| **OrientationCompass with solid fill** | **QR audio** |
| --- | --- |

Through the preceding activities, some questions arose regarding the painting "Women's Bazaar II" ....

1. What were the main components of the materials used in the 1971 painting "Women's Bazaar II"?

2. Can these materials give us information about the artist's technique or socio-economic status?

*Discuss the above questions in the classroom as a whole*

**How can we answer these questions?**

**Record the results of the discussion**

| ***The students record the results of the discussion, concluding with the following***  **To answer the above questions we need to:**   * **Zoom in on the object to see details** * **Identify the ingredients from which it is made** |
| --- |

| *Record the views heard with a short video or audio recording  Name it “1.a Problems and Solutions”* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | | |

*Discuss as a whole class.*

**How can we see item details?**

*Note or draw instruments that we can use  
to see details of an object*

| Instruments / Devices | Select |
| --- | --- |
| **Magnifying glass** |  |
| **Binoculars** |  |
| **Telescope** |  |
| **Optical microscope** |  |
| **Close up eye vision** |  |
|  |  |
|  |  |

| ***The students fill in their ideas above or draw the above means/instruments in this space.*** |
| --- |

*Discuss as a whole class about the instrument that can give us the best results and choose it from the table above.*

***Through the discussion we come to the optical microscope.***

| *Record the views heard with a short video or audio recording*  *Name it “1.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Research Research with solid fill** | **QR audio** | |

Use your mobile devices (tablets, mobile phones, etc.) and scan the QR below.

Watch the video and download the results given by your chosen device for the painting by clicking on the **"Results"** button.

****

***Discuss the results of this device in the classroom***

* In the first point of interest, how does the yellow colour of the dress appear under the optical microscope?



Picture 1 Picture 2 Picture 3

***The discussion with the students concludes that with the Optical Microscope we can identify areas of interest, such as the area of the yellow dress (Picture 1). By zooming in on the area of interest (yellow) we observe evidence of wear, so we can take a sample without damaging the artifact (Picture 2). The cross-section of the sample (Picture 3) shows us the yellow layer between the other layers. A discussion can be held with students about how we intervene in an artifact for research or conservation purposes without destroying/altering it.***

* In the second point of interest, what textile is the canvas at the back of the painting made of?



Picture 1 Picture 2: close up observation Picture 3: 10x magnification Picture 4: 40x magnification

***In the back area of the painting (Picture 1) we observe the canvas (Picture 2), which is interesting to study. With a higher magnification of the Optical Microscope (Picture 3), students can observe that the canvas is made up of threads, which in turn are made up of fibers. Picture 4 shows a higher magnification of the textile fibers. The magnification achieved is not enough to understand what kind of fibers they are.***

| *Discuss and record what the device does with a short video or audio recording.*  *Why do we use it and what results does it give us?  Name it “1.c Research”* | *QR audio* |
| --- | --- |

| **Conclusion Thought outline** | **QR audio** |
| --- | --- |

* **Why do we see three different images for the same point of interest? Can you sort them from the smallest to the largest magnification?**

**The three images give us an increasingly higher magnification of the same point.**

**The higher the magnification, the greater the detail we can observe.**

* **Do you observe anything different in the images of the different areas of the object we focused on?**

*Write down your observations or draw the pictures below with arrows for the points of special interest.*

| **In the images taken by the Optical Microscope, the points of interest are the yellow colour of the dress and the canvas. So, it would be interesting to get more information about those two areas.** |
| --- |

***All oil paintings are made on the canvas textile.***

| *Record your answers in three different short videos or audio recordings*  *Name them "1.d Conclusion A", "1.d Conclusion B"* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | | |

*Discuss as a whole class.*

**What do we need to do to get more information  
about the points of interest?**

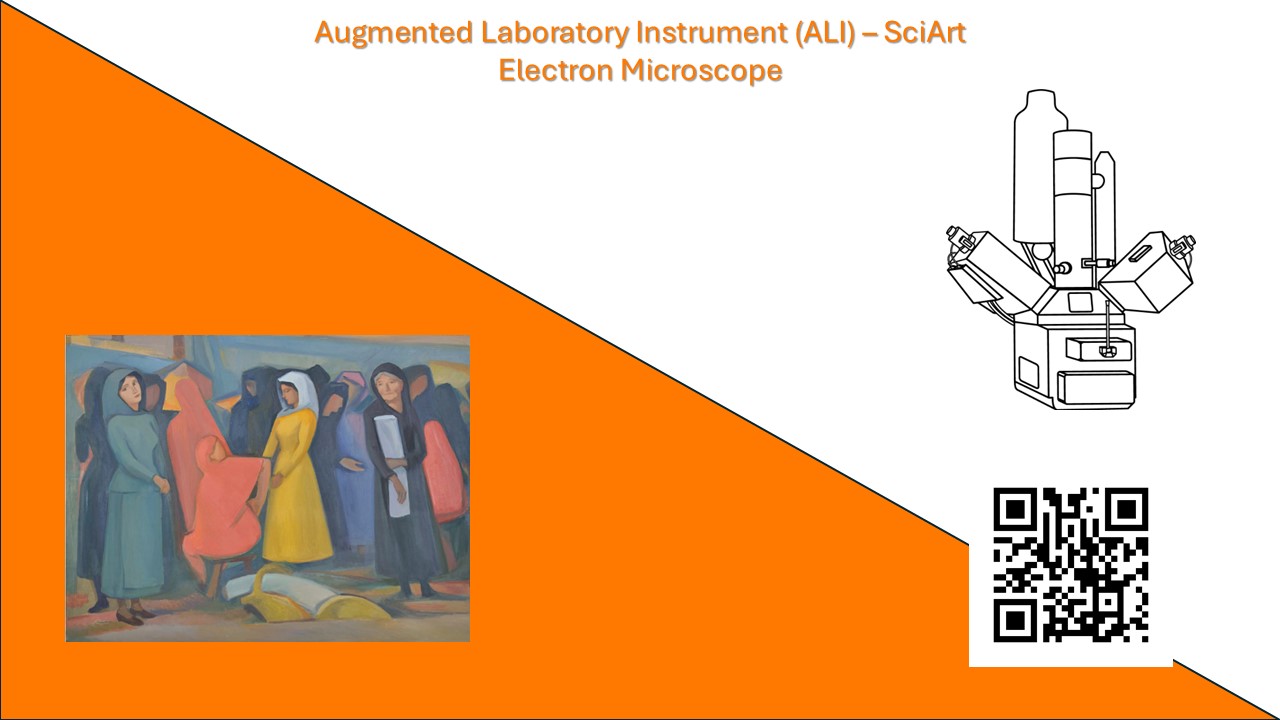
***A discussion is provoked in the class, in which we guide the students to focus on the need for further magnification.***

***The teacher introduces the Electronic Microscope as a solution for extra magnification.***

| *Record the views heard with a short video or audio recording*  *Name it “2.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Research Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobile phones, etc.) and scan the QR below.

Watch the video and download the results the device gives for the painting by clicking on the **"Results"** button.

****

***Discuss the results of this device in the classroom***

* In the first region of interest, from the sample taken from the yellow dress, what do you observe in the SEM image? What does the yellow layer look like? Can you measure its thickness? How are the pigment grains visualized?

***The different black-and-white gradation from the SEM image on the left depicts the yellow painting layer (yellow arrow), among the other layers in the painting. We can identify the yellow pigment grains of the layer (optionally we can measure the width of each painting layer).***

* In the second point of interest, the sample taken from the canvas, what do you observe in the SEM image? How do the textile fibers look like in the SEM and what material are they made of?

