

*The*  
**HISTORIAN'S  
APPRENTICE**

# The Technological Triumphs of Tang and Song China

**Sourcing  
Contextualizing  
Finding Bias  
Corroborating  
Interpreting**

*Students learn the historian's craft by  
analyzing primary and secondary sources*

**MindSparks**  
CHALLENGING STUDENTS TO THINK HISTORICALLY

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# The Technological Triumphs of Tang and Song China

by Jonathan Burack

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Each unit in *The Historian's Apprentice* series deals with an important historical topic. It introduces students to a five-step set of practices designed to simulate the experience of a historian and make explicit all key phases of the historian's craft.

## ***The Historian's Apprentice: A Five-Step Process***

### **1. Reflect on Your Prior Knowledge of the Topic.**

Students discuss what they already know and how their prior knowledge may shape or distort the way they view the topic.

### **2. Apply Habits of Historical Thinking to the Topic.**

Students build background knowledge on the basis of five habits of thinking that historians use in constructing accounts of the past.

### **3. Interpret the Relevant Primary Sources.**

Students apply a set of rules for interpreting sources and assessing their relevance and usefulness.

### **4. Assess the Interpretations of Other Historians.**

Students learn to read secondary sources actively, with the goal of deciding among competing interpretations based on evidence in the sources.

### **5. Interpret, Debate and Write About the Topic Yourself.**

Students apply what they have learned by constructing evidence-based interpretations of their own in a variety of ways.



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# Teacher Introduction

## ★ *Teaching the Historian's Craft*

The goal of *The Historian's Apprentice* units is to expose students in a manageable way to the complex processes by which historians practice their craft. By modeling what historians do, students will practice the full range of skills that make history the unique and uniquely valuable challenge that it is.

Modeling the historian's craft is not the same as being a historian—something few students will become. Therefore, a scaffolding is provided here to help students master historical content in a way that will be manageable and useful to them.

Historical thinking is not a simple matter of reciting one fact after another, or even of mastering a single, authoritative account. It is disciplined by evidence, and it is a quest for truth; yet, historians usually try to

clarify complex realities and make tentative judgments, not to draw final conclusions. In doing so, they wrestle with imperfect sets of evidence (the primary sources), detect multiple meanings embedded in those sources, and take into account varying interpretations by other historians. They also recognize how wide a divide separates the present from earlier times. Hence, they work hard to avoid present-mindedness and to achieve empathy with people who were vastly different from us.

In their actual practice, historians are masters of the cautious, qualified conclusion. Yet they engage, use their imaginations, and debate with vigor. It is this spirit and these habits of craft that *The Historian's Apprentice* seeks to instill in students.

## ★ *The Historian's Apprentice: Five-Steps in Four Parts*

*The Historian's Apprentice* is a five-step process. However, the materials presented here are organized into four parts. Part I deals with the first two of the five steps of the process. Each of the other three parts then deals with one step in the process. Here is a summary of the four parts into which the materials are organized:

**Teacher Introduction.** Includes suggested day-by-day sequences for using these materials, including options for using the PowerPoint presentations. One sequence is designed for younger students and supplies a page of vocabulary definitions.

**Part 1.** A student warm-up activity, an introductory essay, a handout detailing a set of habits of historical thinking, and two PowerPoint presentations (*Five Habits of Historical Thinking* and *The Technological Triumphs of Tang and Song China*). Part 1 (including the PowerPoints) deals with *The Historian's Apprentice* Steps 1 and 2.

**Part 2.** A checklist for analyzing primary sources, several primary sources, and worksheets for analyzing them. Part 2 deals with *The Historian's Apprentice* Step 3.

**Part 3.** Two secondary source passages and two student activities analyzing those passages. Part 3 deals with *The Historian's Apprentice* Step 4.

**Part 4.** Two optional follow-up activities enabling students to write about and/or debate their own interpretations of the topic. Part 4 deals with *The Historian's Apprentice* Step 5.

## ★ Suggested Five-Day Sequence

Below is one possible way to use this *Historian's Apprentice* unit. Tasks are listed day by day in a sequence taking five class periods, with some homework and some optional follow-up activities.

**PowerPoint Presentation: *Five Habits of Historical Thinking*.** This presentation comes with each *Historian's Apprentice* unit. If you have used it before with other units, you need not do so again. If you decide to use it, incorporate it into the **Day 1** activities. In either case, give students the “Five Habits of Historical Thinking” handout for future reference. Those Five Habits are as follows:

- History Is Not the Past Itself
- The Detective Model: Problem, Evidence, Interpretation
- Time, Change, and Continuity
- Cause and Effect
- As They Saw It: Grasping Past Points of View

**Warm-Up Activity:** Homework assignment: Students do the “Warm-Up Activity.” This activity explores student memories and personal experiences shaping their understanding of the topic.

**Day 1:** Discuss the “Warm-Up Activity.” Then either have students read or review the “Five Habits of Historical Thinking” handout, or use the *Five Habits* PowerPoint presentation.

**Homework assignment:** Students read the background essay “Science and Technology in Tang and Song China.”

**Day 2:** Use the second PowerPoint presentation, *The Technological Triumphs of Tang and Song China*, to overview the topic for this lesson. The presentation applies the Five Habits of Historical Thinking to this topic. Do the two activities embedded in the presentation.

**Homework assignment:** Students read the “Interpreting Primary Sources Checklist.” The checklist teaches a systematic way to handle sources:

- Sourcing
- Contextualizing
- Interpreting meanings
- Point of view
- Corroborating sources

**Day 3:** In class, students study some of the ten primary source documents and complete “Source Analysis” worksheets on them. They use their notes to discuss these sources. (Worksheet questions are all based on the concepts on the “Interpreting Primary Sources Checklist.”)

**Day 4:** In class, students complete the remaining “Source Analysis” worksheets and use their notes to discuss these sources. Take some time to discuss briefly the two secondary source passages students will analyze next.

**Homework assignment:** Students read these two secondary source passages.

**Day 5:** In class, students do the two “Secondary Sources” activities and discuss them. These activities ask them to analyze the two secondary source passages using four criteria:

- Clear focus on a problem or question
- Position or point of view
- Use of evidence or sources
- Awareness of alternative explanations

**Follow-Up Activities** (optional, at teacher discretion):

Do as preferred: the DBQ Essay Assignment and/or the Structured Debate.





## Suggested Three-Day Sequence

If you have less time to devote to this lesson, here is a suggested shorter sequence. The sequence does not include the PowerPoint presentation *Five Habits of Historical Thinking*. This presentation is included with each *Historian's Apprentice* unit. If you have never used it with your class, you may want to do so before following this three-day sequence.

The three-day sequence leaves out a few activities from the five-day sequence. It also suggests that you use only six key primary sources. Yet it still walks students through the steps in the *Historian's Apprentice* approach: Clarifying background knowledge, analyzing primary sources, comparing secondary sources, and debating or writing about the topic.

**Warm-Up Activity.** Homework assignment: Ask students to read or review the “Five Habits of Historical Thinking” handout and read the background essay “Science and Technology in Tang and Song China.”

**Day 1:** Use the PowerPoint presentation *The Technological Triumphs of Tang and Song China*. It overviews the topic for this lesson by applying the Five Habits of Historical Thinking to it. Do the two activities embedded in the presentation.

**Homework assignment:** Students read or review the “Interpreting Primary Sources Checklist.” The checklist teaches a systematic way to handle sources.

**Day 2:** In class, students study some of the ten primary source documents and complete “Source Analysis” worksheets on them. They use their notes to discuss these sources. We suggest using Documents 1, 2, 5, 6, 7, 9, and 10.

