RETHINKING THE REGION:

New Approaches to 9-12 U.S. Curriculum on the Middle East and North Africa

UNIT:
ARTS AND TECHNOLOGY

TOPIC **Innovation and Interaction**	
LESSON OVERVIEW	In Part 1 of this two-part lesson, students will work in pairs to explore the roles and contributions of MENA scholars and the interaction and dissemination of their ideas, objects, and practices to other world regions. Each pair will be given an item to discuss and locate on a world map, and then asked to illustrate its movement to other world regions using colored yarn or markers. In Part 2, which can be conducted in class or assigned for homework, students will read and critically analyze an article about the spread of ideas from MENA to Western science. They will reflect on the many roles played by MENA peoples in the development and dissemination of science, technology, engineering, and mathematics (STEM) innovation and the significant contributions by MENA scholars to our shared past.
ESSENTIAL QUESTIONS	• What roles have peoples from the Middle East and North Africa (MENA) played in the development and spread of ideas, objects, and practices in the fields of science, technology, engineering, and mathematics (STEM)? • How did interactions among scholars and others allow for their contributions to travel to other world regions?
LESSON OBJECTIVES	**Learners will be able to:** • Understand the many roles played by MENA peoples in the development and dissemination of STEM innovation (including research, discovery, invention, scientific and medical practice, travel, trade, book peddling, translation, etc.). • Recognize that contemporary science emerged and continues to develop from the spread of ideas, objects, and practices which have their roots in a number of societies that constitute our shared past.

STANDARDS	**Common Core Standards** CCSS.ELA-Literacy.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-Literacy.CCRA.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. CCSS.ELA-Literacy.CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently. (Optional assignment) CCSS.ELA-Literacy.CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. (Optional assignment) CCSS.ELA-Literacy.CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. (Optional assignment) CCSS.ELA-Literacy.CCRA.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. **New York State Standards** Learning Standards for Social Studies: Performance Indicators Students will: Standard 2, Key Idea 1 • Understand the development and connectedness of Western civilization and other civilizations and cultures in many areas of the world and over time • Understand the broad patterns, relationships, and interactions of cultures and civilizations during particular eras and across eras • Analyze changing and competing interpretations of issues, events, and

	developments throughout world history Standard 2, Key Idea 2 • Analyze evidence critically and demonstrate an understanding of how circumstances of time and place influence perspective • Explain the importance of analyzing narratives drawn from different times and places to understand historical events Standard 2, Key Idea 3 • Analyze the roles and contributions of individuals and groups to social, political, economic, cultural, and religious practices and activities • Explain the dynamics of cultural change and how interactions between and among cultures has affected various cultural groups throughout the world Standard 2, Key Idea 4 • Interpret and analyze documents and artifacts related to significant developments and events in world history • Analyze different interpretations of important events, issues, or developments in world history by studying the social, political, and economic context in which they were developed; by testing the data source for reliability and validity, credibility, authority, authenticity, and completeness; and by detecting bias, distortion of the facts, and propaganda by omission, suppression, or invention of facts (Taken from National Standards for World History) Standard 3, Key Idea 1 • Understand how to develop and use maps and other graphic representations to display geographic issues, problems, and questions • Understand the development and interactions of social/cultural, political, economic, and religious systems in different regions of the world Standard 3, Key Idea 2 • Locate and gather geographic information from a variety of primary and secondary sources (Taken from National Geography Standards, 1994)

	• Select and design maps, graphs, tables, charts, diagrams, and other graphic representations to present geographic information • Analyze geographic information by developing and testing inferences and hypotheses, and formulating conclusions from maps, photographs, computer models, and other geographic representations (Adapted from National Geography Standards, 1994) • Develop and test generalizations and conclusions and pose analytical questions based on the results of geographic inquiry
MATERIALS	**PART 1: Introduction Mapping Innovation and Interaction** • Handout 1: The Origins and Movement of Ideas, Objects, and Practices. Cut up the handout into 12 strips. • One large world map pinned to a wall. Optional: photocopied maps (1 copy per group), or 12 copies. Possible sources: a. Printable World Map: http://www.PrintableWorldMap.net/preview/continents_labeled_1 b. Geology.com: http://geology.com/world/world-map.shtml c. Maps of the World: http://www.mapsofworld.com/world-maps/ • Colored yarn; tape, sticky tack, or pins; markers (1 per group, or 15 markers) • Almanac, for reference **PART 2: Critical Reading A Narrative of Innovation and Interaction** • Article: "Influence of Arab-Muslim Science on Western Science," http://www.grouporigin.com/clients/qatarfoundation/chapter3_2_2.htm (1 copy per student). Or see alternative article by Richard Covington under Additional Resources below. • Handout 2: Article Analysis Worksheet (1 copy per student)
NOTES TO TEACHER	**Lesson pairing** • This lesson traces STEM innovation through interaction between MENA and other world regions over a number of historical periods. It can be used to supplement a unit of study on any period to highlight the contributions and interaction of MENA scholars, travellers, and tradesmen to the ideas, objects, and practices of modern science. Teachers may consider partnering with STEM teachers for cross-disciplinary thematic instruction.

