passage of time changes our surroundings.

Figure 25. Study of stratigraphy.

Once a period has ended, or a place is abandoned, the houses are left empty and in that place new houses might later be built. The passing of time and the succession of different occupations in the same place favour the formation of strata (of new ground layers).

Then the children coloured their own ground strata.

This activity helped the children understood the concept of stratification: they learned that the lowest layer is the oldest and the one on top is the most recent. They discovered that this concept allows archaeologists to date their discoveries.

Figures 26 and 27. Identifying and colouring strata.

3.4.8. *Activity: Underground*

To introduce the activity, which is closely tied to the previous one, we showed the children the Flash presentation in which a house is abandoned and collapses (http://museovirtual.csic.es/salas/paisajes/medulas/6_med.htm). They understood why the roof collapsed first, and why during an archaeological excavation the stratum with the roof is beneath the rest.

Next, we showed the children two images of the same area: the first showed a meadow next to a river; the second showed the same place but with an excavation site in the meadow. In the first picture the children tried to identify the characteristic that could have led to an archaeological investigation of that site and

why that area could be valuable from an archaeological perspective.

Using these two images, the children drew a picture of what the site might have been like in ancient times, when people lived there.

3.4.9. *Activity: How time affects objects*

Each group in the school chose an object made of different materials (wood, paper, metal, glass, plastic) and placed it in a marked area of the playground. After a week, the children checked how the items were affected by time, weather conditions and the type of material they were made of. The children concluded that all three aspects affected the state of the objects. With the help of an illustration of a semi-buried car, they noted that as more time passed objects would be increasingly affected by the three factors mentioned.

Then they analysed shelf-life of various materials and how long they would last depending on external conditions.

Figure 28. Making pottery.

3.4.10. *Activity: Visit to Biskupin*

After the children discovered and experienced how archaeologists work and the scientific nature of archaeology, we spoke to them about where archaeologists work: archaeologists work all over the world!

Indeed, the area of study of archaeology is the entire world. We can select any point on the globe, or choose any time period: there will always be an archaeological problem to investigate. And given that archaeology spans our entire history, we can choose any period, from the earliest humans to medieval times or the modern age.

A good example of archaeological research in Poland is the Biskupin archaeological site, which is located very near Bydgoszcz. In that site you can see and experience the life of ancient people. Biskupin is well known by teachers in Poland, who normally have a good understanding of the archaeological and historical background of the site, so it was easy to introduce it to the children.

Biskupin is an archaeological site located in the Kuyavian-Pomeranian Voivodeship. Excavations have been carried out there since the start of the 20th Century by an cross-disciplinary team and the reconstruction of this settlement has played an important role in shaping Poland's historical identity. Today the Biskupin site and its museum form part of the National Archaeological Museum, located in Warsaw. As mentioned, the site is close to Bydgoszcz, less than an hour by bus.

More information about the site, which has been referred to as 'Poland's Pompey' can be found at http://www.biskupin.pl.

Before the tour we did some work on Biskupin

Figures 29, 30 and 31. Biskupin with chopsticks.

with different materials, for example this reconstruction made with chopsticks.

During the spring we took a field trip to Biskupin, in order to visit the site and carry out in situ various archaeological activities. The people in charge of educational workshops at the site showed the children the procedures involved with excavating and recording the artefacts discovered. The students took part in a simulated excavation with wooden boxes filled

Figure 32. Reconstruction of Biskupin.

Figures 33, 34, 35 and 36. Excavating, documenting and drawing our findings at Biskupin laboratory.

with sand. They then recorded, described and drew the material that they documented.

3.4.11. *Activity: Meeting an archaeologist*

To close the activities on archaeology, we organized a meeting with reputed archaeologist Robert Grochowski, an expert in the archaeological heritage at Bydgoszcz. He shared his experience with us and showed us the tools he uses and some of the artefacts he has studied. The children had the opportunity to broaden their knowledge, to learn more about the history of the city and to practice how archaeologists work.

