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Dust to Dust:
The Changing Face of a Desert

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Lesson Title: Dust to Dust, The Changing Face of a Desert

Grade Level: 7th Eastern Hemisphere Geography

Purpose/Overview:
The study of geography, history, and the social studies in general, provide ample opportunities for students to evaluate the positive and negative consequences of human modification the Earth's surface through the use of limited and non-renewable resources. This lesson focuses on the ways imported technology rapidly transformed the arid environment of the Arabian Peninsula, only to be transformed again by human mismanagement of fossil aquifers just a few decades later.

National Geography Standards from *Geography for Life* Geographic Elements & Standards:
1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information.
14. How human actions modify the physical environment.
16. The changes that occur in the meaning, use, distribution, and importance of resources.
17. How to apply geography to interpret the past.

2012 Oklahoma Academic Standards for the Social Studies:	2019 Oklahoma Academic Standards for the Social Studies:
1.1. Cite specific geographic information to support analysis from primary and secondary sources.	**7.1.1** Integrate specific geographic information to support analysis from primary and secondary sources located in texts, documents, newspapers, magazines, journals, political cartoons, and online news sources
1.2. Integrate visual information, draw conclusions, and make predictions from geographic data and analyze spatial distribution and patterns by interpreting that data as displayed on globes, graphs, charts, satellite and other forms of visual imagery.	**7.1.5** Integrate visual information, draw conclusions, and make predictions from geographic data and analyze spatial distribution and patterns by interpreting that data as displayed on geographic tools.
2.5. Explain and summarize how and why regions change over time through physical and human processes which operate to modify Earth's surface.	**7.5.1** Define the concept of region and explain how and why regions change over time through physical and human processes which operate to modify the Earth's surface.

5.2.C Evaluate the effects of human modification of and adaptation to the natural environment including the transformation of arid lands of the Arabian Peninsula through introduction of western irrigation methods.	**7.4.4** Evaluate the effects of human modification of and adaptation to the natural environment through transformation caused by agriculture, the use of modern irrigation methods, industry, demand for energy, and urbanization.
5.3 Integrate visual information to analyze regional problems and policies having spatial dimensions in the Eastern Hemisphere.	**7.1.4** Integrate visual information and apply the skill of mental mapping of the political and physical features of the Earth's surface in order to organize information about people, places, and environments.
1.1. Cite specific textual evidence to support analysis of primary and secondary sources.	**4.A.** Students will comprehend, evaluate, and synthesize textual sources to acquire and refine knowledge in the social studies.
2.A.2. Write informative/explanatory texts, including the narration of historic events.	**5.A.6-8.2** Compose informative essays and other written products about social studies topics, incorporating evidence (e.g. facts, examples, details) from multiple sources, maintaining an organized, formal structure.
2. B. 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	**5.A.6-8.4** Write independently over extended periods of time and for shorter time frames, varying modes of expression to suit audience, purpose, and task and/or to analyze different perspectives.
2. B. 8. Gather relevant information from multiple print and digital sources.	**4.A.6-8.2** Integrate the use of visual information (e.g. maps, charts, photographs, videos, political cartoons) with textual information from primary and secondary sources.

Geographic Themes: (Five Themes of Geography)
Human-Environment Interaction
Movement
Region

Objectives:

1. **Key Topic:**
   Students will be engaged in the study and analysis of the impact of recent agricultural technology on agricultural practices and use of nonrenewable water resources in Saudi Arabia at the turn of the century. Students will be given multiple opportunities to develop their skills in analyzing geographic data in the form of satellite imagery of change over time, focusing on the region of the Arabian Peninsula.
2. **Essential Questions:**

How do we, as humans, significantly impact our environment for both positive and negative consequences?
How does our environment affect the decisions we must make regarding the use and conservation of natural resources?

3. **Student Knowledge:**
   Students will come to a better understanding of how human decisions to adapt desert environments for the goal of becoming self-sufficient in food production temporarily met such a goal, yet misuse of water resources ultimately doomed the effort.
4. **Application of the Lesson:**
   Students will be able to apply the skills of visual evidence analysis in any given region for any topic involving environmental changes over time, whether man-made or natural. Students will also be able to transfer in future units of study the need to conserve all types of limited and unlimited resources, such as fossil fuels, air, and soil.