You may wish to make your own choices of primary sources. Use your judgment in deciding how many of them your students can effectively analyze in a single class period.

**Homework assignment:** Students read the two secondary source passages.

**Day 3:** In class, students do the two “Secondary Sources” activities and discuss them. These activities ask them to analyze the two secondary source passages using four criteria.

**Follow-Up Activities** (optional, at teacher discretion):

Do as preferred: the DBQ Essay Assignment and/or the Structured Debate.

## ★ *Suggestions for Use with Younger Students*

For younger students, parts of this lesson may prove challenging. If you feel your students need a somewhat more manageable path through the material, see the suggested sequence below.

If you want to use the *Five Habits of Historical Thinking* PowerPoint presentation, this sequence takes four class periods. If you do not use this PowerPoint, you can combine **Day 1** and **Day 2** and keep the sequence to just three days. We suggest using six primary sources only. The ones listed for **Day 3** are less demanding in terms of vocabulary and conceptual complexity. For **Day 4**, we provide some simpler DBQs for the follow-up activities.

**Vocabulary:** A list of vocabulary terms in the sources and the introductory essay is provided on page 7 of this booklet. You may wish to hand this sheet out as a reading reference, you could make flashcards out of some of the terms, or you might ask each of several small groups to use the vocabulary sheet to explain terms in one source to the rest of the class.

### SUGGESTED FOUR-DAY SEQUENCE

**Warm-Up Activity.** Homework assignment: Students do the “Warm-Up Activity.” This activity explores student memories and personal experiences shaping their understanding of the topic.

**Day 1:** Discuss the “Warm-Up Activity.” Show the *Five Habits of Historical Thinking* PowerPoint presentation (unless you have used it before and/or you do not think it is needed now). If you do not use this PowerPoint presentation, give students the “Five Habits of Historical Thinking” handout and discuss it with them.

**Homework assignment:** Ask students to read the background essay “Science and Technology in Tang and Song China.”

**Day 2:** Use the PowerPoint presentation *The Technological Triumphs of Tang and Song China*. This introduces the topic for the lesson by applying the Five Habits of Historical Thinking to it. Do the two activities embedded in the presentation.

**Homework assignment:** Students read or review the “Interpreting Primary Sources Checklist.” The checklist teaches a systematic way to handle sources.

**Day 3:** Discuss the “Interpreting Primary Sources Checklist” and talk through one primary source document in order to illustrate the meaning of the concepts on the checklist. Then have students complete “Source Analysis” worksheets after studying primary source documents 1, 2, 4, 6, 9, and 10.

**Homework assignment:** Students read the two secondary source passages.

**Day 4:** Students do *only* “Secondary Sources: Activity 2” and discuss it. This activity asks them to choose from among the sources the two that best back up each secondary source passage.

**Follow-Up Activities** (optional, at teacher discretion):

Do as preferred: the DBQ Essay Assignment and/or the Structured Debate.

Here are some alternate DBQs tailored to the six primary sources recommended here:

**Using these sources, explain why historians say that China was the most technologically advanced society of all by the year 1200.**

**“China was full of brilliant engineers and technically trained people, but the imperial government did not make the best use of them.” Do you agree or disagree with this statement. Why?**

## Vocabulary: The Introductory Essay

- **feudal:** Describes a social order stressing landholding and based on personal obligations between a lord and a vassal
- **Renaissance:** A time of renewed interest in classical learning in Italy and elsewhere in Europe in the 15th century
- **bureaucracy:** A clear organization of administration into numerous offices governed by formal rules
- **escapement:** A mechanism in a clock to keep the movement of the wheel at a perfectly even pace

## Vocabulary: The Primary Sources

- **celestial:** Having to do with the heavens or skies
- **ignition:** In this case, the setting on fire of an explosive fuel
- **weathercock:** A weather vane

## Vocabulary: The Secondary Sources

- **advent:** Arrival
- **autonomous:** Independent
- **implications:** Things that are implied, suggested, or inferred
- **interdictions:** In this case, things prohibited by law or legal authority
- **manifest:** Obvious
- **medieval:** Refers to a time in Europe when feudal relationships were prevalent in society
- **naturalistic:** In this case, realistic or in accord with nature or natural laws
- **predecessors:** Those who preceded or came before
- **synthesis:** Combining of elements or ideas into a complex and harmonious whole



## Part 1: China's Technology—Providing the Context

**Note to the teacher:** The next pages provide materials meant to help students better understand and evaluate this topic. The materials also seek to teach students the Five Habits of Historical Thinking.

This section includes the following:

- **PowerPoint presentation: *The Five Habits of Historical Thinking***

This presentation illustrates five habits of thought or modes of analysis that guide historians as they construct their secondary accounts of a topic. These five habits are not about skills used in analyzing primary sources (those are dealt with more explicitly in another handout in the next section). The Five Habits are meant to help students see history as a way of thinking, not as the memorizing of disparate facts and predigested conclusions. The PowerPoint uses several historical episodes as examples to illustrate the Five Habits. In two places, it pauses to ask students to do a simple activity applying one of the habits to some of their own life experiences.

If you have used this PowerPoint with other *Historian's Apprentice* units, you may not need to use it again here.

- **Handout: “The Five Habits of Historical Thinking”**

This handout supplements the PowerPoint presentation. It is meant as a reference for students to use as needed. If you have used other *Historian's Apprentice* units, your students may only need to review this handout quickly.

- **Warm-Up Activity**

A simple exercise designed to help you see what students know about the topic, what confuses them, or what ideas they may have absorbed about it from popular culture, friends and family, etc. The goal is to alert them to their need to gain a clearer idea of the past and be critical of what they think they already know.

- **Introductory essay: “Science and Technology in Tang and Song China”**

The essay provides enough basic background information on the topic to enable students to assess primary sources and conflicting secondary source interpretations. At the end of the essay, students get some points to keep in mind about the nature of the sources they will examine and the conflicting secondary source interpretations they will debate.

- **PowerPoint presentation: *The Technological Triumphs of Tang and Song China***

This PowerPoint presentation reviews the topic for the lesson and shows how the Five Habits of Historical Thinking can be applied to a clearer understanding of it. At two points, the presentation calls for a pause and students are prompted to discuss some aspects of their prior knowledge of the topic. Our proposed sequences suggest using this PowerPoint presentation after assigning the introductory essay, but you may prefer to reverse this order.

# Warm-Up Activity

## *What Do You Know About Chinese Civilization?*

This lesson deals with science and technology in the Tang and Song dynasties in China. Whenever you start to learn something about a time in history, it helps to think first of what you already know about it, or think you know. You probably have impressions, or you may have read or heard things about it already. Some of what you know may be accurate. You need to be ready to alter your fixed ideas about this time as you learn more about it. This is what any historian would do. To do this, study this illustration and take a few notes in response to the questions below it.



This photo shows part of the court of the Imperial Palace in the Forbidden City. How can you tell that this is a scene in China? Where is the Forbidden City?

China first invented the compass, gunpowder, woodblock printing, and wooden movable type? Does it surprise you to know that China did these things? Why or why not?

These inventions all appeared in China before or during the Tang and Song dynasties there (618–1279 CE). What else do you know about science and technology in China? Why do you suppose China led the world for so long in technology?