***The SEM image on the left shows the textile fibers of the canvas. The SEM image of the textile fibers shows that they have a uniform cylindrical shape with some vertical breaks.***Εικόνα που περιέχει στιγμιότυπο οθόνης, κείμενο

Περιγραφή που δημιουργήθηκε αυτόματα

*Εικόνα που περιέχει στιγμιότυπο οθόνης, ασπρόμαυρο, μονοχρωματικό, μονοχρωματική φωτογραφία

Περιγραφή που δημιουργήθηκε αυτόματα*

| *Describe how the device works and what purpose we use it for with a short video or audio recording.*  *Name it “1.c Research”* | *QR audio* |
| --- | --- |

| **Conclusion Thought outline** | **QR audio** |
| --- | --- |

* **Which one of the two different points of interest, scanned with the SEM method, has the highest magnification? How can we find it?**

**Image 2 has the highest magnification of 3000x. We can read the magnification directly from the information given at the image's bottom. We can also calculate the magnification from the given scale.**

***The two images have a magnification of 100x (Image 1) and 3000x (Image 2). We can read the magnification from the information given at the image’s bottom. We can also calculate the magnification from the given scale.***

* **Why do we get black and white images?**

**We get black and white images because SEM does not use natural light but electrons.**

***We help students come to the above conclusion by mentioning the video's information.***

* **Comparing the SEM image of the textile with the data from the table, what do you conclude about the material of the textile?**

**By comparing the SEM image of the canvas we are studying with the photos in the data table we conclude that the canvas is made of linen.**

***The students conclude that the textile is linen.***

* **What do we observe in the images? What might they mean about our object? Can we conclude the components in the points of interest (yellow paint and canvas)?**
* **No matter how high the magnification of the artifact is, it cannot give us clear answers about the components that the yellow colour and the canvas consist of.**
* **We assume from the points of different white-black gradation the existence of different materials. It would be interesting to use a new method to identify the components of the materials.**
* **So, we select the points where the SEM magnification shows us that there are different materials to find their components with a new method, EDS.**

| *Record your answers in three different short videos or audio recordings*  *Name them "2.d Conclusion A", "2.d Conclusion B"* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | |

*Discuss in plenary class.*

**What do we need to do to find the components   
of the points of interest of the artifact we are studying?**

**What should we recognize?**

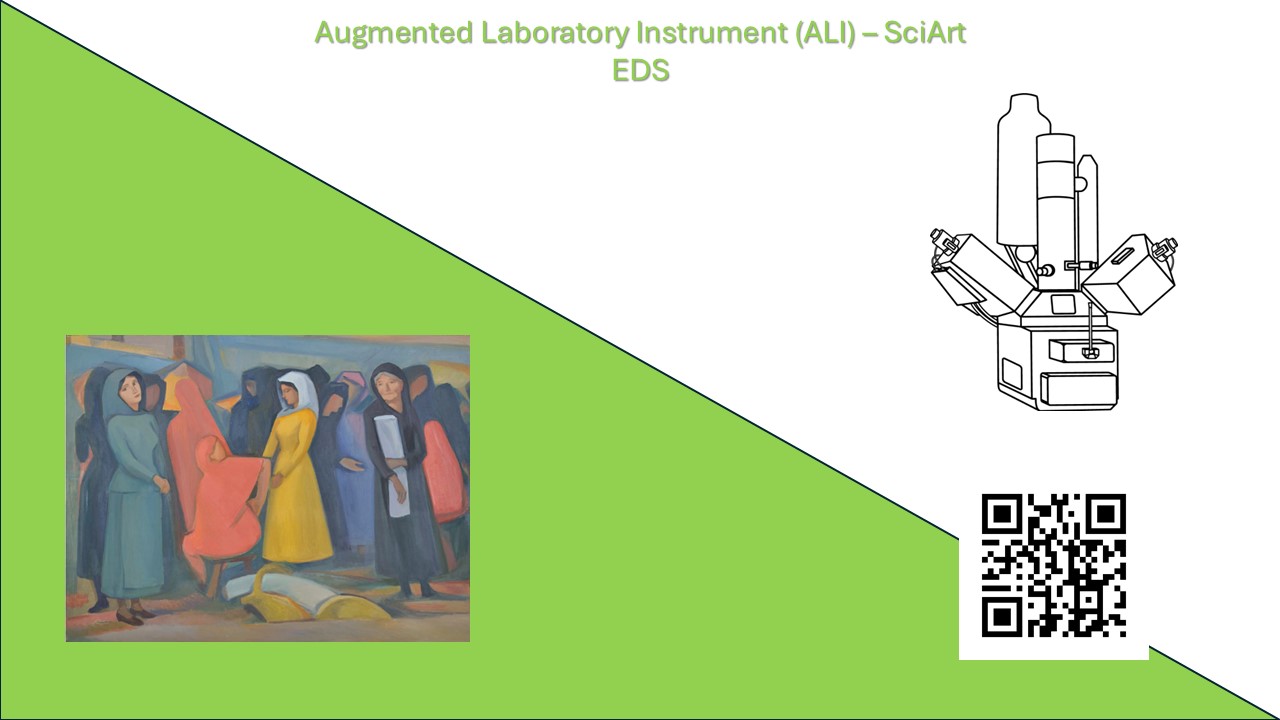
***A class discussion is provoked which leads to the need to identify the elements that the materials in the areas of interest (yellow colour, textile) are made of.***