Materials:

Changing Face of the Desert Powerpoint presentation
Image A and B handout (one copy per pair of students; option- use Powerpoint slide #5)
Image A and B Venn Diagram colored handout (one copy per pair of students)
Satellite Imagery Over Time colored handout (one copy per student)
Saudi Arabia Agricultural Project, reading passage (one copy per pair of students)
Water, Oil, and Food- A Crisis, reading passage (one copy per pair of students) Five Themes of Geography Organizer, handout (one copy per team of 4 students) R.A.F.T. Writing Options chart (viewed from Powerpoint) Video: Earth From Space- Desert Growth
https://drive.google.com/file/d/1GPR1JJYc27etdM5cejDDpIulN2SJcODd/view Video: Food Self-Sufficiency in Saudi Arabia
https://drive.google.com/file/d/1OH7yRGPvir8MR3gxpm0GvB4I1I0lEpqg/view
Rubric for R.A.F.T. Writing Assessment
Internet Access to Livebinder Resources www.livebinders.com/play/play?id=1841891
(for optional Extension task only)
What Happens When the Wells Go Dry, reading passage (for optional Extension task only)
Water Politics in the Middle East, reading passage (for optional Extension task only) Rubric for Story Book (optional Extension task only)

Time Frame: 2 periods of 45-50 minutes; 1-2 additional days for Extension Options

Procedures:

Engage-

1. In order for students to begin thinking on the lesson's objectives, the teacher will use the slide #2 of Powerpoint presentation, *Changing Face of the Desert*, to lead a whole-class brainstorming activity. Remind students that the study of geography will take them to many regions of the world

which are being changed and transformed due to human modification of the environment. In fact, the history of the world is a history of humans bringing about change through the many inventions mankind creates and develops.

2. Ask students to think about all of the many inventions that have changed our world... What invention would make it to the top of your list? Allow time for each student to contribute their top response and compose a class list of all contributions onto a master list. Encourage selected students to share why they think a particular invention has brought about such significant change.

3. Use the next slide of the Powerpoint and offer time for the class to compare its list to the public poll's responses, found on slide #3.

4. Using slide #4, introduce the Essential Questions that students will consider during this lesson. Ask students to independently note one example in which human interaction with the environment has led to both a positive and negative consequence. Allow time for students to share their responses with the class. Inform students that they will revisit the second Essential Question at the close of the lesson when they will be asked to explain the necessity of conservation of the Earth's finite and unrenewable resources.

Note: A Nearpod presentation of the Powerpoint, including student interactive activities, is available at https://share.nearpod.com/vsph/Ue1Mz8AmrJ. *(Nearpod is free software for educators, combining aspects of powerpoint presentations and interactive activities for whole class instruction. To set up Nearpod for classes, teachers need to establish their own free accounts; then, a copy of the Nearpod presentation can be added to a teacher's own library.)*

Explore-

5. The teacher will assign students to work in pairs. Give each pair a printed copy of Image A and B handout. (Option: Powerpoint slide #5 can be used for viewing Image A and B. Option: classrooms with mobile devices can access Image A and B from the Livebinder link at http://www.livebinders.com/media/get_centered/MTcxMTk4MzA.)

6. Provide pairs with one minute of silence to observe both images. Inform students that these are satellite images from two very distant locations. Ask students to look for what they see in common, as well as differences. Remind students to observe patterns, drawing no conclusions to explain what they see, but merely making observations.

7. The teacher will provide one Venn diagram handout to each pair. Allow a maximum of 2 minutes for pairs to write at least 2 things they observe from both images. Note the observations in the "similarities" section of the Venn diagram. Allow an additional 2 minutes for pairs to write one things unique to each image, noting these observations in the "image A" and "image B' sections of the Venn diagram.

8. Using the reflection questions at the bottom of the Venn diagram, the teacher will lead a brief class discussion, assisting students to share any conclusions they can draw from the images' comparison. Focus the discussion on these questions, "What is your team's explanation of the patterns you observe in both images?" "How did your team reach this conclusion?"

Explain (part A.)