## Science and Technology in Tang and Song China

In 1620, English philosopher Francis Bacon published his *Novum Organum* (“New Instrument”) about a new, experimental system of logic and discovery which he felt would replace Aristotle’s logic. In one passage, Bacon seemed to celebrate Europe’s growing power by referring to three inventions he felt had changed the world:

*Printing, gunpowder and the compass: These three have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes, in so much that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries.*

Bacon believed these inventions helped explain Europe’s rapid economic development, its growing power around the world, and the breakthrough it was then making in knowledge—a breakthrough many historians today call the “Scientific Revolution.” After all, the compass helped make possible overseas exploration. Kings could use gunpowder to destroy the stone castles of feudal princes standing in the way of national unity. Printing vastly expanded the ability to spread ideas via books, paving the way for the impact of the Renaissance, the Reformation, and a new spirit of individualism and scientific curiosity.

However, these three inventions were not European—all three originated in China. In fact, China was already developing all of them by the end of the Tang dynasty (618–906 CE). Europe would not know about them for several more centuries after that. This calls attention to a very important fact about China: Up until about the time of Francis Bacon, China was the source of the world’s greatest inventions. For a very long time, its technology led the world in a great many areas.

Long before the Tang dynasty, China was already excelling in various technologies: Iron plows and other tools made farmers more productive. An efficient horse collar tapped far more of that animal’s energy than Europeans would learn how to use

for many centuries. Paper, the compass, other navigational devices, and bronze and iron casting were all highly advanced in China. Technological breakthroughs continued in the Tang era, and then accelerated even more during the Song dynasty (960–1279 CE). Under that dynasty, China’s imperial government extended its territory and expanded its power through a vast bureaucracy of officials chosen through a unique imperial examination system. The exams tested “scholar-officials” in the Confucian classics, literary skills, and moral training meant to instill respect for tradition and ritual, filial piety, and a strict sense of duty toward the emperor and the people.

The modern industrial era, driven by coal, iron, and steam, only began in England in the 1700s. Well before the Industrial Revolution, however, China enjoyed an amazing time of technological change and invention of its own. China’s inventiveness and economic growth in the Tang and Song eras were based on an ability to feed far more than just those working the land. The completion of the Grand Canal at the start of this era allowed northern China to tap the agricultural surpluses of the south. New strains of rice from the south allowed Chinese farmers to plant two crops a year. Irrigation systems, water pumps, terracing of hillsides, and other techniques added to the land available for farming.

China’s iron industry grew rapidly. One historian estimates iron production at 125,000 tons per year during the Song dynasty, a level not reached in Europe until the 1700s. Along with the compass, the Chinese developed the sternpost rudder, watertight compartments, and other features for large seagoing junks of many masts, able to carry hundreds of sailors. Gunpowder resulted in oil-burning flamethrowers, catapults to hurl explosive devices, bamboo tubes for mortars, and other weapons of war.

Astronomical instruments were refined, such as a water-driven escapement for a clock designed to measure movements of the heavens. These held religious and political importance because the emperor’s key role was to perform precise

rituals linked with astronomical movements so as to maintain harmony between heaven and nature on one hand, and human society on the other.

In woodblock printing, an entire page was carved in reverse on a wooden surface which was inked and pressed against sheets of paper. Movable and reusable type appeared by 1100. However, written Chinese uses thousands of individual characters, rather than just a few letters. This may have limited the usefulness of movable type and the spread of literacy. Could this be one factor explaining why China did not lead the world into the industrial age or the Scientific Revolution, despite its many technological triumphs?

Aside from limits to the spread of literacy, another factor may have been China's powerful centralized state and its ruling scholar-bureaucrats. These officials were educated in Confucian classic literature. They had little training in technological matters

and little interest in scientific studies. Middle-class merchants and other professionals might have had more interest in science and technology, but their political and social influence was much less than their counterparts' was to become in the West. Few independent universities or other institutions existed to encourage and protect scholars interested in pursuing scientific fields of knowledge.

The great historian of Chinese science and technology is Joseph Needham. Even he has asked, "If the Chinese were so advanced in antiquity and the Middle Ages, how was it that the Scientific Revolution, the coming of modern science into the world happened only in Europe?" The sources for this lesson are meant to help you debate the question Needham asks, even as they also help you appreciate the enormous technological accomplishments of the Tang and Song eras of Chinese history.

## Points to Keep in Mind

### Historians' Questions

Joseph Needham's challenge still shapes debate about science and technology in China's history. On the one hand, many historians have focused on China's failure to develop a modern scientific approach to theoretical issues about the nature of the universe and the laws that determine how it works. The Scientific Revolution was the work of Copernicus, Kepler, Galileo, Newton, and others in 16th- and 17th-century Europe. Historians search for factors that prevented the emergence of science as an independent theoretical activity in China in spite of that society's enormous technological achievements.

Other historians may agree with Needham that China did not make the breakthrough to a modern "scientific revolution," but they say this was merely a matter of timing. They say China deserves credit for many technological advances once thought to have originated in Europe, and that China did have its own forms of science that in time could have evolved as science did elsewhere. Some of them say that it is not really meaningful for historians to ask why a society did *not* do something, and that what is important is to understand fully what it did do.

### The Primary Source Evidence

For this lesson, you will study ten primary source documents on science and technology in Tang and Song China. Some of the sources are examples of specific Chinese inventions or techniques; others illustrate attitudes of some Chinese writers and rulers toward scientific knowledge and technology, or toward related social or cultural values. These sources should give you evidence to help you better understand China's great technological accomplishments and the debates about its traditions of scientific thought. The sources will also help you make informed judgments of your own on what two historians say about these matters.

### Secondary Source Interpretations

After studying and discussing the primary sources, you will read two short passages by two different historians. The historians who wrote these passages differ somewhat in their views about the place of science and scientific reasoning in China's history. You will use your own background knowledge and your ideas about the primary sources as you think and answer some questions about the views of these two historians.

## Five Habits of Historical Thinking

History is not just a chronicle of one fact after another. It is a meaningful story, or an account of what happened and why. It is written to address questions or problems historians pose. This checklist describes key habits of thinking that historians adopt as they interpret primary sources and create their own accounts of the past.

### *History Is Not the Past Itself*

When we learn history, we learn a story about the past, not the past itself. No matter how certain an account of the past seems, it is only one account, not the entire story. The “entire story” is gone; that is, the past itself no longer exists. Only some records of events remain, and they are never complete. Therefore it is important to see all judgments and conclusions about the past as tentative or uncertain. Avoid looking for hard-and-fast “lessons” from the past. The value of history is in a way the opposite of such a search for quick answers; that is, its value is in teaching us to live with uncertainty and see even our present as complex, unfinished, open-ended.

### *The Detective Model: Problem, Evidence, Interpretation*

Historians can’t observe the past directly. They must use evidence, just as a detective tries to reconstruct a crime based on clues left behind. In the historian’s case, primary sources are the evidence—letters, official documents, maps, photos, newspaper articles, artifacts, and all other traces from past times. Like a detective, a historian defines a very specific problem to solve, one for which evidence does exist. Asking clear, meaningful questions is a key to writing good history. Evidence is always incomplete. It’s not always easy to separate fact from opinion in it, or tell what is important from what is not. Historians try to do this, but they must stay cautious about their conclusions and open to other interpretations of the same evidence.

### *Time, Change, and Continuity*

History is about the flow of events over time, yet is not just one fact after another. It seeks to understand this flow of events as a pattern. In that pattern, some things change while others hold steady over time. You need to see history as a dynamic interplay of both change and continuity together. Only by doing this can you see how the past has evolved into the present—and why the present carries with it many traces of or links to the past.

