

STRUCTURE AND FUNCTION: MATERIALS SCIENCE AND EVERYDAY OBJECTS

How does design relate to function?



ACTIVITY DESCRIPTION

Students will analyze early Chinese artifacts to understand how the design, or structure, of an object is related to its function. Students will also explore how materials can be best suited for the function of the object. Finally, students will infer what materials were used to create objects in a geographic region of China, based on its natural resources.

If you are planning to use this as part of a visit to The Field Museum, see the field trip guide on page 7.

BACKGROUND INFORMATION

During China's Bronze Age, rulers expanded control over vast distances and diverse groups, sometimes through war and sometimes by claiming divine right to rule. This led to a tumultuous period when many states competed for power. China was ultimately unified by the Qin emperor in 221 BC forever altering Chinese civilization.

Though the Qin and Han Dynasties mark the unification of China, earlier dynasties are described in ancient texts, and some of these storied dynasties left archaeological evidence as well. The Shang Dynasty, which dates somewhere around 1600 BC, is the earliest dynasty with both documentary and archaeological evidence.

During the Shang Dynasty, cities became important centers of political, ritual, economic, and military activity. Capital cities were the centers of a ruler's political and spiritual power.

Bronze was highly prized in the Shang period, and bronze vessels were only used by elites. Important families used bronze vessels in communal feasts and rituals honoring their ancestors. The king's ancestors



*Image: Wine Vessel, Shang-Western Zhou period (c. 1600-770 BC), China.
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were most important because they could speak on his behalf to the high god, Di. Di controlled many things, including battles, weather, harvests, and natural disasters. A Shang king's ability to reach Di through his ancestors gave him authority and legitimacy among his people.

Though it gives the period its name, bronze was not the only important material of the time. This activity asks students to explore the other materials used during the Bronze Age and across Chinese history and to theorize about the relationship between structure and function.

Keywords: 6-8, 9-12, object-based learning, world history, geography, materials science, social empathy

Lens: history, geography, art, science

COMPELLING QUESTIONS

How does an object's design relate to its function?
How do the materials around us affect our lives?

SUPPORTING QUESTIONS

What kinds of objects were used in daily life during the Bronze Age of China?
What materials were used to make those objects?
What natural materials were used?
Where did they come from?
Why is the design of each object well-suited for its function?
Why were the materials and design used for each object well-suited for their function?

OBJECTIVES

Students will analyze objects to understand the relationship between form of an object and its intended function.

Students will compare and contrast various materials used to make objects and infer why these materials were appropriate for the function of each object.

Students will apply their understanding of the environmental conditions and resources available in the regions of China and how people used these available resources in making everyday objects.

STANDARDS

C3 Framework

D2.Geo6.6-8: Explain how the physical and human characteristics of places and regions are connected to human identities and cultures.

D2.Geo10.6-8: Analyze the ways in which cultural and environmental characteristics vary among various regions of the world

Common Core

CCSS.ELA-LITERACY.SL.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade level topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CPS Framework Alignment:

Grade 6, Unit 1: Introduction to Geography; Unit 7: Rise of Asia

Grade 9, Unit 1: Introduction to Geography

APPROXIMATE TIME

1-2 class periods

PREPARATION NOTES

Students will be working in groups to explore content. You may consider pre-selecting student groups.

OTHER MATERIALS

Access to museum content (in exhibit or online exhibition: <http://chinahall.fieldmuseum.org/>)

Graphic organizers

Clipboards (in exhibit)

OBJECTS OF FOCUS

Example objects include:

Clay objects: Bowls, jars, wine vessels

Gallery 1: <http://chinahall.fieldmuseum.org/gallery-1>

Gallery 2: <http://chinahall.fieldmuseum.org/gallery-2>

Gallery 3: <http://chinahall.fieldmuseum.org/gallery-3>

Gallery 4: <http://chinahall.fieldmuseum.org/gallery-4>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

Metal objects: Axe head, daggers, tools, bell, cup, coins

Gallery 2: <http://chinahall.fieldmuseum.org/gallery-2>

Gallery 3: <http://chinahall.fieldmuseum.org/gallery-3>

Gallery 4: <http://chinahall.fieldmuseum.org/gallery-4>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