This meeting allowed us to initiate a collaboration with local archaeologists, though which we were able to visit an archaeological site where we could continue our work in archaeology.

To close these activities and in order to consolidate the knowledge acquired over the previous two weeks dedicated to archaeology, we searched for information on the topic in different books and on the internet. The children discovered that the work of archaeologists is not limited to excavating and documenting elements on the surface of a terrain, but that they also use other non-destructive methods, such as geophysical surveying, geochemical surveying or aerial photograph or satellite image analysis.

3.5. FINAL EVALUATION OF THE ACTIVITY

After two weeks of classroom work dedicated to archaeology we have observed that:

- The children have come to understand and assimilate that archaeology studies aspects related to humanity and our civilizations: how people lived; how they ate, their beliefs, etc.

- The students now know that the study of dinosaurs is the subject of a different scientific discipline, palaeontology.

- They also comprehend that the observation of everything that surrounds the artefacts is very important for archaeology. Therefore, the concept of context is essential to understanding artefacts and for them to provide something to scientific research.

- Finally, the children now appreciate how important carefully documenting observations of our surroundings is for scientific research.

The drawings made during and after the project reveal a significant change in the ideas of the children. We again asked them, what does an archaeologist do? 70% of the children could answer the question: the answers were more extensive and detailed than those provided on the first test.

Figure 37. We show what was learned.

In fact, after analysing the drawings and carrying out surveys of the children we have observed important changes in their conception of archaeology. There was an increase in the comprehension of the topic of archaeology. Among the 3 year old students there was a 76% increase; among the 4 year olds, 77%; and among the 5 year olds, 71%, and among the 6 year olds a 75% increase.

However, it is necessary to continue working along these lines.

In any case, we have observed that due to its interdisciplinary nature, archaeology can be a pillar of teaching science in the classroom: it can easily be applied to a transversal study plan and it has great potential to help develop the basic cognitive abilities related to research. Another advantage it has is the strong presence of topics related to archaeology in today's society, which makes it very interesting to children and their families.

4.5. TEACHER AND RESOURCE CENTRE OF GIJÓN-ORIENTE (GIJÓN, SPAIN).
THIS IS ABOUT ARCHAEOLOGY

1. COORDINATOR'S INTRODUCTION

In February 2017 CSIC at School imparted a training course on Archaeology in the Classroom, directed at preschool and primary school teachers. The course was held under the supervision of the Gijón-Oriente Teacher Training and Resource Centre, a partner of the SciLit project.

The objective of the course was to show that studying ancient societies and, more specifically, archaeological research, offers many possibilities to teach science in the earliest stages of education. The guiding principle of the course was based on archaeological methodology, the way in which various key topics could be approached through experimentation: archaeological sources, the definition of the archaeological record, or the complex nature of the data employed by archaeology.

The activities carried out during the training course were later put into practice in various schools. The project presented here integrated the training acquired during the course on the content of the education curriculum with the school's study plan at that time. The result was a proposal to apply a classroom approach with great didactic potential that wonderfully combines various subjects, the abilities developed in preschool education and the use of different physical spaces.

2. COMMON METHODOLOGY USED IN THE PROJECT

The methodology proposed by CSIC at School was used to design the activities and develop the research project: the teachers guided the students along a path aimed at introducing the content related to archaeology, taking advantage of its didactic possibilities. This experimental approach was guided by a series of questions that introduced the concepts in accordance with the cognitive stage of the children.

To carry out the project the ideas learned during the training course were employed as well as other different material, especially the Spanish language video 'Qué es la arqueología?' (What is archaeology?).

www.youtube.com/watch?v=tY8497681l0

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'THIS IS ABOUT ARCHAEOLOGY'

3.1. DESCRIPTION AND CHARACTERISTICS OF THE GROUP

The project was developed by two teachers from Antonio Machado Public School, a preschool and primary school located in the city of Gijón,

which is attended by children aged 3-12 years old.

The 'This is about archaeology' research project was carried out with two groups of preschool children, all of whom were 5 years old, during the first semester of 2017.