### *Cause and Effect*

Along with seeing patterns of change and continuity over time, historians seek to explain that change. In doing this, they know that no single factor causes change. Many factors interact. Unique, remarkable, and creative individual actions and plans are one factor, but individual plans have unintended outcomes, and these shape events in unexpected ways. Moreover, individuals do not always act rationally or with full knowledge of what they are doing. Finally, geography, technology, economics, cultural traditions, and ideas all affect what groups and individuals do.

### *As They Saw It: Grasping Past Points of View*

Above all, thinking like a historian means trying hard to see how people in the past thought and felt. This is not easy. As one historian put it, the past is “another country,” in which people felt and thought differently, often very differently, from the way we do now. Avoiding “present-mindedness” is therefore a key task for historians. Also, since the past includes various groups in conflict, historians must learn to empathize with many diverse cultures and subgroups to see how they differ and what they share in common.



## Part 2: Analyzing the Primary Sources

**Note to the teacher:** The next pages provide the primary sources for this lesson. We suggest you give these to students after they read the background essay, after they review the “Five Habits of Historical Thinking” handout, and after they watch and discuss the PowerPoint presentation for the lesson.

This section includes the following:

- **Handout: “Interpreting Primary Sources Checklist”**

Give copies of this handout to students and ask them to refer to it when analyzing any primary source.

- **Ten Primary Source Documents**

The Documents are as follows:

- Document 1. A page of woodblock printing
- Document 2. A waterwheel powering a bellows
- Document 3A & 3B. Two photos of the Grand Canal
- Document 4. Description of the “south-pointing needle”
- Document 5. Description of a naphtha flamethrower
- Document 6. Description of sails on some ships
- Document 7. A Song-era piece of paper money
- Document 8. An 1873 photo of imperial examination cells
- Document 9. Fu Zuan defends the engineer Ma Jun
- Document 10. A complaint about the imperial exams

- **Ten “Source Analysis” Worksheets for Analyzing the Primary Sources**

Each worksheet asks student to take notes on one source. The prompts along the side match the five categories in the “Interpreting Primary Sources Checklist.” Not every category is used in each worksheet, only those that seem most relevant to a full analysis of that source.

You may want students to analyze all of the sources. However, if time does not allow this, use those that seem most useful for your own instructional purposes.

Students can use the notes on the “Source Analysis” worksheets in discussions, as help in analyzing the two secondary sources in the next part of this lesson, and in follow-up debates, DBQs, and other activities.



## Interpreting Primary Sources Checklist

Primary sources are the evidence historians use to reach conclusions and write their accounts of the past. Sources rarely have one obvious, easily grasped meaning. To interpret them fully, historians use several strategies. This checklist describes some of the most important of those strategies. Read the checklist through and use it to guide you whenever you need to analyze and interpret a primary source.

### *Sourcing*

Think about a primary source's author or creator, how and why the primary source document was created, and where it appeared. Also think about the audience it was intended for and what its purpose was. You may not always find much information about these things, but whatever you can learn will help you better understand the source. In particular, it may suggest the source's point of view or bias, since the author's background and intended audience often shape his or her ideas and way of expressing them.

### *Contextualizing*

"Context" refers to the time and place of which the primary source is a part. In history, facts do not exist separately from one another. They get their meaning from the way they fit into a broader pattern. The more you know about that broader pattern, or context, the more you will be able to understand about the source and its significance.

### *Interpreting Meanings*

It is rare for a source's full meaning to be completely obvious. You must read a written source closely, paying attention to its language and tone, as well as to what it implies or merely hints at. With a visual source, all kinds of meaning may be suggested by the way it is designed, by such things as shading, camera angle, use of emotional symbols or scenes, etc. The more you pay attention to all the details, the more you can learn from a source.

### *Point of View*

Every source is written or created by someone with a purpose, an intended audience, and a point of view or bias. Even a dry table of numbers was created for some reason, to stress some things and not others, to make a point of some sort. At times, you can tell a point of view simply by sourcing the document. Knowing an author was a Democrat or a Republican, for example, will alert you to a likely point of view. In the end, however, only a close reading of the text will make you aware of point of view. Keep in mind, even a heavily biased source can still give you useful evidence of what some people in a past time thought. But you need to take the bias into account in judging how reliable the source's own claims really are.

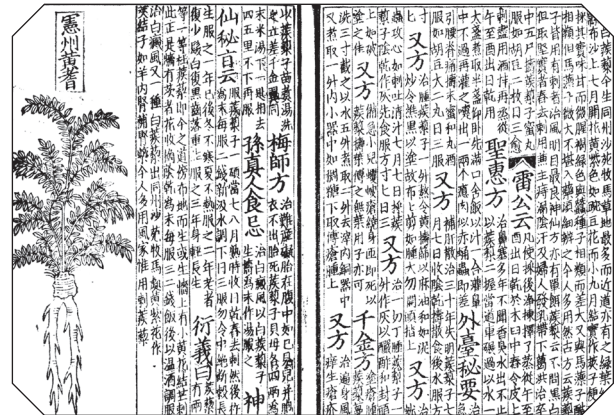
### *Corroborating Sources*

No one source tells the whole story. Moreover, no one source is completely reliable. To make reasonable judgments about an event in the past, you must compare sources to find points of agreement and disagreement. Even when there are big differences, both sources may be useful. However, the differences will also tell you something, and they may be important in helping you understand each source.

# The Primary Sources for the Lesson

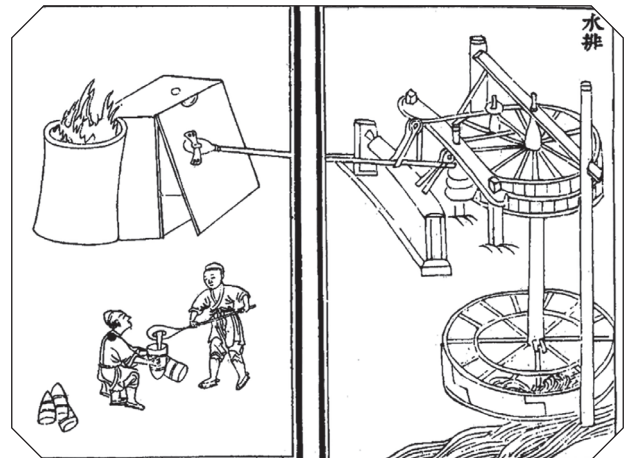
## Document 1

**Information on the source:** The Chinese developed woodblock printing at least as early as the third century CE. In this technique, Chinese characters are carved in relief on wood which can then be inked and pressed against cloth, silk, paper, or other surfaces for printing. China also developed movable wooden type possibly as early as 1040 CE, long before Johannes Gutenberg's press first made use of metal movable type in Europe in the 1400s. This is a page from the *Pen Ts'ao*, a book on Chinese herbal medicine, printed with woodblock in 1249. Illustration made available by Wikipedia.



## Document 2

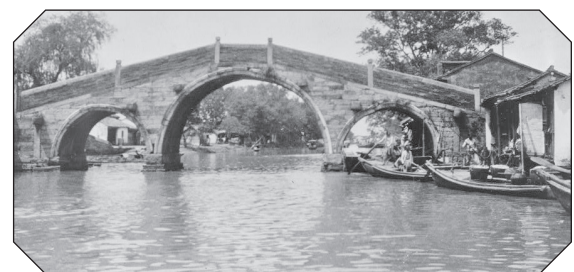
**Information on the source:** China was casting iron centuries before Europe or other regions. Farmers were using iron-tipped hoes and plows well before the Tang and Song dynasties. China also developed double-acting piston bellows to maintain a continuous blast of air to raise furnace temperatures. This enabled them to produce steel. During the Song economic expansion, iron production soared to 125,000 tons per year, a per capita production not matched in Europe until the Industrial Revolution of the 18th and 19th centuries. This print depicts a waterwheel powering the bellows of a blast furnace for creating cast iron. The illustration is from a 14th-century treatise by Wang Zhen. Illustration made available by Wikipedia.