Wood objects: Statues, stands, tools, ships

Gallery 2: <http://chinahall.fieldmuseum.org/gallery-2>

Gallery 3: <http://chinahall.fieldmuseum.org/gallery-3>

Gallery 4: <http://chinahall.fieldmuseum.org/gallery-4>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

Stone objects: Statues, tools, jade

Gallery 1: <http://chinahall.fieldmuseum.org/gallery-1>

Gallery 3: <http://chinahall.fieldmuseum.org/gallery-3>

Gallery 4: <http://chinahall.fieldmuseum.org/gallery-4>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

Sue Ling Gin Garden: <http://chinahall.fieldmuseum.org/east-garden>

Cotton/silk objects: clothing, gowns, robes, shoes

Gallery 3: <http://chinahall.fieldmuseum.org/gallery-3>

Gallery 4: <http://chinahall.fieldmuseum.org/gallery-4>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

Bone: Oracle bones, ivory

Gallery 2: <http://chinahall.fieldmuseum.org/gallery-2>

Gallery 5: <http://chinahall.fieldmuseum.org/gallery-5>

PROCEDURES

› Engage

Share one mysterious object with students (either in the exhibition online or in the Museum) and ask students the following questions:

- What do you think this object might be made of? What do you see that makes you say that?
- What do you think this object may have been used for? What do you see that makes you say that?
- What questions do you have about the object?

Have students share their responses, and prompt students to think about why the people who made this object may have used this material.

To further discussion, select an object from students' daily lives, and ask about the ways in which its materials reflect its function. For example, why do we use blended fabrics to make clothing? Why do we use glass and/or plastic to hold liquids?

› Explore (Questions and Inquiry)

Explain that scientists studying human societies attempt to determine the use of an object but also ask questions about what an object is made of and how that suits its form. Understanding the resources people use can tell us a lot more about that society. For example, we can learn about relationships between people from different areas by analyzing where materials came from and who had access to what.

Split students into groups to observe different materials. Assign each group a material (metal, clay, silk, etc). They can work throughout the exhibit – online or in the Museum – to find multiple objects made from that material and use the graphic organizer to take notes on what they observe, what they infer, and questions for investigation. Students should also write the location and time period of each object they focus on. This information can be found in the object label. For example, the metal stinkpot: http://chinahall.fieldmuseum.org/gallery-3/case-304/g3-4_m1_b2 dates to the Qing Dynasty (1644-1911 AD) and comes from Xi'an in the Shaanxi Province of China. This information will be helpful later in the research process.

Content can be explored in one of two ways:

- Visiting the museum in person
- Using the online exhibition: <http://chinahall.fieldmuseum.org/>

Students will keep a record of questions that they have throughout the lesson. These questions can be used during class discussions, as bell-ringers, think-pair-share activities, and small group discussions.

PROCEDURES (CONTINUED)

➤ Explain (Apply Disciplinary Lens)

After focusing on specific objects, have students explore the first gallery in the *Cyrus Tang Hall of China*, which focuses on the geography, environment, and societies of early China. Have them take general notes on the geographic features they observe. The dioramas might be particularly helpful for students because they show people using materials within the environment.

When students complete their exhibit observations, they will continue to work in their material groups to research the materials. Some of this information can be found in the digital rails or the online exhibition, but students may have to do additional research online to fully explore the geographic regions. Have students focus on the following questions:

- Where were these objects found? Students can create a map in Google Maps marking the location of each object.
- Are there any patterns to where objects were found?
- What natural resources occur in this area?
- How were these objects made?
- Who would use these objects? How were they used?
- How is the object's form (design) related to its function (use)?
- Were similar objects made out of different materials?
If so, when were different materials used (before, after, at the same time?)

➤ Elaborate (Gather and Evaluate Evidence)

Push student thinking further by asking the students to determine why each region would have these resources available, focusing on the environmental conditions of the region.

Have students share the different objects they examined in small groups jigsaw style with one member of each material group in each new group. Have them compare and contrast the artifacts together.

➤ Evaluate (Develop Claims, Communicate and Critique Conclusions)

Return to the original question: How is the design of an object (form) related to its function?