9. The teacher will lead a phase of whole-class instruction, beginning with use of the videoclip,

Earth From Space- Desert Growth. This video will remind students of the value of visualizing the Earth from remote distances, such as those provided by satellite imagery. The video also begins to explain the causes for the circular patterns of vegetation growth observed in images A and B, as well as reviews how to analyze evidence from satellite images.

10. The teacher will continue using the Powerpoint presentation, slides #7-14, to explain in narrative format how the American invention of pivot irrigation transformed desert regions of the Arabian Peninsula. Point out the goal of self-sufficiency for such drastic and rapid change in agricultural practices. Help students understand the role government officials played in reaching this goal over a short amount of time. Be sure to delineate for students the differences in food selfsufficiency for a nation and food security for a nation's people. Answer and clarify any questions students may have during the presentation, However, be careful not to reveal the ending of this episode in Saudi Arabia's decisions about water usage from fossil aquifers and food production. 11. Conclude this phase of direct instruction by viewing the videoclip, *Food Self-Sufficiency in Saudi Arabia*. Conduct a brief class discussion to compare and contrast details about the transformation of deserts provided by the video versus those grasped through the Powerpoint presentation. What additional questions do students have at this point? Make a class list of questions yet unanswered.

Expand-

12. The teacher will join pairs together into groups of four. Provide each member of the team with a copy of the *Satellite Imagery Over Time* colored handout. (Option: Powerpoint slide #17 can be used for viewing the four images. Option: classrooms with mobile devices can access online imagery at http://www.livebinders.com/media/get_centered/MTcxMjgzMzE).

13. The teacher will inform the class that teams will be working together to dig deeper into the transformation of the Nafud region of the Arabian Peninsula, as an example of how pivot irrigation impacted the desert environment. Using the four images, ranging from 1987 to 2012, allow teams 45 minutes will begin to draw conclusions from the evidence provided from the images and from the knowledge they gained during the Explain phase of the lesson. Encourage students to discuss their conclusions openly with team members, challenging and supporting conclusions, based on the evidence provided.

14. The teacher will provide each team with one copy of the handout *Five Themes of Geography Organizer.* Review the Fives Themes of Geography briefly, if necessary. Draw the class's attention to the theme of Location, at the bottom of the organizer. Ask teams to volunteer a piece of evidence from the satellite images that would support the relative location of the events seen in the images.

15. The teacher will allow teams ten minutes to note their conclusions in the remaining places on the Five Themes Organizer. *(Option: Teams may assign one student to serve as the team's "recorder. Or, the teacher may wish to provide one copy of the organizer to each team member for noting the team's responses independently.)* Each team should attempt to note at least two signs of evidence supporting each of the Five Themes.

16. Conduct a brief class discussion. How did analyzing four images over time help visualize modifications to the Earth's surface? Based on the progression of changes seen in these four images, what do students predict an image taken this year would look like? Ask student volunteers to explain their predictions to the class.

Explain (part B)-

17. The teacher will respond to student predictions by completing the Powerpoint presentation. Slides #19-26 explain the dependence of irrigated fields on finite resources of the fossil aquifers lying beneath the Arabian deserts. Allow time on slide #21 for students to use the line graph of Saudi grain production from 1976 to 2006 to test the various predictions made in step 16 of this lesson. Also, pause on slide 25 for students to examine the level of stress on aquifers throughout the region of Southwest Asia and North Africa. Help students make the connection between overuse of water resources and the climate of a region. Use slide #26 to examine aquifers around the world. What other regions are overstressed? Does climate also play a key role in these regions? Note the aquifers of North America, especially those accessed by farmers of the Great Plains. What do students know about the climate of our region, compared to that of the Arabian Peninsula?

18. The teacher will conclude the instructional phase of the lesson by asking students to return to their original pairs. The teacher will provide one student in each pair with a copy of the article *Saudi Arabia Agricultural Project a*nd provide the other student in each pair with a copy of the article, *Water, Oil and Food Crisis*. Allow students 3-4 minutes to read the articles. Students may wish to use a highlighter to note new information about the recent transformation of the natural environment of Saudi Arabia. When completed, student pairs will verbally share with each other any additional information they learned from the reading passages. Encourage students to be specific in their sharing because such information will be useful for their final assessment.

Evaluate (Assessment):

19. The teacher will introduce the authentic assessment writing task by using slide #29 from the Powerpoint presentation. The R.A.F.T chart will provide students with the many options available for their written assessment. The teacher should review all steps of the process below.