3A

## Documents 3A & 3B

**Information on the sources:** A key factor in China's history has been technologies to control water flowing from its large but unpredictable and often dangerous rivers. During the Sui dynasty (581–618 CE), just before the Tang era, China connected various waterways into the Grand Canal, over a thousand miles long. Parts of the Grand Canal are shown here. This canal linked the southern, rice-producing parts of China with the north. The increased surpluses of goods this made available allowed China to grow rapidly in the centuries ahead. The invention of the pound lock in the tenth century made it easy for ships to rise to the higher elevations of the canal.



3B



## Document 4

**Information on the source:** From the *Zhu Fan Shi* (“Records of Foreign People”) of 1225, by geographer Chao Ju-Kuan, as quoted in *The Shorter Science and Civilization in China, Volume 3*, by Joseph Needham (New York: Cambridge University Press, 1986), pp. 30–32.

To the east (of Hainan Island) are the “Thousand-Li Sand Banks” and the “Myriad-Li rocks”, and [beyond them] is the boundless ocean, where the sea and sky blend their colours, and the passing ships sail only by means of the south-pointing needle. This has to be watched closely by day and night, for life or death depend on the slightest fraction of error.

## Document 5

**Information on the source:** From the *Wu Jing Zong Yao* (“Collection of the Most Important Military Techniques”) of 1044 CE, part of a passage describing a naphtha flamethrower. It is well known that the Chinese invented gunpowder. It is also commonly said that they only used it for fireworks, not in weapons of war. This is not so, as this description makes clear. The description also indicates the careful attention to detail in many Chinese accounts of their inventions, techniques, and mechanical devices. As quoted in *The Shorter Science and Civilization in China, Volume 3*, by Joseph Needham (1986), pp. 93–94; Needham adds words in parentheses to make the meaning clearer.

On the right is the fierce fire-oil shooter. The tank is made of brass, and supported on four legs. From its upper surface arise four (vertical) tubes attached to a horizontal cylinder above; they are all connected with a tank. The head and tail of the cylinder are large, (the middle) is of narrow (diameter). In the tail end there is a small opening as big as a millet-grain. The head end has (two) round openings 3.8 cm in diameter . . . Inside the cylinder there is a (piston-) rod packed with silk floss . . .

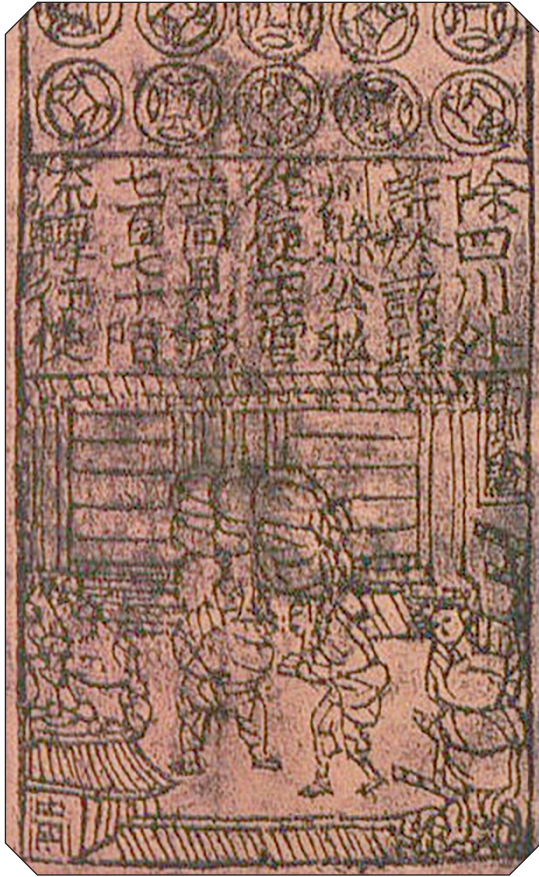
Before use, the tank is filled with rather more than three catties [1.8 kg] of the oil with a spoon through a filter; at the same time gunpowder (composition) is placed in the ignition chamber at the head. When the fire is to be started one applies a heated branding iron (to the ignition chamber), and the piston-rod is forced fully into the cylinder—then the man at the back is ordered to draw the piston-rod fully backwards and work it (back and forth) as vigorously as possible. Whereupon the oil (the naphtha) comes out through the ignition chamber and is shot forth as blazing flame.

## Document 6

**Information on the source:** This passage is from the *Kao-Li Thu Ching* (“Illustrated Record of an Embassy to Korea”) of 1124. In it, the author Hsu Ching describes the sails on some of the ships carrying the personnel of the embassy. As quoted in *The Shorter Science and Civilization in China, Volume 3*, by Joseph Needham (1986), pp. 194–195.

When the wind blows favorably they hoist the cloth sails made of 50 strips. But when the wind blows from the side they use the advantageous mat sails, set to the left or to the right like wings according to the direction of the wind. At the top of the main mast they add a small topsail, made of ten strips of cloth. This is called the “wild fox sail,” and is used in light airs, when there is almost no wind. Of all the eight quarters whence the wind may blow, there is only one, the dead ahead quarter, which cannot be used to make the ship sail. The sailors also attach some bird feathers to the top of an upright pole to act as a weathercock; this is called the “Five Ounces.” To get a favorable wind is not easy, so that the great cloth sails are not as useful as the mat sails, which when skillfully employed will carry men wheresoever they may wish to go.





## Document 7

**Information on the source:** Block printing made paper money possible. The Chinese began using paper money sometime in the Tang dynasty. Paper money probably began as certificates the government gave merchants in exchange for goods delivered, or as a record of cash that merchants had deposited in the capital city. The merchants could then simply exchange their certificates for goods or cash elsewhere. In this way, these pieces of paper themselves began to function as money. During the Song dynasty, true paper money began to be issued, at first by some rich merchants and in 1023 CE by the government exclusively. This is a Song-era piece of paper money. Illustration made available by Wikipedia.

## Document 8

**Information on the source:** The teachings of Confucius became the basis for training officials in China's imperial government. This started during the Han dynasty (206 BCE–220 CE), but became especially important during the Song dynasty. Thousands of students hoping to become imperial officials had to take and pass very challenging exams based on Confucius and the written classics associated with him. This 1873 photo is of some imperial examination cells still being used then.



## Document 9

**Information on the source:** Ma Jun was a minor official at the Chinese emperor's court in the third century CE. He also happened to be an excellent engineer. In this passage the philosopher and poet Fu Zuan defends Ma Jun against the criticisms of some higher officials. The passage offers some insight into attitudes toward science among the top imperial officials. These were men trained in the Confucian classics, literary skills, moral values, and political policy — not science at all. As quoted in *The Shorter Science and Civilization in China, Volume 4*, by Joseph Needham (1986), pp. 17–18.

