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

Through the preceding activities, some questions arose regarding the Museum's glass vase...

1. What was the (social) position of the craftsmen in Byzantium? Can we investigate the components of the glass used during the 4th century AD?

2. Have these products been exported and to where? Can we find similar products in Portugal, Cyprus or elsewhere?

3. Can we compare it with a glass product manufactured today? Are there commonalities/differences?

4. Can we make assumptions about the use of these glass products? What tests can we perform?

*Discuss the above questions as a whole class*

**How can we answer these questions?**

**Record the results of the discussion**

|  |
| --- |

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “1.a Problem and Solutions”* | | *QR audio* |
| --- | --- | --- |
| **Conceptualization Questions outline** | **QR audio** | | |

*Discuss as a whole class.*

**How can we see details of the object?**

*Write down or draw* instruments or devices *that we can use*

*to see details of an object*

| Devices / Instruments | Selection |
| --- | --- |
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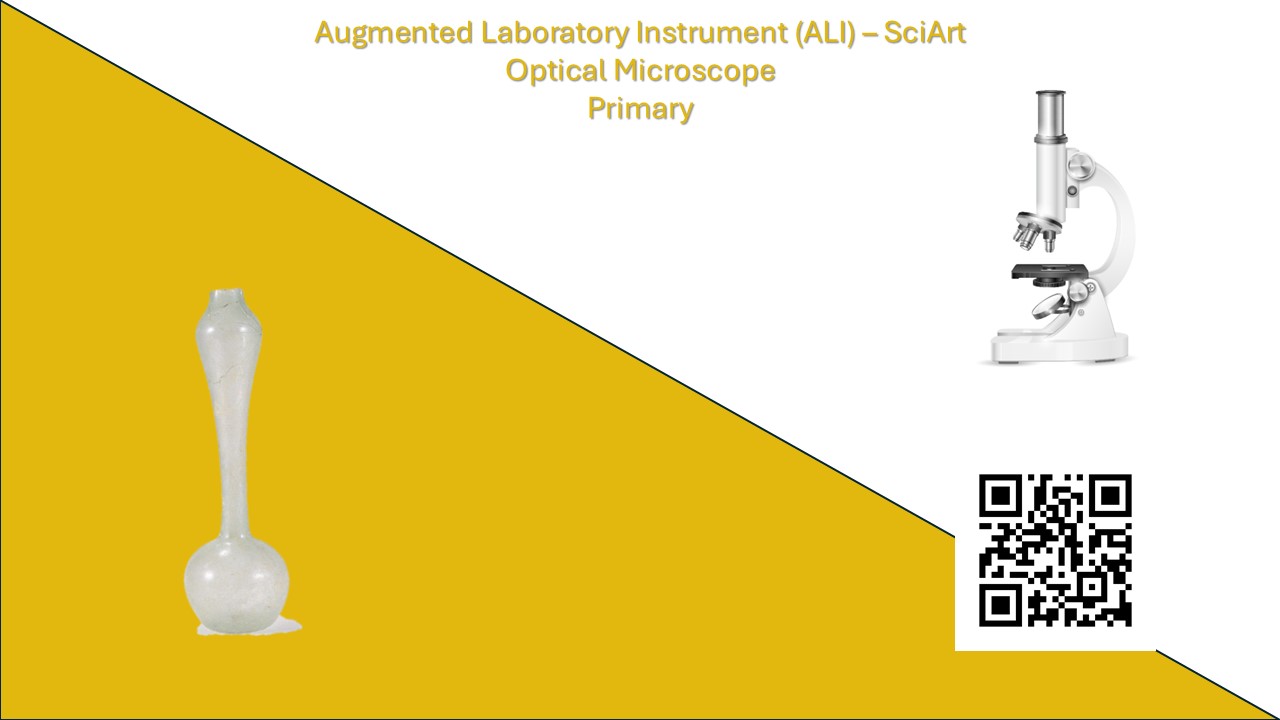
*Discuss as a whole class about the device or the instrument that can give us the best results and choose it from the table above.*

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

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “1.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Investigation Research with solid fill** | **QR audio** | |

Use your mobile devices (tablets, mobiles, etc.) and scan the image below.

Watch the video and download the results provided by the device you selected for the glass vase by clicking the "**Results**" button.