3.2. OBJECTIVE OF THE RESEARCH PROJECT

The general objective of the research project was for the students to learn about archaeological methods within the subject of Prehistory the school was teaching at the time. In this context, we can point out two specific objectives: first of all, to teach the children the difference between studying geological and historical periods and introduce to them how archaeologists organize and carry out their work. Second, to understand that archaeology is a scientific discipline.

Why was archaeology chosen for the project?

- Because during the second trimester the school was working on a project about Prehistory.
- In the prior school year they had studied dinosaurs, which included a discussion on the work of palaeontologists.
- This was a good opportunity to review what had been learned and to further their knowledge by differentiating between the work of archaeologists and palaeontologists.

3.3. ELABORATION AND PREPARATION OF THE RESEARCH ACTIVITIES: DESCRIPTION OF THE ACTIVITY OR ACTIVITIES THAT THE STUDENTS HAVE CARRIED OUT

1st activity. What is an archaeologist?

The first activity was to evaluate what the students knew by asking them: 'What is an archaeologist?'

The children were then asked to write and draw a picture expressing what they thought archaeologists did.

After finishing the drawings the students showed them to the rest of the group and explained what they thought an archaeologist did.

Figure 1. Daniela: 'An archaeologist is someone who looks for bones'.

During this activity the students expressed very diverse opinions: some said they knew what archaeologists did and related their activity to studying dinosaurs, bones, mammoth bones; one girl, Sara, even said that archaeologists

look for bones and 'make hypotheses'. However, many others expressed very different ideas, including that archaeologists take care of flowers.

Figure 2. Sara: archaeologists 'make hypotheses'.

2nd activity. Researching together

The second activity consisted in carrying out research as a group, following the process used by archaeologists. First, the teachers helped the children to investigate the 'state of the art' of archaeology.

The entire group searched for information about archaeologists in books and on the internet and discovered that archaeology:

- Studies aspects of humanity and civilizations: how people lived in the past, what their diet was like, what they believed in…
- Does not study dinosaurs.
- Requires close observation of the surroundings, that is, everything that surrounds the artefacts, bones, etc.
- Needs to record (draw, take note…) everything that it studies.

This research on state of the art served as a 'challenge experiment' to spark the students' interest in the project and also completed the evaluation of their prior understanding of the subject. During the activity the children were asked to describe archaeology in their own words, answering the questions: What? How? and Why?

This was the start of the experimental path that the teachers had set to teach the students about archaeology through various activities. These activities, or experiments, were designed by the teachers to teach the children the necessary concepts. As seen above, this experimental path employed the methodology taught in the CSIC at School training course and was adapted to the age of the students.

3rd activity. Are you observant?

This activity is an adaptation of the 'context game' for 5 year olds.

Because one of the most important aspects of archaeological work is observation, the children were asked to play the following game. Images of different objects were passed out and the children were shown 5 different settings: a school, a hospital, a hairdresser, a restaurant and a hotel.

Who can identify in which place each objects belongs?

Figure 3. The context game.

4th activity. Looking at the ground and my surroundings

Once the children realized that they could be good observers, the teachers proposed that they be archaeologists for a day. They went out to the playground in teams, with the objective of observing and recording everything that they found. Each team was assigned an area of the playground to examine.

Before going out the teachers reminded them how to be good archaeologists:

- Observe first, without touching.
- Look at the surroundings, of everything around you.
- Record what you see (draw it, take pictures, place it on a map…).
- Pick up objects carefully.

Figures 4, 5, 6, 7 and 8. We searched the playground and took notes in our field journals.

Figures 9, 10 and 11. Then we took note of everything in our notebooks.

5th activity. Formulating hypotheses

Using the objects found on the playground we asked the children to carry out one of the steps taken by archaeologists: formulating a hypothesis.

They were explained what a hypothesis was and encouraged to come up with their own hypotheses.

One by one, they were shown the objects that had been found and they came up with hypotheses about them.

Examples:

- 'A man was farming and he forgot some of his grains of corn.'
- 'A worker forgot his helmet.'