PROCEDURE	**PART 1: Introduction Mapping Innovation and Interaction** **1. <u>Warm-up activity</u> (<u>5 minutes</u>)** • On a board at the front of the room write the following words: a. Pulmonary circulation b. Algebra c. Curiosity (Mars rover) • Ask students: What do these have in common? Note: All of these were developed through the significant contributions of MENA scholars. a. Pulmonary circulation: Ibn Al Nafis (1213-1288; born in Syria, practiced in Egypt) discovered how blood circulates. b. Algebra: al-Khwarizmi (c. 780 850; Persian; practiced in Iraq) established algebra as a discipline, separate from geometry and arithmetic (NB: The word *algebra* comes from the Arabic "*al jabr*," meaning "restoration" and the word *algorithm* stems from the Latin form of al-Khwarizmi's name: Algoritmi). c. Curiosity (Mars rover): Charles Elachi (b. 1947; born in Lebanon, current practice in the US) is Director of the Jet Propulsion Laboratory that put Curiosity on Mars in 2012. **2. <u>Small-group work</u> (<u>15 minutes</u>)** • Arrange students into small groups of 2-3 (12 groups) and give each group a slip of paper (from Handout 1) containing an item to discuss. • Ask each pair to: a. Discuss the innovator or innovations described in their item and consider their utility to current practices. b. Identify how the item might be presented on a map in such a way as to represent the interaction or movement of ideas, objects, or practices suggested by the description. Students should consult an Almanac to locate unknown cities or regions. Note: Encourage students to use all of

the information available on their slip of paper and their knowledge from other sources to discuss and locate the item. They should consider the movement of people, as well as influences in considering how they might represent their item. Where possible, the activity can be extended by having students do a quick Internet search to get a broader sense of the movement of ideas, including the information/interaction on which MENA scholars based their innovations and where the ideas travelled from there.

- After each group discusses their item, ask them to stick the item on a wall map of the world, on or around the origin. Then using colored yarn, have them insert lines to illustrate the movement of the idea, object, or practice to other world regions. When all items have been hung, students should have a visual representation of the interaction and movement of ideas to/from the MENA region and other world regions, illustrative of a shared past. Alternatively, students can use blank world maps and markers for this activity. Maps can be hung on the walls to facilitate a "gallery walk."

  Note: If students finish early, give them the article to begin reading for the next activity.

3. **Class discussion** (**10 minutes**)

- As a class, look at the visual representation of the movement of ideas, based on the class's mapping activity. For smaller classes using one world map, consider gathering around the world map and facilitating a discussion there. For larger classes using individual/pair maps, place the maps on the walls around the room and invite students to do a "gallery walk" to look at them.

- Discuss the following questions:

  a. What did you learn about the roles that peoples from MENA and elsewhere have played in the development and spread of ideas, objects, and practices in the STEM fields?

  b. What new ideas emerge for you from seeing a visual representation of the movement of ideas, objects, and practices?

  c. What are some of the ideas, objects, and practices originating from MENA that have an influence on your life? Consider some of the inventions and innovations from today's activity.

d. What surprised you and why?

e. What questions do you have?

PART 2: Critical Reading A Narrative of Innovation and Interaction

1. Introducing the lesson (5 minutes)

Note: This activity can be done in class, individually, or in pairs/small groups, or it can be assigned as homework, with related discussion to follow during the next class meeting.

- Distribute Handout 2 (Article Analysis Worksheet) and the assigned article "Influence of Arab-Muslim Science on Western Science": http://www.grouporigin.com/clients/qatarfoundation/chapter3_2_2.htm.
- Ask students to read silently. While they read, ask students to:

a. Underline important ideas

b. Place an exclamation mark in the margin near new, surprising, or interesting ideas

c. Place a question mark in the margin near ideas about which they have a question

d. Circle any STEM innovations mentioned (i.e. ideas, objects, or practices) that were spread through interactions between MENA and other world regions

e. Put an asterisk in the margin next to sentences that convey the ways in which innovations were spread.