***The teacher introduces the EDS method for the elemental analysis of the selected points. "EDS, is an analytical method used to identify the elements found in a sample".***

| *Record the views heard with a short video or audio recording*  *Name it “1.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Research Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobile phones, etc.) and scan the QR below.

Watch the video and download the results of the method for the painting by clicking on the **"Results"** button.

****

***Study in your group and then discuss with the whole class   
the results of this particular method***

***Students observe the spectrum and the table of elements and identify the elements of the sample.***

***The teacher explains to the students that EDS spectrum is only obtained by selecting points of interest from the SEM images and asks the students to identify the elements found in the spectrum by the EDS method.***

* In the first point of interest, from the sample taken from the yellow layer, what do you observe in the EDS spectrum? What elements does it consist of?



***This is the spectrum obtained from the EDS method for the yellow layer of the point of interest of the painting. It consists mainly of oxygen, lead, calcium and antimony.***

* In the second point of interest, from the sample taken from the canvas fibers, what do you observe in the EDS spectrum? What elements does the linen, as an organic material, consist of?

***This is the spectrum obtained from the EDS method for the canvas region of interest. The spectrum shows that we only have carbon and oxygen. This is a typical spectrum of organic materials. The identification of the linen fibers was already completed from their morphological features by SEM. Here the connection is made that linen, being the organic material that it is, is composed of O and C.***

**Look for materials containing the elements found in our artifact in the source given below (QR) and list possible materials.**

**QR link to the database**

***Students open the database and search for the materials in which the chemical elements (focus on the ratio of the elements) identified through the method are found.***

***Discuss with your class the results of your investigation from the database.***

| **Name** | **Chemical compound** | **Photo** |
| --- | --- | --- |
| Bindheimite | Pb2Sb2O7 |  |
| Rosiaite | PbSb2O6 |  |
| Calcite | CaCO3 |  |

| *Discuss and record how the method works*  *with a short video or audio recording.*  *What results did it give us? What else did we have to do?*  *Name it “3.c Research”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

List the materials in which the elements are found in our sample in the table below.

| **Points of interest** | **Chemical Compounds** |
| --- | --- |
| Yellow dress color | **Bindhaimite (Pb Sb O227 ), Rosiaite (PbSb O26 ), Calcite (CaCO )3** |
| Canvas fibers | **Organic compound containing C and O which confirms in combination with the SEM results that the fabric is composed of flax fibers** |

| *Record your answers in a short video or audio recording*  *Explain how you got there.*  *Name it "3.d Conclusion"* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | | |

*Discuss as a whole class.*

**Is the evidence found in more than one material?   
If so, is there any difference between the materials you can observe in the database?**

***The teacher asks the students to focus on the information given in the database to notice that the materials containing the elements we are looking for, are found in more than one chemical compound that is different from each other.***

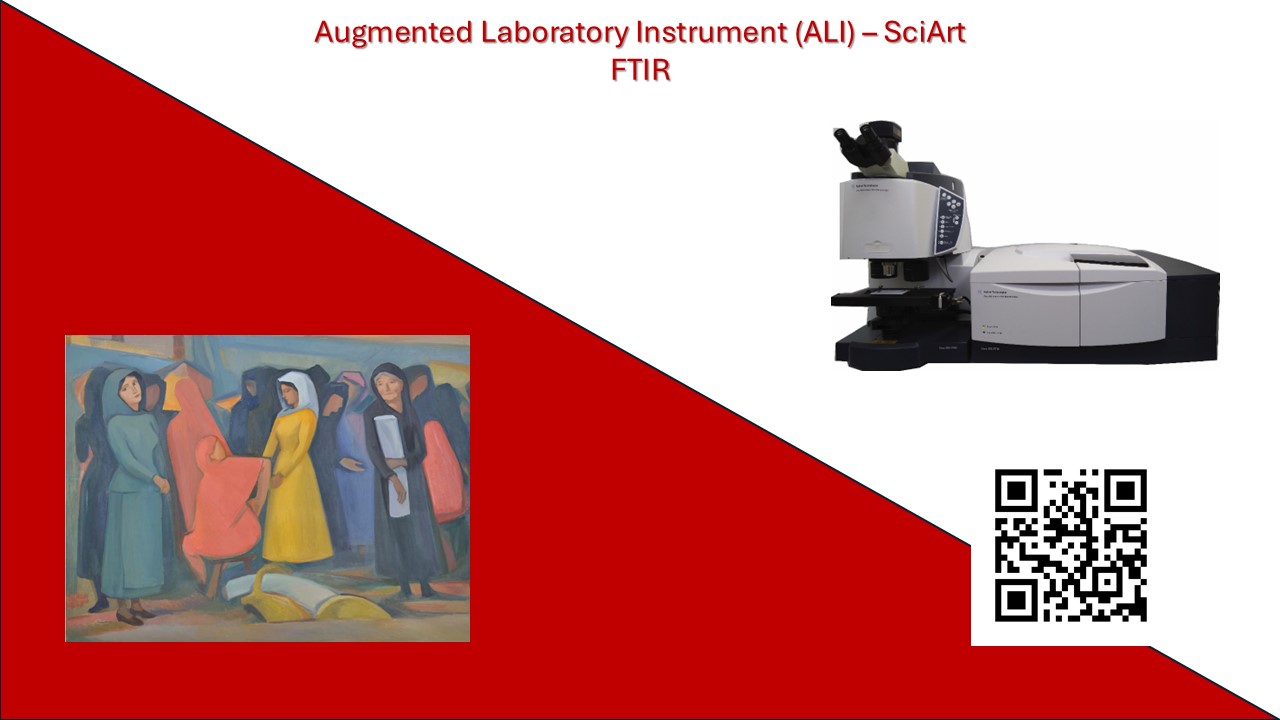
**What do you notice that is different and what do we need to identify  
to limit the materials?**

***The above observation makes it necessary to limit the possible compounds present in our sample. The discussion highlights the need for further analysis to identify a specific chemical compound. Students will use the FTIR method.***

| *Record the views heard with a short video or audio recording*  *Name it “4.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Research Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobile phones, etc.) and scan the QR below.

Watch the video and download the results of the method for the painting by clicking on the **"Results"** button.

****

***Discuss the results of this method with the whole class***

* In the first point of interest, the sample taken from the yellow layer, what do you observe in the FTIR spectrum?