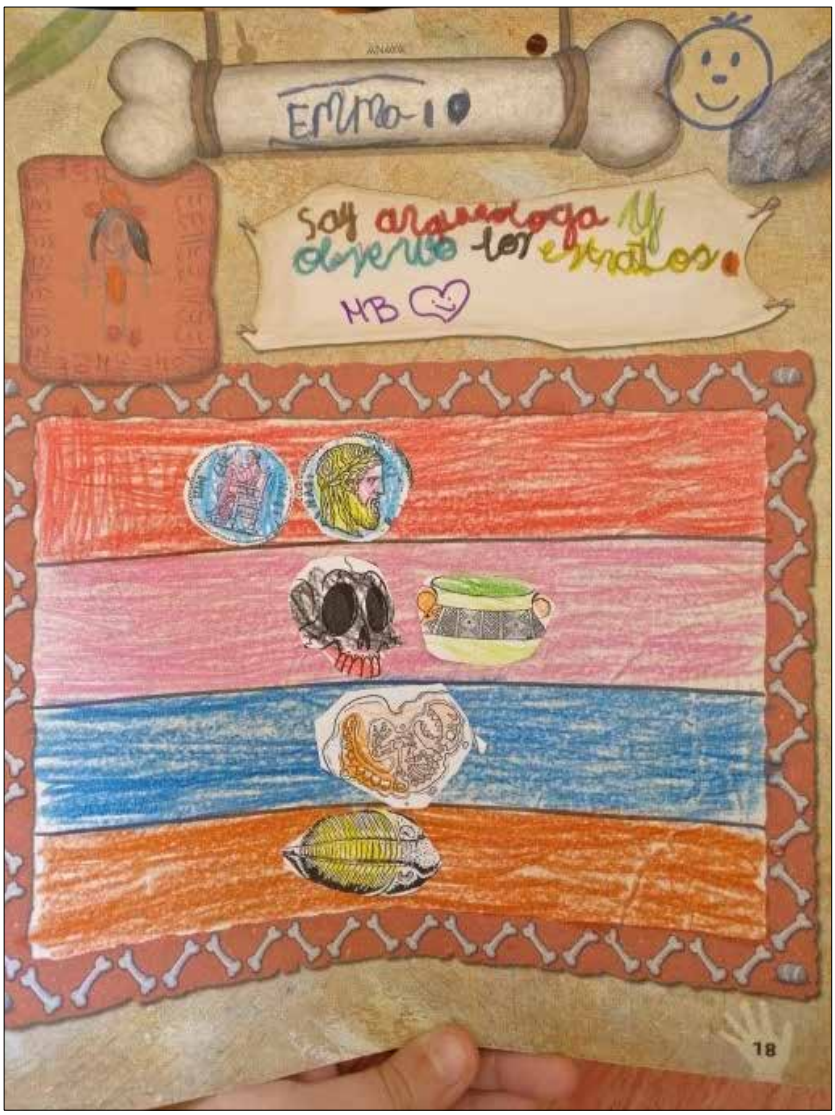


Figure 12. Working with stratigraphies.

6th activity. Underground: strata

But archaeologists do not only observe what they find on the ground, they also study what they discover buried underground.

The students were introduced to strata and they discovered that when a stratum is deeper underground it is from an older era.

They made a stratigraphy. First they coloured each stratum a different colour and then they were given objects from different eras so that they could place them in the correct stratum.

7th activity. Field trip to Teverga Prehistory Park

The Teverga Prehistory Park is a cultural facility whose objective is to make Upper Palaeolithic art in Europe known. It has a large collection of reproductions of art from that period, including rock paintings and portable art. More information about the park can be found at http://www.parquedelaprehistoria.es.

Figures 13, 14 and 15. Field trip to Teverga Prehistory Park.

During our visit to the park we observed some of the prehistoric artefacts that were found in different sites, for example, Venus figurines.