Student Directions:

A. You will be assuming the role of a person directly impacted by the decisions over water usage in Saudi Arabia recently. (Look at the chart; select a person from the "ROLE" category.) You will express your thoughts and share information you have learned through the eyes of the person you are portraying.
B. You will choose an audience (person or group of people) that you want to hear your thoughts and opinions. * Choose a logical person to whom your role would want to communicate. (Look at the chart; select a person from the "AUDIENCE" category.)
C. You next will decide how you will express your thoughts in writing. (Look at the chart; select one type of communication from the "FORMAT" category.) * Choose a logical form of communication that your role would use.
D. Finally, decide what you want to write about. (Look at the chart; select an option from the "TOPIC" category.)
E. Complete these requirements for your R.A.F.T. Writing Assessment: Your writing must be approximately 100-150 words in length.

Use specific facts and information to demonstrate what you have learned.

You must include A.)an explanation of HOW and WHY the environment has been transformed, B.) a description of one POSITIVE effect of the transformation and

C.) a description of one NEGATIVE effect of the transformation.

F. Review the rubric for grading to check that you have completed the task.

Resource Citations:

Rubin Center for International Affairs http://www.rubincenter.org/meria/2008/06/elhadj.pdf State of the Planet, Columbia University, September 14, 2011
http://blogs.ei.columbia.edu/2011/09/14/water-oil-and-food-%E2%80%93-a-crisis-for-saudiarabia-and-the-world/
Center for Strategic and International Studies, March 12, 2010,
https://www.csis.org/analysis/addressing-our-global-water-future Full
Planet, Empty Plates", Earth Policy Institute,
http://www.earthpolicy.org/images/uploads/book_images/FullPlanet
AllChaps.pdf
Pivot Irrigation in Saudi Arabia, https://svs.gsfc.nasa.gov/11290
Earthview, Saudi Wheat and Fossil Water, https://www.usgs.gov/news/earthview-saudiwheatexperiment-relied-fossil-water
Earth From Space, Desert Growth, https://www.youtube.com/watch?v=aeWGQ9rj7P8 Wheat
Farming in Saudi Arabia, https://www.youtube.com/watch?v=kYHH8mzxFOk Farming in the
Desert, Almarai Farming Division,
https://www.scribd.com/document/59688808/New-Almarai-Presentation-Jan-09 Water
and Development, Global Issues,
http://www.globalissues.org/article/601/wateranddevelopment

Enrichment and Extension-

The teacher may wish to provide an optional research task, which would provide opportunities for students to publish online their learning. Use the following set of directions for a successful and enriching experience of online publishing. Directions:

A. Your Task: You have been selected to produce a children's book about the use of limited water resources of Southwest Asia, using the recent events in Saudi Arabia as an example.

B. Your Goal: Help young students around the world to better understand the impact humans have on their environment and the need to make wise decisions about using finite natural resources.

C. The Contents: You will use what you have learned about the changes brought about by human actions in the arid environment of the Arabian Peninsula. In addition, you may use additional resources found at www.livebinders.com/play/play?id=1841891 under the "Enrichment" tab. Each page of your story book will have a specific focus. Your story book should also contain visuals (clip art, photo, map, or graph) which support your story. Follow the rubric for grading the story book; it will guide you through each page of narration.

D. Final Publication: You may create your book using any software or app you wish. Recommendations include Story Jumper. An example is found at https://www.storyjumper.com/book/index/48380026/Drip-Drip-Drip-Diary-of-a-Desert. However, you may use other software such as Powerpoint or Book Creator (for Macs and Ipads).

Image A

Image B

Reflection:

What is your explanation of the patterns you observe in both images?

How did you reach this conclusion?

February, 1986
February, 1991
March, 2000
February, 2003

EYES on the EARTH: Using Evidence from Satellite Imagery to Analyze a Changing Planet

This FIVE THEMES of GEOGRAPHY graphic organizer can help you note the evidence you discover and the conclusions you make about the recent transformation of this region.

PLACE	
Physical: *Describe the land and water features; draw a conclusion about the climate.*	**Human:** *Describe the types of economic activities humans might be engaged in? Describe the way of life for humans living in this place?*
HUMAN-ENVIRONMENT INTERACTION	

What are signs of humans modifying their environment? Why would such modifications be necessary or desirable?

