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| **Title of Lesson: Water Cycle and its Impact on Humans** |
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| **Type of Lesson**: Introductory, Direct Instruction, Discussion**Description of lesson:** This program is the second in the Water Conservation Module. It is intended to be done after the Virtual Water Activity. This lesson covers the water cycle and its impact on agriculture. Oftentimes students are aware of the water cycle; they memorize the steps, but do not think about HOW certain steps of the water cycle occurs and how the water cycle changes depending on the season, climate and human impacts. This lesson covers the water cycle through the lens of drought, extreme precipitation, human impact and climate change. Students will explore issues and solutions to the changes in the water cycle and its impacts on agriculture.  |
| **Enduring Understandings:** Water is crucial for habitability. Humans are impacting water resources in various ways including agriculture, industry, and human caused climate change. | **Essential Questions:** If water is always cycling, why should we care about water conservation? How is water a valuable resource and what are humans doing to change water quality? |
| **Academic Standards:*** HS-ENV4-2. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
* HS-ENV1-2.\* Use a computational representation to illustrate that humans are part of Earth's ecosystems and how human activities can, deliberately or inadvertently, alter ecosystems.
* HS-ENV2-1.\* Construct and revise an explanation based on evidence for the cycling of matter through sources and sinks and how energy is transferred.
* HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes
* HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
* Ag:IAFNR-5.1 Explain interrelationships between natural resources and humans necessary to conduct conservation practices in natural environments
* Ag: IAFNR-5.2 Summarize the relationship between natural resources, ecosystems and human activity
* Ag:IAFNR-5.3 Identify natural resources and their importance to the local community.
* APES: ERT-1.G Explain the steps and reservoir interactions in the hydrologic cycle.
 | **Student learning targets:*** Diagram the changes in the water cycle due to seasons, climate, and human impact
* Understand the impacts of changes in the water cycle, such as drought and extreme precipitation events.
* Connect the water cycle changes to agricultural needs and food needs
* Discover methods farmers can use to adapt to drought and extreme precipitation events
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| **Assessment task -** During the lesson teachers can use the following activities as formative assessmentsWater Cycle DiagramDiscussionCrop Research Activity  |
| **Differentiation:*** Classroom discussion can be done as a Think-Pair-Share if students are not comfortable sharing out as a whole class
* In addition, journal entries or online discussion boards could be used as well.
* For upper level students, encourage them to find solutions to the crop water problems in their Crop Poster at the end of the lesson
 | **Accommodations:*** A guided note sheet could be provided for students to write the answer to the discussion questions for easy recall later
* A water cycle diagram could be printed for students to annotate, instead of drawing the entire thing by hand
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| **Prior Learning:*** Basic water cycle steps (condensation, evaporation, precipitation, runoff, etc.)
* The connection between water cycle, soil health and food production (Virtual Water Lesson)
 | **Prerequisite skills:** * Discussion protocol (i.e. think, pair, share)
* Drawing a model
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| **Materials*** White boards
* Big paper
* Makers
 | **Technology:*** Access to the internet for students to research
* Projector
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| **Vocabulary Development:** * Drought
* Extreme Precipitation
* No-Till
* Cover Crop
* Irrigation
* Desertification
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| **Procedures:** * **Download the PowerPoint from the CEES Website:** [**https://cees.iupui.edu/education-programs/k-12/teacher-resources/sustainable-agriculture.html**](https://cees.iupui.edu/education-programs/k-12/teacher-resources/sustainable-agriculture.html)
* **Follow the PowerPoint as a guide for discussion and classroom pacing. Use the following guide for resources and information**
	+ **What is the water cycle**
		- Have students discuss and review the water cycle. In Indiana they should have learned about the water cycle in elementary school, but I find that many students forget the steps, OR they don’t know why the steps happen. I.e. They don’t know that water gets warmer to evaporate or cools off to condense and that is important for how climate change impacts the water cycle. If we don’t have enough cool air, the water vapor will never condense and if temperatures are too warm, more water will evaporate than precipitate.