3.4. FINAL EVALUATION OF THE ACTIVITY

This activity was evaluated on the experience transmitted by the teachers to the SciLit project coordinator at the Gijón-Oriente Teacher Training and Resource Centre. The project sent to the coordinator demonstrates that it is possible to work with students on topics related to archaeology without deviating from the level of the content of the school curriculum, since the project can be perfectly adapted to any level, in this case preschool.

The teachers have carried out an inspiring project that was perfectly integrated with the school's study plan. Through the project the students gained a better understanding of their surroundings and learned concepts that will be key in their future academic development.

Figure 16. This is about archaeology!

TEACHER AND RESOURCE CENTRE OF GIJÓN-ORIENTE (GIJÓN, SPAIN).
ARCHAEOLOGY IN THE CLASSROOM

1. COORDINATOR'S INTRODUCTION

In February 2017 CSIC at School imparted a training course on Archaeology in the Classroom, directed at preschool and primary school teachers. The course was held under the supervision of the Gijón-Oriente Teacher Training and Resource Centre, a partner of the SciLit project.

The objective of the course was to show that studying ancient societies and, more specifically, archaeological research, offers many possibilities to teach science in the earliest stages of education. The guiding principle of the course was based on archaeological methodology, the way in which various key topics could be approached through experimentation: archaeological sources, the definition of the archaeological record, or the complex nature of the data employed by archaeology.

The activities carried out during the course were later put into practice in various schools.

The project presented here, as we shall see, is highly original. From the start it captured the interest of the students, who participated enthusiastically. The teachers used the content of their training to create their own project, adapting it to a group of students aged between 9 and 10 years old.

2. COMMON METHODOLOGY USED IN THE PROJECT

Although the activities and the development of the research project were based on the methodology proposed by CSIC at School and the content of the training courses on archaeology, the teachers designed a highly original project that revolved around two key concepts: comprehending processes of social change (and how these changes materialize in the sequential formation of the archaeological record) and the process of archaeological investigation, stressing the different approaches to scientific reasoning employed in archaeology.

Using a very experimental and hands-on approach, the teachers guided the students along an experimental path that gradually introduced them to new concepts in accordance with their cognitive stage and prior knowledge.

As we shall see, the project was entirely integrated with the area of Social and Human Sciences in the school's study plan.

3. DEVELOPMENT OF THE RESEARCH PROJECT: 'ARCHAEOLOGY IN THE CLASSROOM'

3.1. DESCRIPTION AND CHARACTERISTICS OF THE GROUP

This research was designed by two teachers from Begoña Public School, a preschool and primary school located in the city of Gijón. Numerous students attend this school from ages 3 to 12.

The 'Archaeology in the classroom' project was carried out with two groups of 4th year primary school students (9-10 years old) during the first semester of 2017.

3.2. OBJECTIVE OF THE RESEARCH PROJECT

The **general objective** of the research project was for the students to learn about the scientific reasoning and methods employed in archaeology using a very original idea: the students would create and excavate a scale reproduction of an archaeological site.

The idea of the project was for each 4th year class of primary education (4A and 4B) to create an 'archaeological site' in their classroom, using a transparent container. The container would represent a site that had been inhabited in various time periods and, therefore, contain the material remains of various periods between Prehistory and the Antiquity that could be discovered and documented through archaeological investigation.

Later, the two classes would exchange their sites and carry out excavations, describing the layers and cataloguing, classifying and analysing the objects discovered.

3.3. ELABORATION AND PREPARATION OF THE RESEARCH ACTIVITIES: DESCRIPTION OF THE ACTIVITY OR ACTIVITIES THAT THE STUDENTS HAVE CARRIED OUT

1st stage: Burying the remains and other evidence of human presence

To start the project the students shared their prior knowledge about history, prehistory and how we can learn about what happened in the past.

Figure 1. First meeting to pool information.

In order to introduce the material and motivate the students, an activity related to observation and deduction was carried out.

Figure 2. Introductory observation activity.

Later, just as archaeologists do when they document a site they are going to investigate, we studied and discussed Prehistory and the Antiquity, with the help of our text book and other documents and materials.

