



HOLOMAKERS PROJECT

**Motivating secondary school students towards STEM careers through
hologram making and innovative virtual image processing practices
with direct links to current research and laboratory practices**

Erasmus+ KA2 2017-1-PL01-KA201-038420

Activity 4

Capturing light: the coins project



Project description for teachers

Overview

This activity is one of the interdisciplinary projects in STEAM for physical holograms that will be developed within the 2nd pilot phase of the Holomakers project.

In this project, we expect from the students to become familiar with the basic principles of optics through the use of physical holography and specifically through the use of the portable HoloKit, which represents a basic holographic set up. This activity revolves around the 'coins' topic, with coins being the main holographic objects. The students will be encouraged to do a short research on this topic, choose a coin and use the HoloKit in order to successfully record the object.

| | |
|-----------------------------------|--|
| Est. Duration | 2-4 hours (dependant on the implementation of the extended activity scenarios) |
| Equipment/materials needed | The portable HoloKit, batteries, holographic film, coins |
| Links to external files | Useful material can be found in Dropbox O3>Projects>Coins Additional OERs that might be useful for introductory purposes: https://holomakers.eu/oers/ External resources: https://holomakers.eu/wp-content/uploads/2019/01/ExternalResources-coins.pdf |
| Learning objectives | We expect students to: <ul style="list-style-type: none">• get familiar with the procedures of making a physical hologram using the HoloKit• understand how basic setups for hologram recording function• problematize upon the materiality and texture of the object to be holographed• practice their collaborative skills towards producing a more complex and meaningful – from an artistic perspective – hologram• go deeper in the context of the project and to explore the topic of coins from many different perspectives (i.e. History, Monetary Heritage, Maths) |
| Preparation needed | The teachers need to become familiar with the process by testing different angles and positions of the object to be holographed as well as different kind of coins with different sizes and various materials/textures. <i>The experience gained during C2 training activity might be useful.</i> |

Preparatory phase

In Dropbox (see folder O1, O2 and O3) there are several resources for physical holography that you may need in order to familiarize your students with the concept of holography. You can also trigger students' curiosity by asking them to do a short/small research on specific topics related to holography and holographic process.

Phase 1: Introduction into the scenario of the activity

At the beginning the students are encouraged to do a short research on monetary coins. The teacher can raise some key questions in order to guide their research: What are coins used for? Do all the countries have the same coins? What is a commodity? What was the problem with commodities? How do the early coins look like? When were the first metal coins introduced? What metals and materials are used in coins? What issues the paper currency solved? What is currency?

The students can also be encouraged to play with the currency and to convert for example euros to zlotys, sterlings, Levas and more (useful link: <http://www.convertmymoney.com/>).

They can also be invited to go back into time and to find information about the monetary coins that had been used in some countries in the past (i.e. drachmas, pesetas, Italian liras). The travelling in time can go even deeper with the students to explore alternative means of payment in different cultures (commodities) and different historical periods (salt, tea, tobacco, cattle, seeds and shells). The teacher can then encourage the students to focus on the different textures/materials, sizes, and even shapes or/and geometries of the coins (Figure 1).

Scenario: John is a Greek teacher that implements the “Coin project” with his students. He thinks that it is important to immerse the students into the scenario of the activity. He forms students in teams and addresses one question to each team (related to the topic of coins) and encourage them to find answers online. The questions revolve around a) the value of coins and currency, b) the materiality of coins, c) the early coins that have been used, d) the coin making process nowadays. The representative of each team presents the findings of the research in the plenary and John ensures that the findings are brought meaningfully together. He thinks that the topic offers good opportunities for doing some maths...and invites the students to play with currencies (i.e. from euros to zlotys, from euros to dollars and more). He then demonstrates pictures of coins as well as real coins (see Figure 1) and encourages the students to highlight the basic characteristics and differences among these coins. How shiny and glossy are they? What shape do they have?



Figure 1 Different coins

Choosing/Selecting the coin

At this stage each team select the coin to be holographed. For better recording results, the students are informed that the selected coins should be shiny and glossy. However, they should be encouraged to test different textures/materials in order to find out themselves the role that the materiality of the object plays in physical hologram recording. In addition, they should keep in mind that the selected coins should not exceed the height of 2-4cm in order to fit the size of the holographic film (that is used in the HoloKit).

Outcome: At this point, the students should be problematized on the significance of materiality in the process of physical holography.

The teacher can raise the following questions to activate the dialogue in the class:

- Does the texture/ materiality of the coin play a role in the holographic recording?
- Does the size of the coin play a role in the holographic recording?

In general, the bigger the object is, the more light is reflected and the better results we get. In the case of the shiny and glossy coins, the reflection is already good thereby we have high chances to obtain good results also with the small coins.

Phase 2: Preparing the set up

In this phase, the students are invited to use the portable HoloKit (Figure 2) and prepare the set up in order to record the selected object. You can find the instructions here (Output 2: <https://holomakers.eu/intellectual-outputs/>), in case the HoloKit is not already assembled from previous activities.