****

***Discuss with the whole class the results of this particular device***

* In the first area of interest, in the middle of the glass vase, what do you observe? Do we have pure glass everywhere or are there areas with bubbles?



* In the second area of interest, in the crack, what do you observe? How does the crack look like under magnification? What does the higher magnification of the crack reveal? Are there any foreign substances? 
* In the third area of interest, at the bottom of the glass vase, what do you observe? Is there a foreign substance inside the vase? If so, how would you describe it?

| *Discuss and record what the device is doing with a short video or audio recording.*  *Why do we use it and what results does it give us?*  *Call it “1.c Investigation”* | *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 smallest to largest magnification?**

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

* **What conclusions can we draw from the three different areas of interest?**

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

|  |
| --- |

| *Record your answers*  *in three different short videos or sound recordings.*  *Call them “1.d Conclusion A”, “1.d Conclusion B”, “1.d Conclusion C”* | *QR audio* |
| --- | --- |

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

*Discuss as a whole class.*

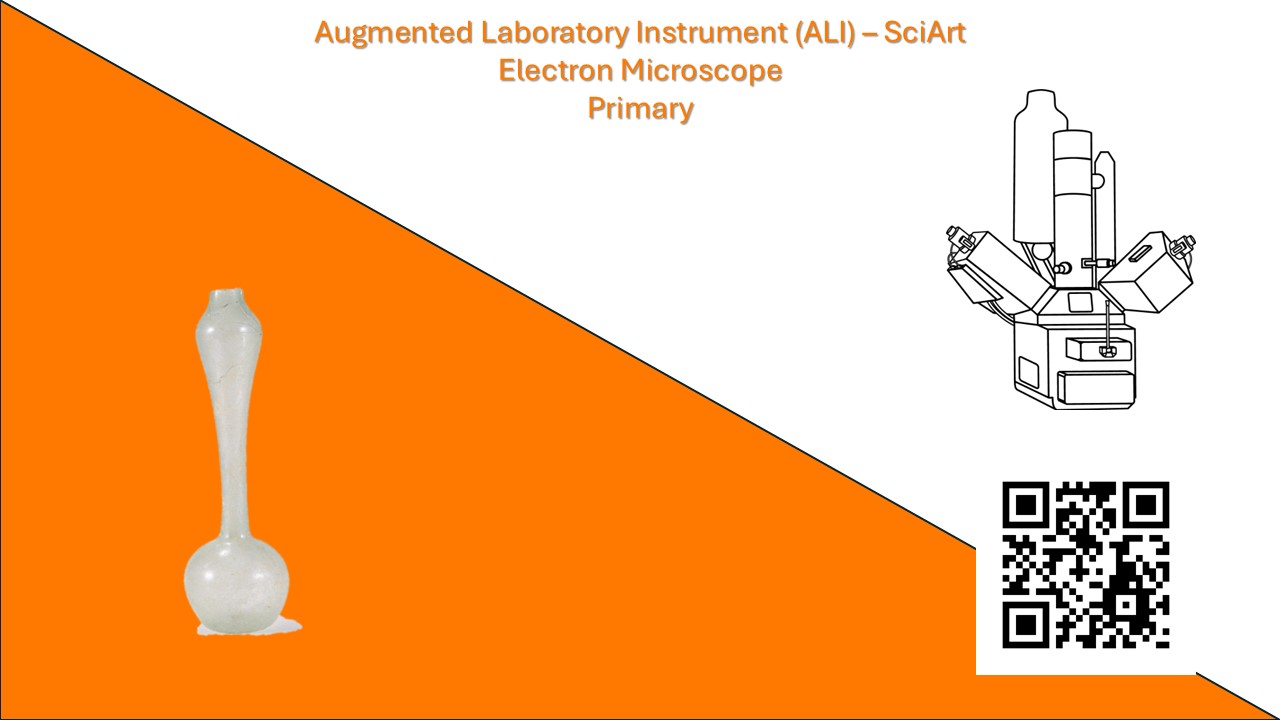
**What do we need to do to get more information**

**about the points of interest?**

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “2.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Investigation Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobiles, etc.) and scan the image below.

Watch the video and download the results provided by the device for the glass vase by clicking the "**Results**" button.

****

***Discuss with the whole class the results of this particular device***

* In the first area of interest, from the sample we took from the middle of the glass vase:

What do the black circles on the glass represent?