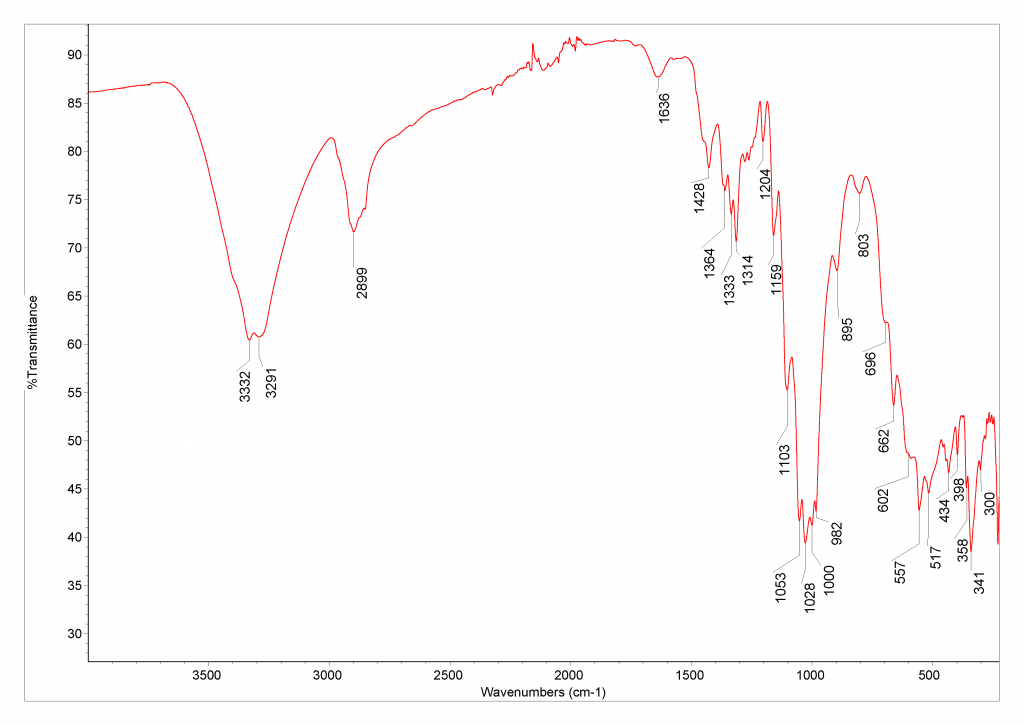
Εικόνα που περιέχει κείμενο, γραμμή, γράφημα, διάγραμμα

Περιγραφή που δημιουργήθηκε αυτόματα

***The FTIR method gives us results for the yellow colour. The pigment identified is Naples yellow which is the mineral Bindhaimite. The inverted peak at 605 cm-1 is typical of Naples yellow.***

* In the second point of interest, the sample taken from the canvas fibers, what do you observe in the FTIR spectrum? What kind of fibers are the linen fibers?

***The FTIR method gives a spectrum with inverted peaks for the fibers collected from the canvas. It is fully identified as cellulose, which is characteristic of fibers of plant origin.***

***.*** 

| *Discuss and document how the method works*  *with a short video or audio recording*  *What results did it give us?*  *Name it “4.c Research”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

* **Which compound was identified for the yellow pigment?**

| **The yellow of Naples** |
| --- |

* **Which compound was identified in the textile by FTIR?**

| **Cellulose (C6H10O5)** |
| --- |

| *Record your answers in a short video or audio recording*  *Explain how you got there.*  *Name it "4.d Conclusion"* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | | |

*Discuss as a whole class.*

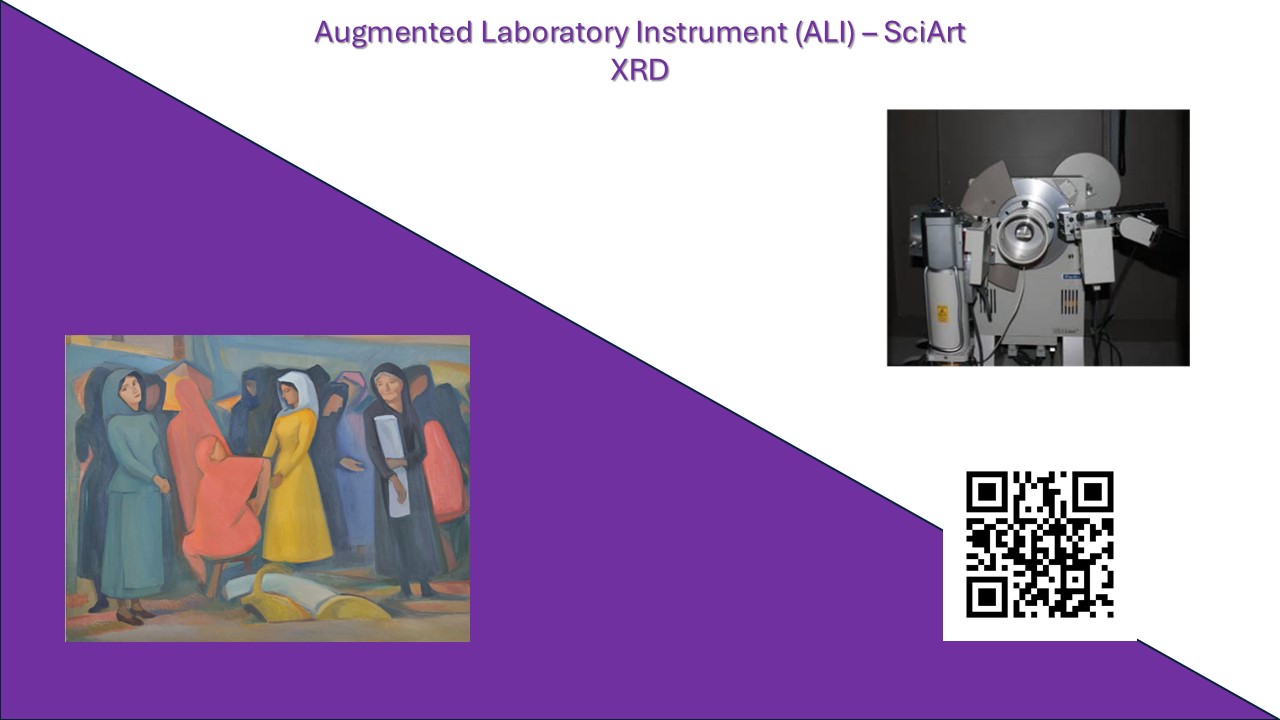
**What difference does the XRD method give for the points of interest?**

***The teacher introduces the XRD method which will not give any additional information from the previous methods for the Naples yellow.***

| *Record the views heard with a short video or audio recording*  *Name it “5.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Research Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobile phones, etc.) and scan the QR below.

Watch the video and download the results of the method for the painting by clicking on the **"Results"** button.

****

***Discuss in the whole class the results of this particular method***

***Students observe the graph (diffractogram graph).***

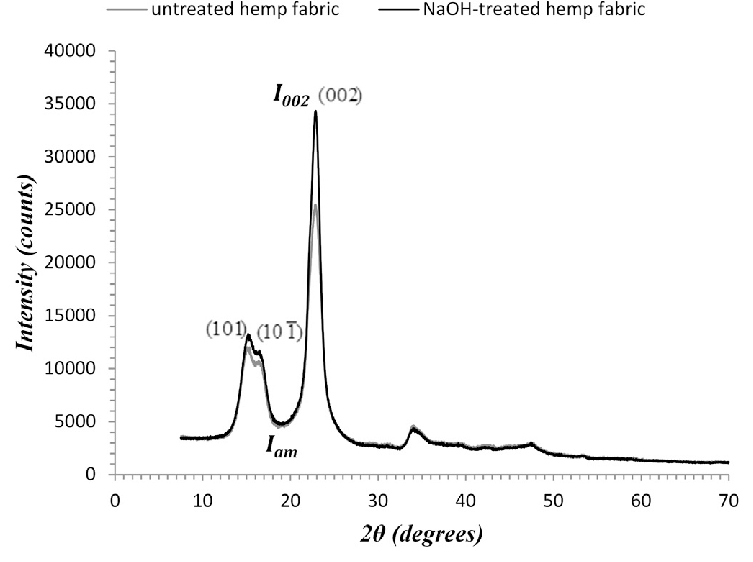
* In the first point of interest, the sample taken for the yellow colour, based on the XRD graph (diffraction pattern), which compound is confirmed?