Students are encouraged to test different angles and positions among the laser beam, the holographic plates as well as the base of the object in order to better understand the mechanisms of holography. They are also encouraged to place the object in various heights and positions by using the provided plasticine. When the students agree that the reflection on the holographic plates of the object (namely the coin) is the finest (that can be done), then the set-up will be ready for the recording phase.

Some general rules/tips that usually give good results:

- Place the kit on a stable table
- Turn on the laser diode at least 5 minutes before making holograms
- Place the object as close to the holographic film as possible
- Place the object at a height that is illuminated by the laser beam
- Check that the reflection of the object is visible on the holographic/plexiglass plate (Figure 3)
- Avoid to change the height of the laser diode

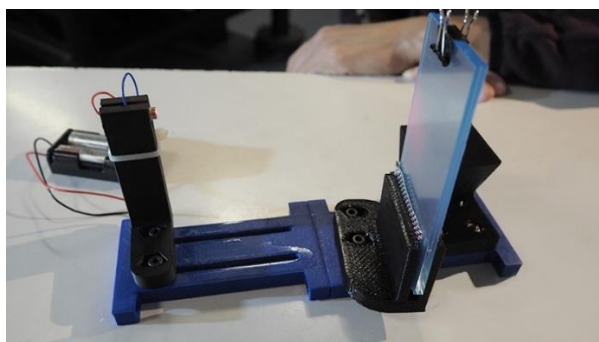


Figure 2 The portable HoloKit

Outcome: At this point, the student should have become familiar with the HoloKit and the underpinning physical holography procedures. The focus is on realizing the importance of choosing the best angle and positions among the basic parts of the set-up.

Capturing the artefact

Once the set-up is ready, the students should mark on the holographic plates the area where the holographic film will be placed (Figure 4, left). They should also place the shutter between the laser beam and the holographic/plexiglass plates (Figure 4, right). Then – with the help of their teachers – and in a semi-dark room, they will place the holographic film between the two holographic plates (before placing the holographic film it is important to check whether or not the holographic/plexiglass plates are clean). After that, they will wait for approximately 3-5 minutes.

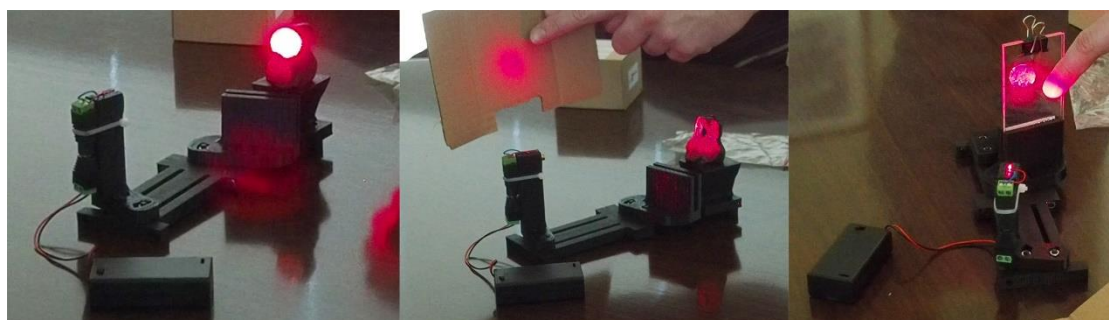


Figure 3 Checking object's reflection on a neutral surface to get familiar with the process and then on holographic/plexiglass plate.

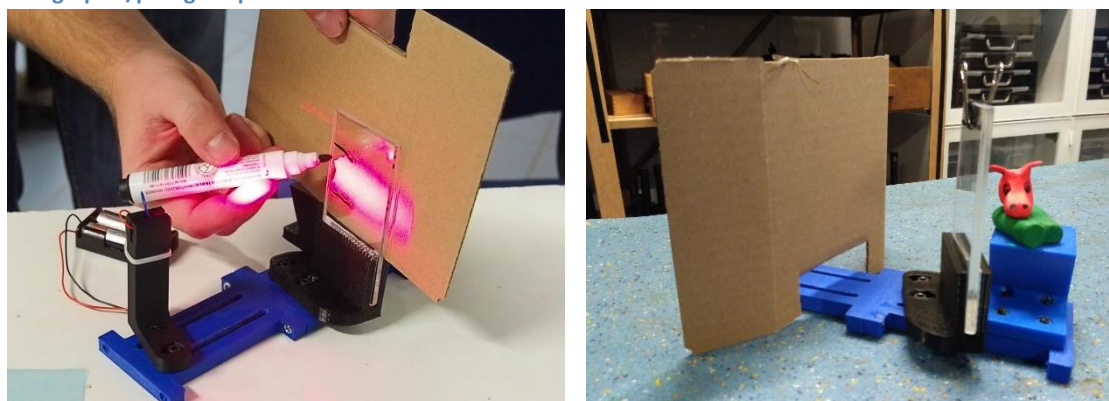


Figure 4 Marking the holographic/plexiglass plate (left), Placing the shutter (right)