What does the gray area represent?

Are the bubbles evenly distributed on the glass?

What do you observe in relation to the size of the bubbles? It is the same;

* In the second area of interest, from the sample we took of the foreign substance in the crack, what do you observe in the SEM image? Is the sample surface smooth?
* In the third area of interest, from the sample we took of the foreign substance at the bottom inside the vase, what do you observe in the SEM image? How would you describe the foreign substance? Can we figure out what the substance is or do we need to apply another method?

| *Describe how the device works and for what purpose we use it*  *with a short video or audio recording.*  *Call it “2.c Investigation”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

* **Of the three different areas of interest depicted with the SEM method, which one do you think has the highest magnification? How can we find it?**
* **Why do we see black and white images?**

* **What do we observe in the images? What might they mean about our subject?**

**Can we draw conclusions about the components in the points of interest (glass, crack and substance residue on the bottom)?**

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

*Discuss as a whole class.*

**What do we need to do to find the components**

**of the areas of interest of the subject we are studying?**

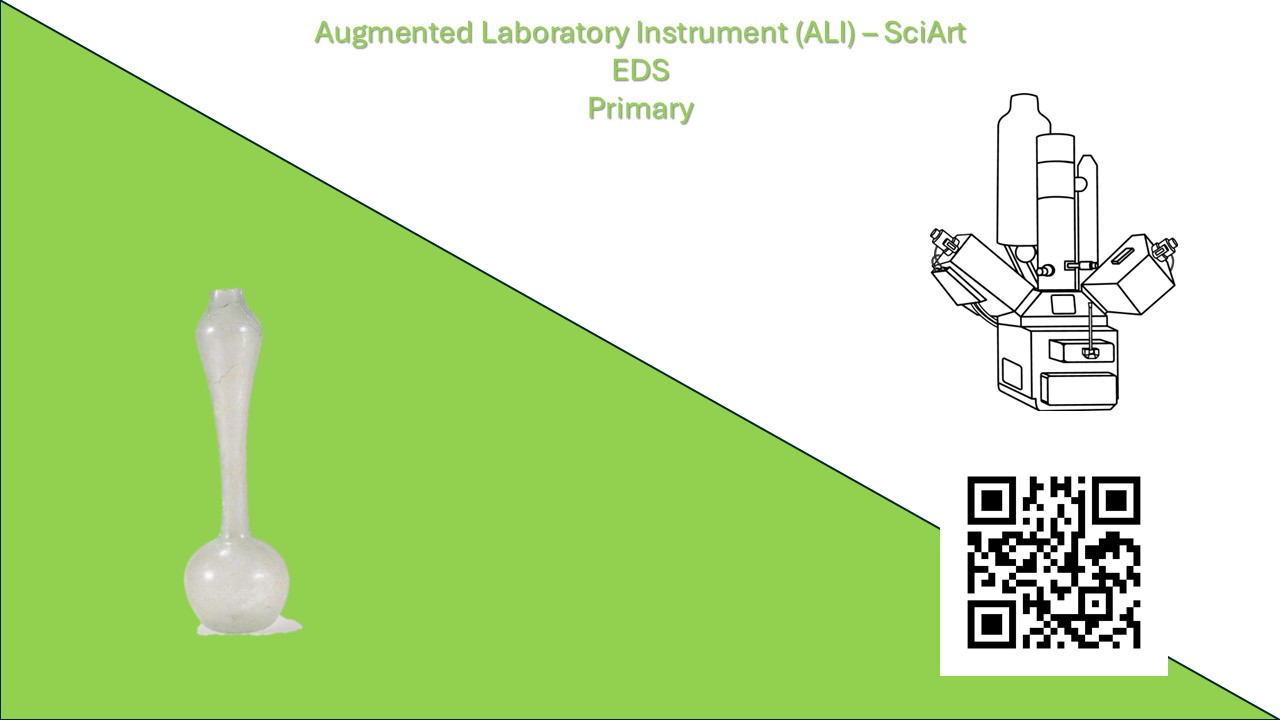
**What do we need to recognize?**

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “3.b Conceptualization”* | *QR audio* |
| --- | --- |

| **Investigation Research with solid fill** | **QR audio** |
| --- | --- |

Use your mobile devices (tablets, mobiles, etc.) and scan the image below.