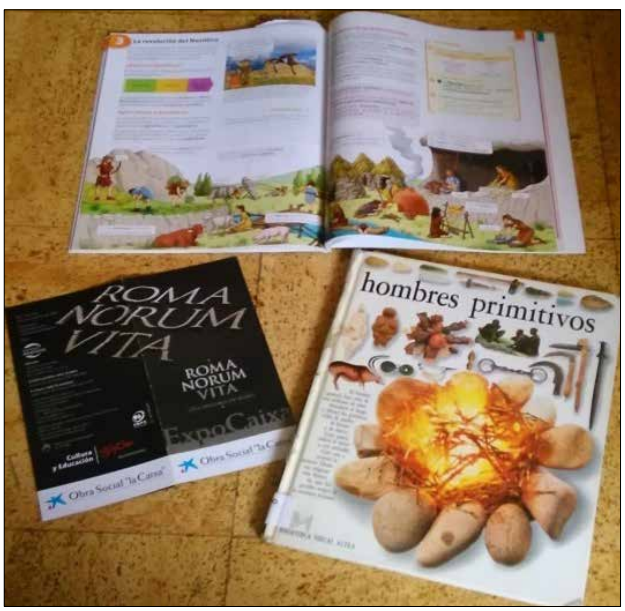


Figure 3. Materials used for the initial study and documentation.

After studying each period, the students made or searched for objects or other types of evidence of human presence in that period. Once the students had chosen or made the objects, they presented them in class and gradually they were deposited in the transparent container. Each object that was deposited was described and recorded in a file.

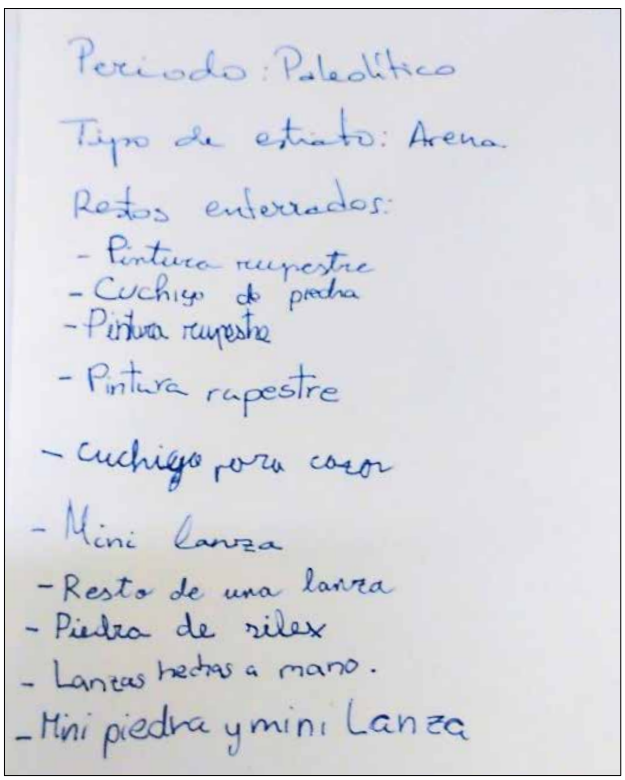


Figure 4. Object description. In this case: 'Period: Palaeolithic. Type of stratum: sand. Buried remains: rock painting (3), stone knife, hunting knife, mini lance, remains of a lance, flint stone, manmade lances, mini stone and mini lance'.

With their prior and new knowledge and quite a bit of creativity, the students constructed their own prehistoric objects.

Once an era was established, the passage of time was simulated after their abandonment: the objects deposited in the terrain ended up

Figure 5. 'Rock' painting.

Figure 6. Tool: sickle.

Figure 7. After being abandoned, a site can be completely buried.

Figure 8. Construction of a circular cabin.