	+ **How does the water cycle change in different seasons and due to climate change**
		- Maybe break students up into groups, then have each group tackle one of the questions. One group talking about how the water cycle is different in the summer and one group doing the winter. Encourage them to draw the model of the water cycle and how it changes based on their scenario. This will help them think about the next step, which is that the water cycle is not the same everywhere nor all the time. Sometimes we have drought and extreme precipitation events and that can have big impacts on humans.
			* <https://www.youtube.com/watch?v=Q8B4tST8ti8&t=7s>
	+ **More about drought**
		- The slides provided give a brief detail of drought.
		- In this lesson the Aral Sea is used as an example of human caused drought. There are two videos embedded in the PowerPoint. The video on the left is very flashy and will catch the attention of a younger audience. It is the type of media that Generation Z is currently consuming. The video on the right is from BBC. It shows a more professional and adult look at the Aral Sea crisis.
			* <https://www.youtube.com/watch?v=miIEOZBNU-M&t=7s>
			* <https://www.youtube.com/watch?v=FzvEW1FHc60>
			* Depending on your students it would be beneficial to show both videos and talk about why they are different, who is the intended audience, which one is from a reliable source?
		- The drought in California is not human caused. The drought was caused by a persistent high pressure system over California. While not directly human caused, such as the Aral Sea, this drought is a product of climate change. When the arctic melts it decreases the albedo and causes a low pressure system over the northern regions. This impacts the jet stream and can create regions of high pressure (cool dry air falling). This persistent high pressure system lasted for 6 years.
		- Teach about what a drought is, how droughts happen and give some examples of droughts impact soils, crops, water supply, and water quality.
	+ **More about extreme precipitation events**
		- Define heavy precipitation event, explain how it happens. What are the impacts of heavy rain on soil, crops, water supply, water quality,
		- This part of the lesson refers to top soil runoff. A lesson on this can be found at the CEES Website under the Weathering and Erosion Module
			* <https://cees.iupui.edu/education-programs/k-12/teacher-resources/sustainable-agriculture.html>
	+ **How can we adapt to these events?**
		- The list of agricultural adaptation to manage the damage caused by drought and extreme precipitation is provided by the USDA
	+ **Activity on crop research**
		- It is important for students to connect the issues in the water cycle with food security. While in Indiana we may not feel the direct impacts of climate change, drought or precipitation because the main crop export of Indiana is corn and soybeans, we do depend on the fruits and vegetables grown around the United States. Especially from California.
		- This activity has students complete research on their favorite fruit or vegetable. The activity can be done as a physical or a digital poster. The digital posters can be done through Google Slides, Canva, or other means of creating a digital work
		- Students can also make physical posters.
		- Students will conduct research on the following questions
			* Choose a crop that you like to eat - corn, potatoes, strawberries etc.
			* Research where the crop is grown
			* Research the crop water needs (what month during the growing season does it need the most water)
			* Research the average precipitation is for that area during the growing months
			* What are farmers doing to grow this crop?
			* Drought resistant crop - irrigation - Field tiles - riparian zones - cover crop etc…
			* What are the impacts of growing this crop?
			* Extension: What can farmers do to reduce the impact of this crop on the water cycle?
		- Special Note for teachers supporting students!
			* When researching for the example crop (almonds) I had to figure out when in the growing season almonds needed the most water. This was not apparent on the internet (as in Google did not have a direct answer for this). I had to do some digging into websites about almond farming and horticulture.
			* This might be difficult for some students, but encourage them to use critical thinking skills when figuring out the puzzle. The task could be broken down even more for those who struggle. In addition, crops could be pre-selected and researched by the educator to help students.

Resources for Teachers: <https://www.fao.org/3/s2022e/s2022e02.htm><https://www.farmprogress.com/management/how-you-can-reduce-flood-risk-on-your-farm><https://www.americanrivers.org/2022/08/five-things-you-should-know-about-californias-drought/><https://www.climatehubs.usda.gov/hubs/northeast/topic/drought-resistant-practices#:~:text='%20Below%20are%20a%20few%20short,%2C%20cover%20crops%2C%20and%20microirrigation>. |

**Attach:**

Water Cycle Lesson