*Mr. Ma, being a Policy Review Adviser one day fell into a dispute at court with the Permanent Counsellor Gaotang Long and the Cavalry General Qin Lang about the south-pointing carriage. They maintained there had never been any such thing and that the records of it were nonsense. Mr. Ma said: "Of old there was. You have not thought the matter out. It is really not far from the truth." But they laughed... To this Mr. Ma replied: "Empty arguments with words cannot compare with a test which will show practical results." All this was reported by Gaotang and Qin to the emperor Ming Di, whereupon Ma Jun received an order to construct such a vehicle. And he duly made a south-pointing carriage. This was the first of his extraordinary accomplishments. But again it was almost impossible to describe in words. However, henceforth the world bowed to his technical skill.*

## Document 10

**Information on the source:** Astronomical instruments were key to tracking the movements of the heavens for the emperor so that he could more accurately perform the rituals meant to harmonize heaven and human society. Due to these religious/political duties of the emperor, astronomical ideas and instruments were treated as closely guarded state secrets. Mathematician Shen Kua here complains about how little effort the imperial examiners made to teach and test all the other future scholar-officials about these astronomical ideas and instruments. As quoted in *The Rise of Early Modern Science: Islam, China and the West*, by Toby E. Huff (New York: Cambridge University Press, 2003) p. 312. Shen Kua is referring to a time in the mid-11th century CE.

*[T]he Ministry of Rites arranged for the examination-candidates to be asked to write essays on the instruments used for gaining knowledge of the heavens. But the scholars could only write confusedly about the celestial globe. However, as the examiners themselves knew nothing about the subject either, they passed them all with a higher class.*

## Source Analysis: Primary Source Document 1

A page from a book on Chinese herbal medicine, printed with woodblock in 1249

### Interpreting meanings

This page on herbal medicine from 1249 CE is an example of woodblock printing. Can you explain how the woodblock printing technique is able to print these Chinese characters onto a piece of paper?

Woodblock printing involved carving a whole page of text at a time. China also developed movable type ahead of Europe. However, the nature of written Chinese may have made movable type less effective as a printing technology than it was in Europe. Can you explain why?

### Corroborating sources

Using this source and Primary Source Document 8, explain why the Chinese imperial government had a strong interest in printing technology of this sort.



## Source Analysis: Primary Source Document 2

A waterwheel powering the bellows of a blast furnace for creating cast iron

### Interpreting meanings

Waterwheels are another key technology the Chinese developed. From this diagram, explain how the circular motion of a waterwheel can be transferred in such a way as to drive the piston of this bellows.

Explain why bellows like the one on the left, attached to the waterwheel, were crucial in producing molten iron.

Can you explain what a double-acting bellows is and why it would be better to use than the single-stroke bellows shown here?

## Source Analysis: Primary Source Documents 3A & 3B

Two photos of the Grand Canal in the late 1800s

### Contextualizing

One of China's two main rivers is known as "China's Sorrow." What are these two rivers and which one is "China's Sorrow." Why has it been given this name?

What do you know about the Grand Canal? Why do you suppose this canal, especially, contributed so heavily to economic growth during the Tang and Song dynasties?

### Interpreting meanings

Human muscle power and nautical technology both were crucial to making the Grand Canal effective. Using these photos, can you explain why that would have been so?

## Source Analysis: Primary Source Document 4

Geographer Chao Ju-Kuan describing the value of the “south-pointing needle”

### Interpreting meanings

What sort of device do you think the “south-pointing needle” was? Why might it be called “south-pointing” as easily as “north-pointing”?

Using this source, explain why the compass could have changed attitudes about seafaring in a major way.

### Corroborating sources

What other sources for this lesson add to your understanding of China’s nautical accomplishments?

## Source Analysis: Primary Source Document 5

A passage from a book in 1044 CE describing a naphtha flamethrower

### Interpreting meanings

Try drawing your own diagram of this flamethrower based on the description provided here.

Aside from gunpowder and oil of some sort for the fuel, what other technologies and skills does this passage suggest the Chinese had mastered in order to construct and use this weapon?

### Contextualizing

During the Song dynasty, the Chinese used rockets, cannons, and explosives against a fierce foe from the northwest, a foe that in the end they could not defeat. Can you explain?

## Source Analysis: Primary Source Document 6

Author Hsu Ching describes the sails on some ships in 1124 CE

### Interpreting meanings

Explain briefly why the Chinese ships needed all the different sails described here. Why weren't one or two of them enough?

### Contextualizing

This description was written three centuries before the famous voyages of the treasure ships commanded by Admiral Zheng He in the early 1400s. What do you know about those voyages? How does this source help explain China's ability to mount such expeditions three centuries later?

### Corroborating sources

How might the compass described in Primary Source Document 4 have helped a ship's captain make decisions about using these sails most effectively?

## Source Analysis: Primary Source Document 7

A Song-era piece of paper money

### Contextualizing

Given the size of China, why might both merchants and the central government find it easier to use certificates to conduct their business, rather than coins?

The Song dynasty was a time of growing economic activity but also growing central control by a more powerful government and its many imperial officials. Why might both factors make it easier to get people to accept and use paper money?

### Interpreting meanings

Why do you think the Chinese government printed money with the elaborate writing and images you see on this bill?



## Source Analysis: Primary Source Document 8

An 1873 photo of imperial examination cells

### Interpreting meanings

What do these examination cells suggest about the nature of the imperial exams and about the values China wished to instill in its imperial officials?

### Contextualizing

Confucian teachings stressed filial piety; respect for ritual, tradition, and duty; and the training of moral character. Why do you think his ideas appealed so much to rulers in the Song dynasty as it was expanding and strengthening its central control throughout China?

The most powerful leaders and top officials throughout China were trained in literary skills and Confucian ethics and ideas. Some historians suggest this limited China's ability to develop independent scientific thinkers and researchers? Do you think these historians have a point? Why or why not?

## Source Analysis: Primary Source Document 9

Fu Zuan defends the engineer Ma Jun against criticisms by some higher officials

### Interpreting meanings

How can you tell that Ma Jun had lower status as an imperial official than Gaotang Long or Qin Lang?

Why do you think the emperor reacted the way he did here?

### Contextualizing

Based on what you know about the Confucian values popular with Chinese imperial officials, how might these ideas help explain the attitudes of Gaotang Long and Qin Lang toward Ma Jun's way of thinking about technical innovation?

### Point of view

Do you trust Fu Zuan's account of this incident? Why or why not?

## Source Analysis: Primary Source Document 10

A mathematician comments on the failure to test students about astronomical ideas and instruments

### Contextualizing

The Chinese emperor was both a religious and political figure. The religious aspect had to do with the emperor's central role in maintaining the so-called Mandate of Heaven. What do you know about this concept?

### Interpreting meanings

What does this passage suggest about China's vast imperial bureaucracy and its likely attitudes toward astronomical knowledge or other scientific fields?

Do you think the passage helps to explain the fact that China never made the breakthrough to modern science, as Europe did starting in the 16th century? Why or why not?

## Part 3: Analyzing the Secondary Sources

**Note to the teacher:** This next section includes passages from two secondary source accounts on the fall of Rome along with two activities on these sources. We suggest you first discuss the brief comment “Analyzing Secondary Sources” just above the first of the two secondary sources. Discuss the four criteria the first activity asks students to use in analyzing each secondary source. These criteria focus students on the nature of historical accounts as 1) problem-centered, 2) based on evidence, 3) influenced by point of view and not purely neutral, and 4) tentative or aware of alternative explanations.

Specifically, this section includes the following:

- **Two secondary source passages**

Give copies of these passages to students to read, either in class or as homework. The two passages are from *A History of Chinese Civilization*, Second Edition, by Jacques Gernet (New York: Cambridge University Press, 1996), p. 330, and from *The Rise of Early Modern Science, Islam, China and the West*, by Toby E. Huff (New York: Cambridge University Press, 1993), p. 277.