Placing the holographic film: Before placing the holographic film, it is important to check the colour of the film and specifically if it is blue or red. Blue colour indicates that the film hasn't been previously exposed to light, while red indicates previous exposure. The holographic film is covered by two thin transparent foils, a colourless one and a green one. The student in charge should firstly remove the colourless foil, and carefully stick the film on the marked area (Figure 5, Left). It is crucial to firmly and slowly stick the film on the surface in order to avoid getting/having bubbles. In case of mistake, do not try to unstick the film, but put some pressure on film's surface in order to pop the trapped air out. After sticking the film, it is time for the green foil to be removed and for the second holographic/plexiglass plate to be placed. Then, the two plexiglass plates with the embedded film should be placed on the kit (Figure 5, right). You can find more instructions here: <https://www.youtube.com/watch?v=4lwSLHOQpWM>

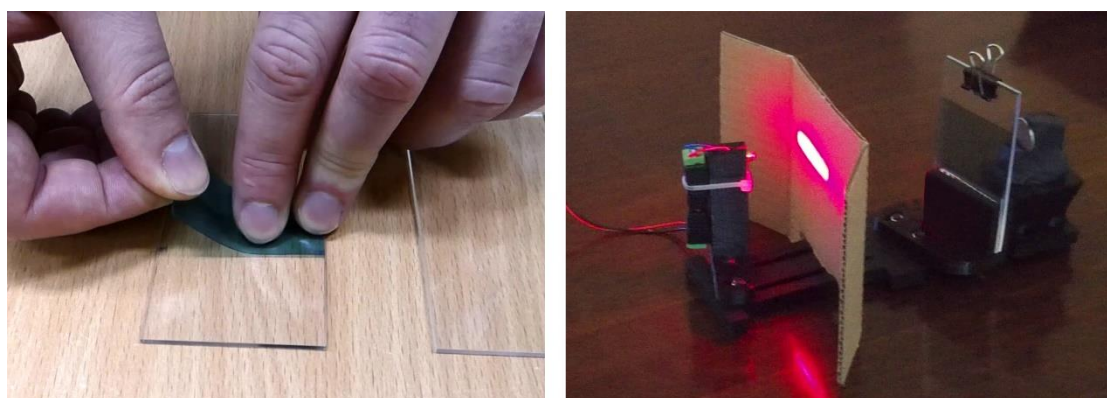


Figure 5 Sticking the film on the holographic/plexiglass plate (Left), Placing the holographic/plexiglass plates with the embedded film on the kit (Right)

Important notes: During recording the parameters of stability and silence are of crucial importance. Thus, apart from placing the HoloKit on a stable surface (e.g. the floor) it is recommended to have in charge one student for each HoloKit who, after removing the shutter, will stand still and silent for the entire recording time. The shutter should not be abruptly removed, but rather slowly in order to avoid any disturbance or/and failure that can be created by the air flow.

Checking the produced holograms

After 3-5 minutes the students can check if the object was holographed. Therefore, with the laser beam still connected to the feed supply, they should look at the holographic film (which will still be between the holographic/plexiglass plates) from different angles in order to find out if their object (the entire object or part of it) was successfully recorded on the film. If the object has been holographed, then the set-up was correct. If the object is not holographed, then the

set up should be modified. In general, it is recommended to test at least 2 or 3 different setups in order to engage the students to the entire procedure.

Note: To avoid any disappointment or even frustration, the students should be informed that the process of holography is not always straightforward, and it takes a lot of tests and practice in order to have the best possible results. You should also have in mind to check the level of the provided power to the laser beam because low power levels can lead to failure during the recording process.

Additional activities

Recording the holograms of metallic-like objects

The students can be triggered to test other metallic or metallic-like objects that they may use on daily basis. For example, they could test if a paper clip, a key, a keychain or other similar objects can be holographed. They can also try to remodel a paper clip, and/or combine other materials from previous activities (like white plasticine) to create a smiley face or anything else they can imagine (Figure 6).



Figure 6 Ideas for further experimentation

Holography goes to monetary/numismatic museums

Through the centuries, the system of trade and exchange has evolved from the barter system to coins, notes and now, credit cards. Museums have been established in many countries to feature a display on the history of money, host collections of coins and real historical artefacts, present issues related to currency and coin making processes.

- Can you find online monetary/numismatic museums and explore digital exhibits that revolve around the story of money?
- Has holography a place in monetary/numismatic museums? How can museums bring artefacts to as many people as possible?
- Can you imagine how hologram recording can be used to offer immersing experiences to visitors of numismatic museums?

The tree of coins

The students can be encouraged to prepare (using plasticine) their trees of coins. They can mix different coins, they can select coins from a specific country, they can create “trees of specific value” and more (Figure 7).



Figure 7 An example of a tree of coins

The teacher should discuss with the students the limitations underpinning this activity. The size of the tree should not exceed 4cm. If it is bigger, only a part can be recorded in the holographic film.

Discussing students' experiences in class

After accomplishing the project, the students should be encouraged to discuss and share their experience with their teachers as well as with their classmates. It is important to provide the link between this experience and the previous activities and thus make a comparison between analog/physical and computer-generated holograms. Here are some questions that can be addressed to the students:

- Can you describe the process in your own words?
- What is the most challenging part in this process?
- Can you think of similar activities?

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Declaration

This report has been prepared in the context of the HOLOMAKERS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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