Watch the video and download the results provided by the device for the glass vase by clicking the "**Results**" button.

****

***Study in your group and then discuss as a whole class***

***the results of the particular method***

* In the first area of interest, from the sample we took from the glass in the middle of the vase, what do you observe in the EDS spectrum? What elements are detected?
* In the second area of interest, from the sample we took from the crack, what do you observe in the EDS spectrum? What elements does the foreign substance consist of?
* In the third area of interest, from the sample we took from the residues inside the vase,

*what do you observe in the EDS spectrum*; What elements does the foreign substance consist of?

| *Discuss and document how the method works*  *with a short video or audio recording.*  *What results did it give us?*  *What else did we have to do?*  *Call it “3.c Investigation”* | *QR audio* |
| --- | --- |

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

* **In the first area of interest, from the results you got, what conclusions do you draw about glass? Which of the elements detected by the method is related to the green tint of the glass? Vased on the results you obtained, can you explain why the glass of the vase is opaque?**
* **In the second area of interest, in the crack, what kind of substance was found?**

**Can you make any assumptions about what it might be?**

* **In the third area of interest, inside the vase. what kind of substance was found?**

**Can you make any assumptions about what it might be?**

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

*Discuss as a whole class.*

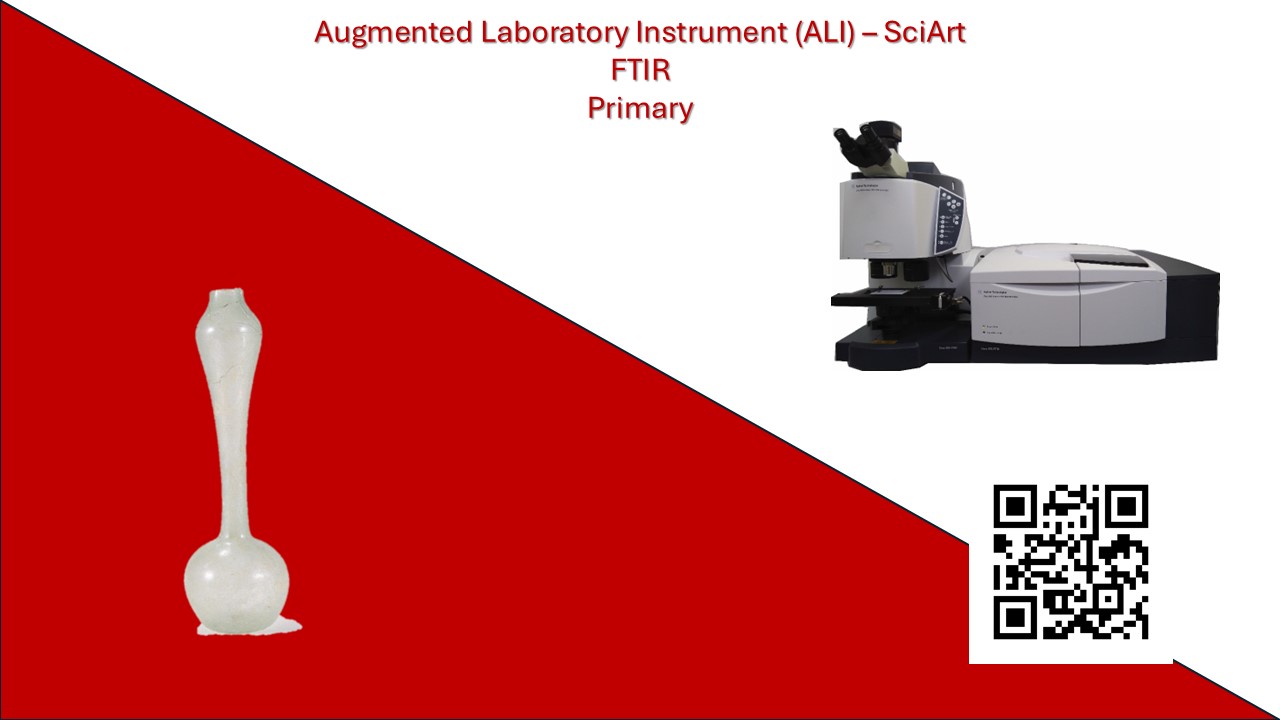
**What do we need to do to get more information about the points of interest?**

**Can we use the FTIR method to see what additional information it can give us?**

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “4.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Investigation Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobiles, etc.) and scan the image below.