2. Individual reading (15 minutes)

- Students read the article, paying attention to content and perspective.

3. Summarizing (5 minutes)

- After reading the article individually, have students return to their assigned pairs, or arrange them into small groups of 4. Have students make two lists of ideas presented in the article:

a. Innovations that were spread through interactions between MENA and other world regions (e.g. armor; Arabic numerals; principles of astronomy, mathematics, chemistry, physics, medicine, infectious disease, optics; medical texts; hospital practices, etc.)

b. Different ways in which innovations were spread (e.g. war; correspondence and exchange of gifts between rulers; travellers and tradesmen; religious leaders; translation; books and book peddlers; libraries, etc.)

4. **Analyzing (10 minutes)**

- Individually, or in pairs/small groups, ask students to analyze the content and perspective of the article, using Handout 2 (Article Analysis Worksheet) as a guide.

5. **Class discussion (10 minutes)**

- On the board draw two columns. Label one column "Innovations" and the other "Means of Spread." Go around the room and ask each student, pair, or small group to add an item to either column, based on the article and mapping activity.
- As a class, discuss the following questions:

a. After reading the article, what new ideas do you have about the roles that peoples from MENA and elsewhere have played in the development and spread of ideas, objects, and practices in the STEM fields?

c. What does the article tell us about how interactions among scholars and others allowed for their contributions to travel to other world regions?

d. From what perspective is the article presented and why do you think this is?

e. What surprised you and why?

f. What do you have questions about?

4. **Questions for Further Reflection/Connections to Today**

- Consider how the history of science and ideas has been narrated. Why might the contributions of particular groups or world regions be

	underrepresented in these accounts? How might these accounts be revised to better reflect the rootedness of ideas in the interactions among a number of societies? • What social, political, and/or economic conditions or practices facilitate the development and interaction of innovations during particular periods of time? What may hinder this process during other periods? • Research the work of a contemporary MENA scientist or innovator. • Explore the website "Arab Science: A Journey of Innovation" (see link under Additional Resources below). (a) Select a scholar or innovation from the timeline of contributions to further study and trace over time and space. (b) Write a review of the website in which you describe, analyze, interpret, and evaluate the web content, including how the history of science and ideas is narrated.
Additional Resources	**Articles:** Covington, Richard. "Rediscovering Arab science." *Saudi Aramco World.* 2007. http://www.saudiaramcoworld.com/issue/200703/rediscovering.arabic.science.htm. This article provides a rich illustrated overview of MENA science, including influences from other regions and contemporary relevance. Dajani, Rana. "How women scientists fare in the Arab world." *Nature.* 2012: http://www.nature.com/news/how-women-scientists-fare-in-the-arab-world-1.11705. This commentary offers a woman's perspective on the challenges women scientists face in the Arab world and argues that they are not unlike women scientists' challenges elsewhere. See also Sarant, Louise. "Empowering Arab female scientists." *Nature*. 2013: http://www.nature.com/nmiddleeast/2013/130507/full/nmiddleeast.2013.67.html. **Educational websites:** "Arab Science: A Journey of Innovation." http://www.grouporigin.com/clients/qatarfoundation/introduction.htm. This website, developed with the support of the Qatar Foundation,

highlights the contributions of Arab and Muslim scholars to the spread of innovation. It includes descriptions and a visual timeline of discoveries.

Muslim Heritage. http://muslimheritage.com/. This website is published by the Foundation for Science, Technology, and Civilisation, based in Manchester, UK. It includes articles on Muslim contributions to science and innovation.

Teacher resource:

Khan, Yasmin. "1000 Years of Missing Science." *Science in School.* http://www.scienceinschool.org/print/171.

Curricular resources:

"Educating for Cultural Literacy and Mutual Respect: Muslim Contributions to Civilization." http://www.ing.org/muslim-contributions-to-civilization. Developed by ING, this curricular resource for Middle and High Schools includes lesson plans and materials that introduce contributions to a number of areas of scientific inquiry and daily practice.

"1001 Inventions Teachers' Pack: Discover the Muslim Heritage in Our World." http://www.1001inventions.com/files/1001iTeachersPacksHiRes.pdf. This curricular resource is intended for science classrooms for students aged 11 to 16. It includes a number of science activities and experiments that highlight the contributions of Muslim scientific scholars. It was developed by the Foundation of Science, Technology and Civilisation (UK), science teachers, and consultants.