MOVEMENT	**REGION**
Identify signs or evidence of the movement of people, resources, products, ideas or technology?	*Explain how this place is similar to other physical, economic, or cultural regions.*

LOCATION
What is the relative location of this place, based on conclusions you have made from the satellite image?

Saudi Arabia's Agricultural Project: From Dust to Dust

Arid conditions have always prevented the development of any sizeable agricultural communities in the Arabian Desert. Beginning in the early 1980s, however, Saudi Arabia spent enormous amounts of money and exhausted massive volumes of water from nonrenewable aquifers in an effort to achieve food self-sufficiency. Now, the Saudi government has abandoned its food independence strategy!

Huge government subsidies encouraged the importation of technology, equipment, seeds, fertilizers, and farm workers. Between 1980 and 1992, wheat production grew making the Saudi desert the world's sixth-largest wheat exporting country! Within four years, 75% of the new wheat farms were abandoned. What happened?

The dramatic rise and fall of Saudi Arabia's agriculture reflected haphazard planning. The experience proved that merely throwing money to import machinery, such a pivot irrigation systems from the United States, could make a desert bloom, but only until either the money or the water ran out.

If money was of no concern to Saudi Arabia, water should have been. Two-thirds of the water used was nonrenewable. To make matters worse, Saudi Arabia exported over one-third of its finite water sources to nearby nations of the Arabian peninsula!

Why did Saudi Arabia pursue expensive agricultural development in the desert? Was it to achieve food independence? Was it to protect Saudi Arabia from the risk of a wheat boycott by food-producing countries? Or, was it to show how Saudi

wealth could help humankind overcome food shortages? The answer is probably a combination of all these factors.

The Saudi government's embarrassing abandonment of its proud achievement could be a sign of serious trouble that the nonrenewable aquifers have reached perilous levels. The day of reckoning is near.

Rubin Center for International Affairs, 2008

1. Role	2. Audience
Saudi farmer Saudi king Saudi Agricultural Official News reporter Agricultural Scientist Saudi parent of large family	Citizens of Saudi Arabia Saudi king Saudi government official Worldwide news readers Personal Family or Friend Myself
3. Format	**4. Topic**
Personal Letter Diary entry Email Editorial Announcement Speech Twitter post	Opinion about the Situation Proposed Action to Address the Problem How Decisions have Impacted You

Student Name:_____

My Role is _____

My Audience is _____

My Topic is _____

My Format is _____

My R.A.F.T. Writing Includes:	**Points Possible**	**Points Earned**
1. Detailed information about the event(s)	10	
2. Accurate facts about the events	10	
3. Explanation of how humans modified their environment	10	
4. Explanation of why the environment was changed	10	
5. Accurate description of a positive effect of the human-environment interaction	10	
6. Accurate description of a negative effect of human-environment interaction	10	
7. Completely addressed the topic chosen	10	
8. First-person account through the eyes of my role	10	
9. Followed directions for minimum length	10	
10. Demonstrated a good understanding of geographic concepts	10	

Dust to Dust: Documentary of the Water & Food Crisis in Saudi Arabia

Slide #.	**Focus:**	**Goal:**	**Points:**
1	Location	Describe the relative location of Saudi Arabia	10
2	Place: Physical	Describe the physical features (environment, climate, resources) that have impacted the crisis.	10
3	Place: Human	Describe the human characteristics (population, government, economics) that have impacted the crisis.	10
4	Movement	Explain how the migration of ideas and/or technology have affected the crisis.	10
5	Region	Compare the crisis within the region of the Middle East and/or compare to other similar regions on the Earth.	10
6	Human-Environment-Interaction	Explain one way that Saudi Arabia modified its environment to meet its needs.	10
7	Human-Environment-Interaction	Explain another way that Saudi Arabia modified its environment.	10
8	Summary	Summarize the crisis and its impact on the future.	10
Detailed and accurate evidence from research is presented in the documentary.			10
Narration is clearly presented and easy to understand.			5
Visuals (illustrations, maps, graphs, photographs, etc.) support the evidence and ideas presented in the documentary.			5

Comments:	100 possible