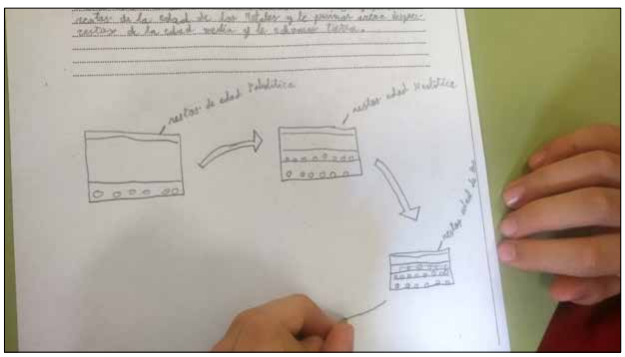


Figure 9. Record of the work: conceptualization of the stratigraphic sequence.

being buried by sediments (caused by erosion, rain, intake of new soil…).

In one class, the students built, even with stones from the patio, a circular cabin.

And so objects from the Palaeolithic, Neolithic, the Iron Age and the Roman era were successively buried. Once the box was completed a record was made of the activity.

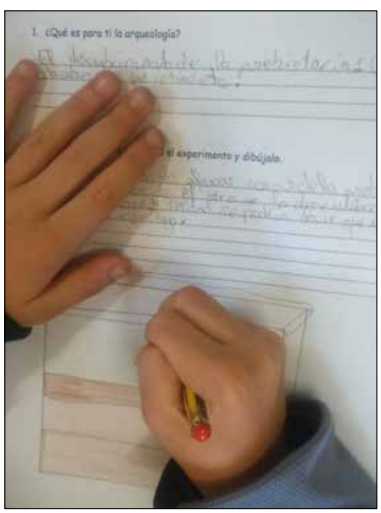


Figure 10. Record of the work: summary of the main concepts and drawing of the stratigraphic sequence.

The notebooks and records were then read and reviewed and a follow up discussion was held. These activities were completed with a presentation on the excavations at Atapuerca (video obtained from the internet).

The Atapuerca Mountains located in the province of Burgos (Castile and León, Spain) have been declared a World Heritage Site due to the exceptional archaeological and palaeontological discoveries that have been made there, including fossils of various different hominid species. More information can be found at the Atapuerca Foundation website (https://www.atapuerca.org) and the Museum of Human Evolution (http://www.museoevolucionhumana.com).

All of this documentation allowed the students to very clearly conceptualize the meaning of the superposition of the archaeological remains and to realize that the oldest remains are normally buried further below.

They also learned the importance of respecting archaeological heritage, that is, why it is necessary not to alter the superposition of strata with illegal excavations. This principle is the basis of any archaeological excavation: it is necessary not to move the material that is found and to record them in their original position.

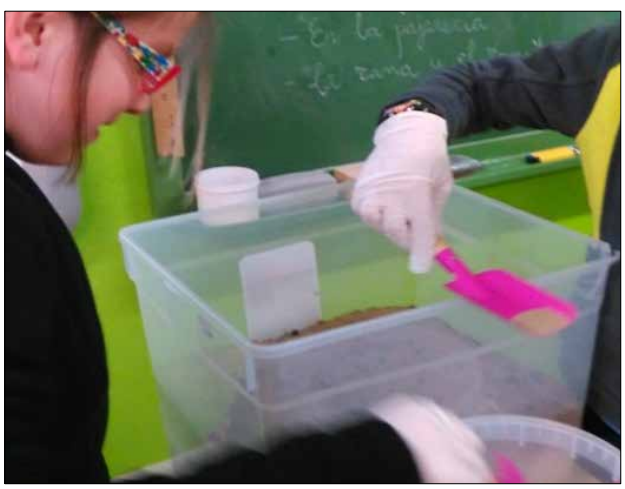
The students were given some guidelines on how to excavate the remains and use the trowels and brushes.

They also learned new vocabulary, such as 'archaeological site', 'stratigraphic superposition' and 'sediment'.

2nd stage: Unearthing remains and other evidence of human presence

The second stage started when the containers were exchanged between the two classes.

Each class then proceeded to document and study the container prepared by the other class.



Figures 11, 12 and 13. Images of the excavation process.

Figure 14. Images of the excavation process.