- **Two student activities**

Activity 1

Students analyze the two passage taking notes on the following questions:

- How clearly does the account focus on a problem or question?
- Does it reveal a position or express a point of view?
- How well does it base its case on primary source evidence?
- How aware is it of alternative explanations or points of view?

Activity 2

In pairs, students select two of the primary sources for the lesson that best support each author’s claims in the secondary source passages. Students discuss their choices with the class.

## The Secondary Sources for the Lesson

### Analyzing Secondary Sources

Historians write secondary source accounts of the past after studying primary source documents like the ones you have studied on Tang and Song China. However, they normally select documents from among a great many others, and they stress some aspects of the story but not others. In doing this, historians are guided by the questions they ask about the topic. Their selection of sources and their focus are also influenced by their own aims, bias, or point of view. No account of the past is perfectly neutral. In reading a secondary source, you should pay to what it includes, what it leaves out, what conclusions it reaches, and how aware it is of alternative interpretations.

\* \* \* \*

### Secondary Source 1

**Information on the source:** The passage in the box below is an excerpt from *A History of Chinese Civilization*, Second Edition, by Jacques Gernet (New York: Cambridge University Press, 1996), p. 330.

One has the impression that a whole series of psychological changes took place, which an analysis of the literature of the time would doubtless reveal. The educated Chinese of the eleventh century was as different from his T'ang predecessors as Renaissance man from medieval man. What is strikingly manifest is the advent of practical rationalism based on experiment, the putting of inventions, ideas, and theories to the test. We

also find curiosity at work in every realm of knowledge—arts, technology, natural sciences, mathematics, society, institutions, politics. There was a desire to take stock of all previous acquisitions and to construct a synthesis of all human knowledge. A naturalistic philosophy which was to dominate Chinese thinking in the following ages developed in the eleventh century and attained its definitive expression in the twelfth.

## The Secondary Sources for the Lesson

### Secondary Source 2

**Information on the source:** The passage in the box below is an excerpt from *The Rise of Early Modern Science: Islam, China and the West*, by Toby E. Huff (New York: Cambridge University Press, 1993), p. 277.

The nature and function of the Chinese examination system, with its three degrees (“cultivated talent,” “recommended man,” and “presented scholar”), has been known for some time and was discussed by Max Weber in *The Religion of China*. What has not received adequate attention, however, is the fact that the Chinese educational system was both rigidly controlled and focused on literary and moral learning, while the European universities were both autonomous and self-controlled as well as centered on a core curriculum that was

essentially scientific. . . . The implications of these institutional contrasts for the development of science, as in the case of Arabic science, can hardly be overstated. For if science is to flourish over the long run, it must have official approval as well as public support—something that was rarely available in China. The fields of astronomy and mathematics did benefit from state support, but just as often there were state-sponsored interdictions of the study of astronomy and mathematics, especially in the Ch’ing dynasty.

## The Secondary Sources: Activity 1

In this exercise, you read two short passages from much longer secondary sources dealing with China during the Tang and Song dynasties. For each secondary source, take notes on the following four questions (you may want to underline phrases or sentences in the passages that you think back up your notes):

1. How clearly does this account focus on a problem or question. What do you think that problem or question is? Sum it up in your own words here.

*History of Chinese Civilization*, Gernet   *Rise of Early Modern Science*, Huff

2. Does the secondary source take a position or express a point of view about science and technology in China? If so, briefly state that point of view or quote an example of it.

*History of Chinese Civilization*, Gernet   *Rise of Early Modern Science*, Huff

3. How well does the secondary source seem to base its case on primary source evidence? Take notes about any specific examples, if you can identify them.

*History of Chinese Civilization*, Gernet   *Rise of Early Modern Science*, Huff

4. Does the secondary source seem aware of alternative explanations or points of view about this topic? Underline points in the passage where you see this.

*History of Chinese Civilization*, Gernet   *Rise of Early Modern Science*, Huff

**In pairs, discuss your notes for this activity.**



## The Secondary Sources: Activity 2

This activity is based on the passages from *A History of Chinese Civilization*, Second Edition, by Jacques Gernet, and from *The Rise of Early Modern Science: Islam, China and the West*, by Toby E. Huff. From the primary sources for this lesson, choose two that you think best support each source's point of view about science and technology during the Tang and Song dynasties. With the rest of the class, discuss the two secondary source passages and defend the choice of sources you have made.

1. From this lesson, choose two primary sources that best back up the interpretation in Gernet's *History of Chinese Civilization*. List those sources here and briefly explain why you chose them.
2. From this lesson, choose two primary sources that best back up the interpretation in Huff's *Rise of Early Modern Science*. List those sources here and briefly explain why you chose them.
3. Does your textbook include a passage describing science and technology in Tang and Song era China? If so, with which of the two secondary source passages (*History of Chinese Civilization* or *Rise of Early Modern Science*) does it seem to agree most? What one or two primary sources from this lesson would you add to this textbook passage to improve it?

**Discuss your choices with the rest of the class.**

## Part 4: Follow-Up Options

**Note to the teacher:** At this point, students have completed the key tasks of *The Historian's Apprentice* program. They have examined their own prior understandings and acquired background knowledge on the topic. They have analyzed and debated a set of primary sources. They have considered secondary source accounts of the topic. This section includes two suggested follow-up activities. Neither of these is a required part of the lesson. They do not have to be undertaken right away. However, we do strongly recommend that you find some way to do what these options provide for. They give students a way to write or debate in order to express their ideas and arrive at their own interpretations of the topic.

Two suggested follow-up activities are included here:

- **Document-Based Questions**

Four document-based questions are provided. Choose one and follow the guidelines provided for writing a typical DBQ essay.

- **A Structured Debate**

The aim of this debate format is not so much to teach students to win a debate, but to learn to listen and learn, as well as speak up and defend a position. A more interactive and more civil debating process is the goal.

## Document-Based Questions

Document-Based Questions (DBQs) are essay questions you must answer by using your own background knowledge and a set of primary sources on that topic. Below are four DBQs on science and technology in China. Use the sources for this lesson and everything you have learned from it to write a short essay answer to one of these questions.

### Suggested DBQs

**Using the documents for this lesson, describe some of China's most important technological accomplishments and explain why so many of them were developed most fully during the Tang and Song dynasties.**

**Explain why you think the Chinese imperial examination system helped or hindered the development of science and technology in China.**

**"Confucian teachings encouraged the wrong intellectual values and skills for the development of scientific culture in China." Assess the validity of this statement (that is, explain why you do or do not agree with it).**

**"The Scientific Revolution could just as easily have occurred in China as in Europe. It was sheer chance that it did not take place in China first." Assess the validity of this statement (that is, explain why you do or do not agree with it).**

### Suggested Guidelines for Writing a DBQ Essay

- **Planning and thinking through the essay**

Consider the question carefully. Think about how to answer it so as to address each part of it. Do not ignore any detail in the question. Pay attention to the question's form (cause-and-effect, compare-and-contrast, assess the validity, etc.). This form will often give you clues as to how best to organize each part of your essay.

- **Thesis statement and introductory paragraph**

The thesis statement is a clear statement of what you hope to prove in your essay. It must address *all* parts of the DBQ, it must make a claim you can back up with the sources, and it should be specific enough to help you organize the rest of your essay.

- **Using evidence effectively**

Use the notes on your "Source Analysis" activity sheets to organize your thoughts about these primary sources. In citing a source, use it to support key points or illustrate major themes. Do not simply list a source in order to get it into the essay somehow. If any sources do *not* support your thesis, you should still try to use them. Your essay may be more convincing if you qualify your thesis so as to account for these other sources.