Students will form a new argument using examples from the different materials discussed in class. Students can respond to this question in writing, as a classroom discussion, or in small group presentations. Students will evaluate each other using the rubric included below.

ENRICHING THE LESSON

Background Knowledge Needed:

Background information about what kinds of objects were used in daily life in China (Bronze Age) would be helpful in completing this lesson.

Students should also have basic knowledge of the relationship between form and function.

Anticipated Misconceptions:

Students may have misconceptions about the materials used to make specific objects.

Methods to Build Empathy:

Social empathy

Students will be working together in groups and forming consensus. This will require active listening, restating each other's ideas, and engaging in discussion.

Opportunities for Informed Action and Contemporary Connections:

Students can learn more about where their own clothing and other possessions are made and think about informed action regarding the status of natural resources around the world today.

DIFFERENTIATION

For an additional challenge, group students based on different geographic regions in China and direct them to research the kinds of raw materials available. Based on this research, have them infer what kinds of tools they would expect to find in that region.

Have students study structures that continued in later designs, like coins, and analyze why they are well-designed for that particular purposes.

Ask students to consider and discuss the following prompt. What if a society needed wood but didn't have any in the area in which they lived? How would they get it? What resources were available in different geographic areas of China? What could they have traded for wood?

Students can also create their own objects, using materials that would be suitable for the function of the object.

Additional Support

Use Venn diagrams for comparing and contrasting different materials and how they were used in design.

LESSON GLOSSARY

These concepts are embedded in the museum content and may be unfamiliar to students.

materials science – the scientific study of the properties and applications of materials for construction or manufacturing

Bronze Age – the period in human history, following the Neolithic and before the Iron Age, during which bronze was first used to make tools and weapons

NOTES FOR FIELD TRIP PLANNING

Before

The “Engage” section of the lesson plan can be use as a pre-visit activity. You can also model the first part of the “Explore” section as a helpful preview of the graphic organizer and different objects in the exhibit. It might be helpful to share images of the objects from the online exhibition with students before they enter the exhibit so they can easily locate them when they arrive. You may also wish to show students how the interactive reading rails work using the online exhibition: <http://chinahall.fieldmuseum.org/>.

During

While in the museum, students can do their observations and inferences described in “Explore” and “Explain.” Relevant objects are found throughout the exhibit, so they can stagger in different sections and investigate materials. Geographic context is mostly in the first gallery.

After

After the exhibit, students will share their findings in the museum and engage in the discussion and writing described in “Elaborate” and “Evaluate.”

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Graphic Organizer

My material focus is (circle one): clay stone metal bone cotton/silk wood

Object What do you see in the exhibit? Describe the objects.	Observations	Inferences What is this made from? What is it used for?	Questions

STUDENT HANDOUT

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Rubric

	4 Exceeds Expectations	3 Meets Expectations	2 Approaches Expectations	1 Does not meet Expectations
Make a clear argument relevant to the content	Argument is clear, and illuminates something new about the content	Argument is clear and connected to the content	Argument is either unclear or not connected directly to the content	Argument is neither clear nor connected to the content.
Use evidence from objects or readings	Student uses 3-4 pieces of evidence from objects or readings, describing them fully	Student uses 1-2 pieces of evidence from objects or readings, describing them fully	Student uses 1-2 pieces of evidence from objects or readings, but does not describe them fully	Student does not mention specific objects or readings, or uses unrelated objects/readings
Explain why the evidence supports their argument	Explanation of connection between evidence and argument offers innovative interpretation and illuminates something new about the content.	Explanation of connection between evidence and arguments is clear and convincing	Explanation of connection between evidence and arguments is unclear or disconnected	No explanation of connection between evidence and argument
Listen to others and restate their ideas	In Speaking			
	Clearly restates the ideas of others and incorporates other's ideas into their own argument, whether agreeing or disagreeing	Clearly restates ideas of others before returning to original argument	Incorrectly restates the ideas of others before returning to original argument	Does not restate the ideas of others before returning to original argument
	In Writing			
	Addresses other perspectives and/or counter arguments and uses them to strengthen their argument	Addresses other perspectives and/or counter arguments and clearly explains reasoning for their original argument	Addresses other perspectives and/or counter arguments but does not connect them to original argument	Does not address other perspectives and/or counter arguments.

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