Following the stratigraphy, the students removed the sediments until they discovered the foundation of each level of occupation. Once that level was identified, they took a photograph and made a sketch of the objects that had been found. The objects were then numbered and stored in bags, so that they could later be analysed in the laboratory.

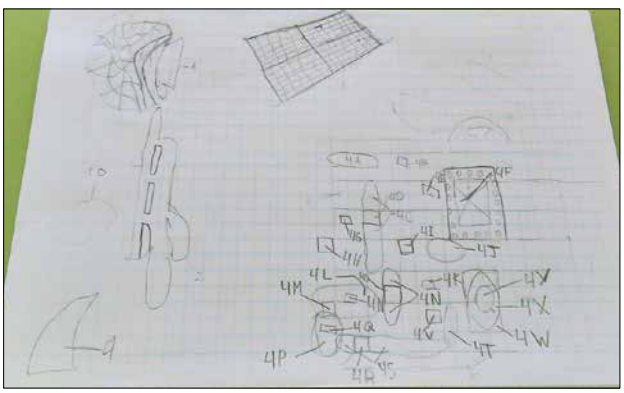


Figure 15. Sketch.

Each of the objects found was described in the laboratory. After analysing the remains of each layer, the period to which they belong was deduced.

Figure 16. Laboratory work. Description of the objects.

Figure 17. Storing the material.

During the process the students acquired scientific vocabulary to express their ideas and to prepare their reports.

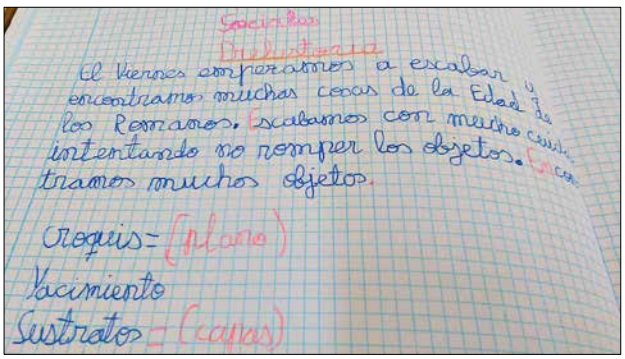


Figure 18. Excavation journal with new vocabulary noted down: sketch, archaeological site, substrate.

3.4. FINAL EVALUATION OF THE ACTIVITY

This activity was evaluated on the experience transmitted by the teachers to the SciLit project coordinator at the Gijón-Oriente Teacher Training and Resource Centre.

When the final report was prepared, there were still three levels left to be excavated. In any case, the teachers emphasized that the students' enthusiasm and interest in the activity sparked their curiosity about the four time periods studied, which makes this activity an ideal complement to the study of historical periods, which begins in these school stages.

The students expressed their satisfaction and enthusiasm when carrying out each of these activities.

Figure 19. The activity motivated the students from the start.

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RESOURCES USED (WEB)

American Society of Archaeology

The resources of the American Society of Archaeology have been a great inspiration for the production of some activities, specifically: 'The context game' (3.1), 'Looking at the ground' (4.3), and 'Why is the past important?' (5.1). These can be accessed at: www.saa.org/publicftp/PUBLIC/home/home.html (last accessed April 19th 2018).

Digital CSIC

The resources produced by Almudena Orejas Saco del Valle, Ana Delia Rodríguez Ovejero and School Zazuar (Madrid, 2013) provide very interesting ideas and figures, in special:

- Busca la huella humana (6º E.P.): http://hdl.handle.net/10261/81855
- Lo que el ojo no ve (5º E.P.): http://hdl.handle.net/10261/88713
- ¿Qué veo yo? ¿qué vieron ellos?: http://hdl.handle.net/10261/88716
- Tiempo y calendarios (E.P. y E.S.O): http://hdl.handle.net/10261/88717

Regional Archaeological Museum of Madrid

The activity 'The trunk of memories' (5.2) has been inspired in the permanent exhibition of the Regional Archaeological Museum of Madrid (www.museoarqueologicoregional.org).