Watch the video and download the results provided by the device for the glass vase by clicking the "Results" button.

****

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

* In the first area of interest, does the FTIR spectrum confirm that the material of the vase is glass? What is the chemical formula of glass?
* In the second area of interest, what is the foreign substance detected by FTIR in the crack?
* In the third area of interest, what is the foreign substance identified by the FTIR method inside the vase;

| *Discuss and record how the FTIR method works*  *with a short video or sound recording.*  *What results did it give us?*  *Call it “4.c Investigation”* | *QR audio* |
| --- | --- |

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

* **The FTIR method identified the components of the glass and foreign substances in the crack and residues found inside the glass. Can you summarize the results of the FTIR method in the table below;**

| **Points of interest** | **Chemical Compounds** |
| --- | --- |
| Glass material in the middle of the vase |  |
| Foreign substance in the crack |  |
| Foreign residue substance inside the glass vase |  |

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

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

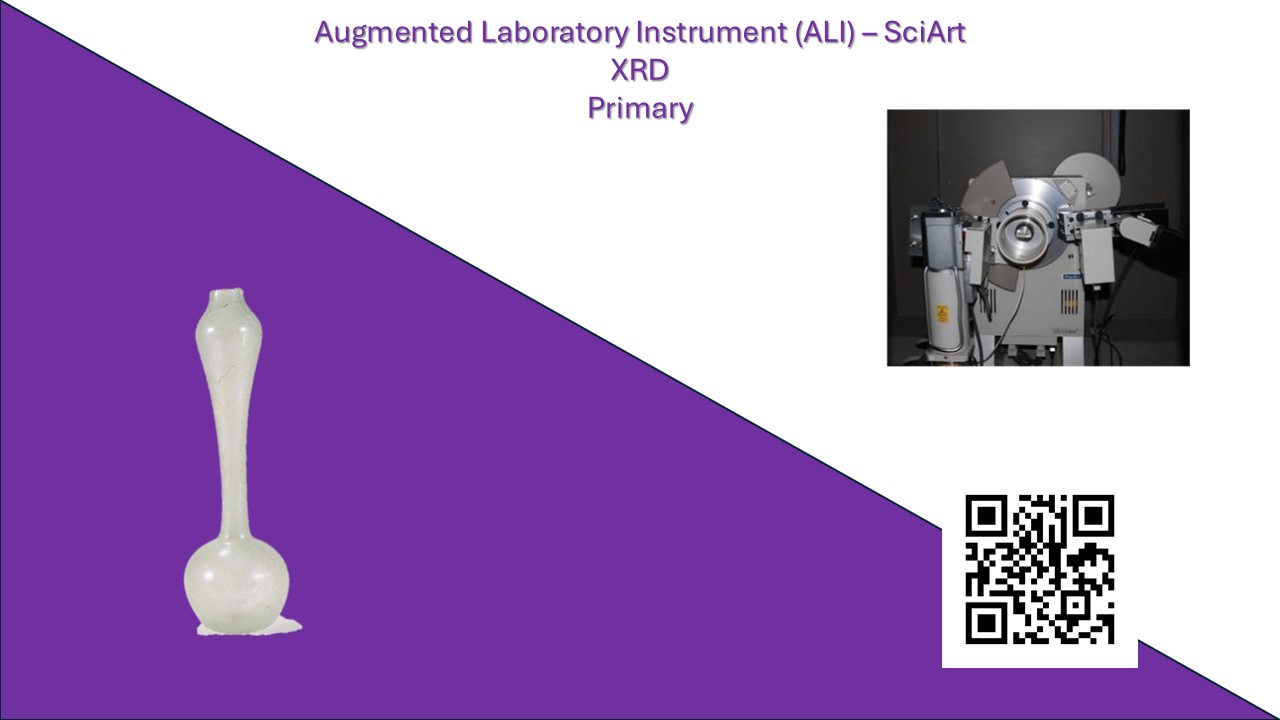
*Discuss as a whole class.*

**What would the XRD method show differently for the three points of interest?**

| *Record the opinions discussed*  *with a short video or sound recording.*  *Call it “5.b Conceptualization”* | | *QR audio* |
| --- | --- | --- |
| **Investigation Research with solid fill** | **QR audio** | | |

Use your mobile devices (tablets, mobiles, etc.) and scan the image below.