- **Linking ideas explicitly**

After your introduction, your internal paragraphs should make your argument in a logical or clear way. Each paragraph should be built around one key supporting idea and details that back up that idea. Use transition phrase such as "before," "next," "then," or "on the one hand..., but on the other hand" to help readers follow the thread of your argument.

- **Wrapping it up**

Don't add new details about sources in your final paragraph. State a conclusion that refers back to your thesis statement by showing how the evidence has backed it up. If possible, look for nice turns of phrase to end on a dramatic note.

## A Structured Debate

**Small-group activity:** Using a version of the Structured Academic Controversy model, debate alternate interpretations of this lesson's topic. The goal of this method is not so much to win a debate as to learn to collaborate in clarifying your interpretations to one another. In doing this, your goal should be to see that it is possibly for reasonable people to hold differing views, even when finding the "one right answer" is not possible.

Use all their notes from previous activities in this lesson. Here are the rules for this debate.

1. Organize a team of four or six students. Choose a debate topic based on the lesson *The Technological Triumphs of Tang and Song China*.

(You may wish to use one of the DBQs suggested for the "Document-Based Questions" activity for this lesson, or you may want to define the debate topic in a different way.)

2. Split your team into two subgroups. Each subgroup should study the materials for this lesson and rehearse its case. One subgroup then present its case to the other. That other subgroup must repeat the case back to the first subgroup's satisfaction.
3. Then the two subgroups switch roles and repeat step 2.
4. Your team either reaches a consensus which it explains to the entire class, or it explains where the key differences between the subgroups lie.

## Answers to “Source Analysis” Activities

### Source Analysis: Document 1

*Interpreting meanings:* Characters are carved in relief and in reverse on the woodblock, which is then inked and pressed against the paper.

There are thousands of complex individual Chinese characters, as compared with only a few dozen letters in alphabetic languages. This makes managing movable type very difficult.

*Corroborating sources:* It needed to print thousands of copies of the Chinese classics and other books on which the exams were based.

### Source Analysis: Document 2

*Interpreting meanings:* Pulleys and gears transform the circular motion into the back-and-forth stroke of the long rod attached to the bellows door on the left.

Bellows provide enough oxygen to get temperatures high enough to melt iron.

Double-acting piston bellows blow air out on both strokes of the handle in contrast to a bellows that blows air only when the stroke is in one direction.

### Source Analysis: Document 3

*Contextualizing:* The Yangtze and the Huang He (or Yellow River). The Huang He is called “China’s Sorrow” because it carries such heavy loess silt that it often builds itself up above its floodplain, overflows, and changes course in devastating floods.

It linked the rice-producing south along the Yangtze with the northern plains around the Huang He, where China’s civilization began.

*Interpreting meanings:* Humans pulled barges and other boats up and down the canal, locks raised and lowered boats, etc.

### Source Analysis: Document 4

*Interpreting meanings:* The device is a compass. Its needle lines up in a north–south direction.

The passage stresses the sense of the sea as dangerous, with hidden obstacles and with no easy way to maintain a sense of direction. The compass must have altered this sense dramatically.

*Corroborating sources:* Primary Source Document 3 calling attention to inland waterways, and Primary Source Document 6 on the variety of sails in use

### Source Analysis: Document 5

*Interpreting meanings:* Share and discuss interpretive sketches. Use the discussion to indicate the precise nature of the description here.

Answers will vary, but could include careful measurement, bronze casting, and a finely tuned military capable of transporting and training soldiers to use such weapons.

*Contextualizing:* The Mongols were the foe, and in the 13th century conquered first the northern part of China and later (by 1279) the southern part as well.

### Source Analysis: Document 6

*Interpreting meanings:* The sails enabled the ship to go in almost any direction regardless of which way the wind was blowing.

*Contextualizing:* Students should share what they know about these seven voyages of Zheng He's huge ships throughout the Indian Ocean and South China Seas; this source suggests how old and strong the tradition of Chinese nautical innovation was.

*Corroborating sources:* Perhaps by keeping the ship on course through the many twists and turns these sails allowed, etc.

### Source Analysis: Document 7

*Contextualizing:* It would make it easier to finance transactions over great distances when carrying coins might be inconvenient or unsafe, etc.

Paper money can be passed from transaction to transaction to more easily facilitate growing trade, etc. A powerful government might instill trust so that people could be sure the paper money would keep its value and be accepted in payment for all kinds of goods, taxes, etc.

*Interpreting meanings:* This would make the bills harder to counterfeit.

### Source Analysis: Document 8

*Interpreting meanings:* Answers will vary and should be discussed.

*Contextualizing:* Perhaps these skills and values would train a reliable yet conscientious and intelligent bureaucracy, etc.

Answers will vary. Some may see Confucian teaching as consistent with scientific curiosity in its emphasis on a search for truth, wisdom, honesty, etc. Others may feel that so much emphasis on literary skills among China's most powerful officials worked against the development of independent centers of scientific research.

### Source Analysis: Document 9

*Interpreting meanings:* From their titles, from the way they laugh at Ma Jun, etc.

Answers will vary and should be discussed.

*Contextualizing:* Gaotang Long and Qin Lang appear to trust clear verbal expression more than experimental science—or as Ma Jun puts it “empty arguments with words.”

*Point of view:* Answers will vary and should be discussed.

### Source Analysis: Document 10

*Contextualizing:* The Mandate of Heaven was the idea that as long as a dynasty ruled well, “heaven” would deal kindly with China; but if the emperor ruled badly, natural disasters and social disorder would prove that his dynasty had lost its mandate.

*Interpreting meanings:* The passage indicates an indifference to scientific or technical knowledge, even when it is important to imperial rule, or a secretiveness that could easily close off open debate.

Answers will vary and should be discussed in relation to the other sources for the lesson and the secondary source passages as well.

## Evaluating Secondary Sources: Activity 1

**These are not definitive answers to the questions. They are suggested points to look for in student responses.**

1. How clearly does this account focus on a problem or question. What do you think that problem or question is? Sum it up in your own words here?

*Gernet* in *History of Chinese Civilization* focuses on the question of what the unique contributions of the Song dynasty were in fostering a new rational spirit in the quest for knowledge in China.

*Huff* in *Rise of Early Modern Science* contrasts the openness and independence of educational and scientific institutions in China with those in Europe to see what this contrast tells us about the development of science and technology in both civilizations.

2. Does the secondary source take a position or express a point of view about science and technology in Tang and Song China? If so, briefly state that point of view or quote an example of it.

*Gernet* sees this era of Chinese history as a time when a thoroughly rational and scientific spirit came to dominate Chinese thinking. In his view, no significant barriers seem to have prevented China from developing both its technology and the scientific knowledge underlying that technology.

*Huff* stresses what he sees as the unique independence and legal protections enjoyed by universities in Europe as compared with China, where the imperial examination system dominated intellectual life and prevented scholars from gaining any real independence in their intellectual life. Huff sees this as partly explaining why China did not make the breakthrough to modern science despite its triumphs and its superiority in many areas of technology,

3. How well does the secondary source seem to base its case on primary source evidence? Take notes about any specific examples, if you can identify them.

Neither Gernet nor Huff make any specific reference to primary sources in these brief passages.

4. Does the secondary source seem aware of alternative explanations or points of view about this topic? Underline points in the passage where you see this.

Neither Gernet nor Huff make explicit reference to alternative explanations, though Huff in particular is implicitly challenging the view that Gernet expresses with little qualification.