Εικόνα που περιέχει στιγμιότυπο οθόνης, γράφημα, γραμμή

Περιγραφή που δημιουργήθηκε αυτόματα

***The XRD pattern for the yellow pigment of the sample confirms the presence of Bindheimite.***

* In the second point of interest, the sample taken from the canvas, based on the XRD graph (diffraction pattern), which compound is confirmed?



***The XRD pattern for the textile confirms that we have cellulose,  which is characteristic of fibers of plant origin.***

| *Discuss and document how the method workswith a short video or audio recording*  *What results did it give us?*  *Name it “4.c Research”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

* **In the table below, summarize the information you have obtained about the mining area of this particular yellow colour and the basic material from which all plant-based textiles, such as linen, are made.**

| **Points of interest** | **Chemical Compounds** |
| --- | --- |
| Yellow colour | **Naples Yellow (Bithaimitis)** |
| Canvas | **Fabrics of plant origin, such as linen, are made of cellulose.** |

| *Record your answers in a short video or audio recording*  *Explain how you got there.*  *Name them "4.d Conclusion"* | *QR audio* |
| --- | --- |

**Back to the initial questions...**

1. What were the main components of the materials used in the 1971 painting "Women's Bazaar II"?

2. Can these materials give us information about the artist's technique or socio-economic status?

| **Conceptualization Questions outline** | **QR audio** |
| --- | --- |

*Discuss as a whole class.*

**How can we use the conclusions drawn from archaeometric methods to answer the initial questions?**

*Please provide questions that you can ask an AI machine. The answers it gives you, combined with the results you already have, will help address the initial questions.*

| ***The teacher facilitates a class discussion to formulate the questions that students need to adress the above questions. Such questions may be:***   * **What is the value of these materials and how rare were they?** * **Where is the yellow of Naples mined?** |
| --- |

| *Record the questions you ask on ChatGPT with a short video or audio recording*  *Name it “6.b Conceptualization”* | *QR audio* |
| --- | --- |
| **Research Research with solid fill** | **QR audio** |

Use ChatGPT to get information on the above questions. Write down the information you need to answer the questions.

| **Question** | **ChatGPT main answer points** |
| --- | --- |
| What materials and pigments are used in paintings today? | **.........** |
| From which region is the yellow of Naples extracted? | **.........** |
|  |  |
|  |  |
|  |  |

*Discuss in class the answers  
to the specific questions you posed on ChatGPT*

| *Note the main points of the answers for each question.  Did it help you find the answer?  How?*  *Name it “4.c Research”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

*Record the answers to the initial research questions.*

| **1. What were the main components of the materials used in the 1971 painting "Women's Bazaar II"?** |
| --- |
| ***The main materials from the samples we studied: the yellow pigment (Bithaimite or Naples yellow) and the linen canvas*** |
| **2. Can these materials give us information about the artist's technique or socio-economic status?** |
| ***................*** |
| **3. How can a linen textile be transformed into a work of art with cultural and historical value?** |
| ***.................................*** |

|  | *QR audio* |
| --- | --- |

**Create a video of your answer to each question  
in interview format**

**One of you will ask the question**

**and the other person will answer!!!!**

*Name the videos "Final Answer 1", "Final Answer 2", etc.*