Watch the video and download the results provided by the device for the glass vase by clicking the "**Results**" button.

****

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

* In the first area of interest, from the glass sample, vased on the XRD pattern (diffraction pattern), which compound is confirmed?
* In the second area of interest, from the crack sample, vased on the XRD pattern (diffraction pattern), which compound is confirmed
* In the third area of interest, from the residues inside the vase, vased on the XRD pattern (diffraction pattern), which compound is confirmed?

| *Discuss and record how the method works*  *with a short video or sound recording.*  *What results did it give us?*  *Call it “5.c Investigation”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

* **Record the material/chemical compound you have identified using the XRD method.**

| **Points of Interest** | **Material - chemical compound** |
| --- | --- |
| Glass material in the middle of the vase |  |
| Substance found in the crack |  |
| Residues inside the glass vase |  |

**But what is Paraloid B-72? What do we know about myrrh?**

**Can we investigate what it is?**

| *Record your answers*  *in a short video or sound recording.*  *Explain how you got there.*  *Name them “5.d Conclusion”* | *QR audio* |
| --- | --- |

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

*Discuss as a whole class.*

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

*Write questions that you can ask an AI machine (ChatGPT) to collect information about what amorphous silica (silicon dioxide, SiO2) is, what Paraloid B-72 found in the crack is, and where it is used, as well as what the myrrh is, found inside the vase, and where it is used.*

*List questions you could ask on the table.*

|  |
| --- |
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| *List the questions you will ask in ChatGPT*  *with a short video or sound recording.*  *Call it “6.b Conceptualization”* | *QR audio* |
| --- | --- |
| **Investigation Research with solid fill** | **QR audio** |

Use ChatGPT to collect information on the above questions. Record the information you need to answer the questions, in the table below.

| **Question** | **Answer** |
| --- | --- |
| What is amorphous silica (silicon dioxide, SiO2)? |  |
| When was amorphous silica (silicon dioxide, SiO2) used to make glass? |  |
| What is Paraloid B-72 |  |
| How is Paraloid B-72 used in glass preservation? |  |
| What is myrrh? |  |
| How was myrrh used in the 4th century AD? |  |
| What ingredients are in glass objects made today? Do they have common elements with the ingredients used in ancient times? |  |
|  |  |

*Discuss the answers as a whole class*

*to the specific questions you asked in ChatGPT.*

*Record the answers to the initial inquiry questions.*

| *Note the main points of the answers for each question.*  *Did it help you find the answer? How;*  *Call it “6.c Investigation”* | | *QR audio* |
| --- | --- | --- |
| **Conclusion Thought outline** | **QR audio** | | |

* **Summarize your conclusions from the results of the methods you applied and the information you collected from ChatGPT for the three points of interest in the table below.**

| **Points of Interest** | **chemical compounds** | **What is it?** | **How and where is it used?** |
| --- | --- | --- | --- |
| Glass material in the middle of the vase |  |  |  |
| Foreign substance found in the crack |  |  |  |
| Foreign residue substance found inside the glass vase |  |  |  |

**Back to the initial questions …**

1. What was the (social) position of craftsmen in Byzantium? Can we investigate the components of the glass used during the 4th century AD?

2. Have these products been exported and to where? Can we find similar products in Portugal, Cyprus or elsewhere?

3. Can we compare it with a glass product manufactured today? Are there any similarities / differences?

4. Can we make assumptions about the use of these glass products? What tests can we perform?

| **1. What was the (social) position of craftsmen in Byzantium? Can we investigate the components of the glass used during the 4th century AD?** |
| --- |
|  |
| **2. Have these products been exported and to where? Can we find similar products in Portugal, Cyprus or elsewhere?** |
|  |
| **3. Can we compare it with a glass product manufactured today? Are there similarities / differences?** |
|  |
| **4. Can we make assumptions about the use of these glass products? What tests can we perform?** |
|  |

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

**Create a video of your answer to each question**

**in the form of an interview.**

**One or the other of you will ask the question**

**and one or the other will answer!!!**

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