

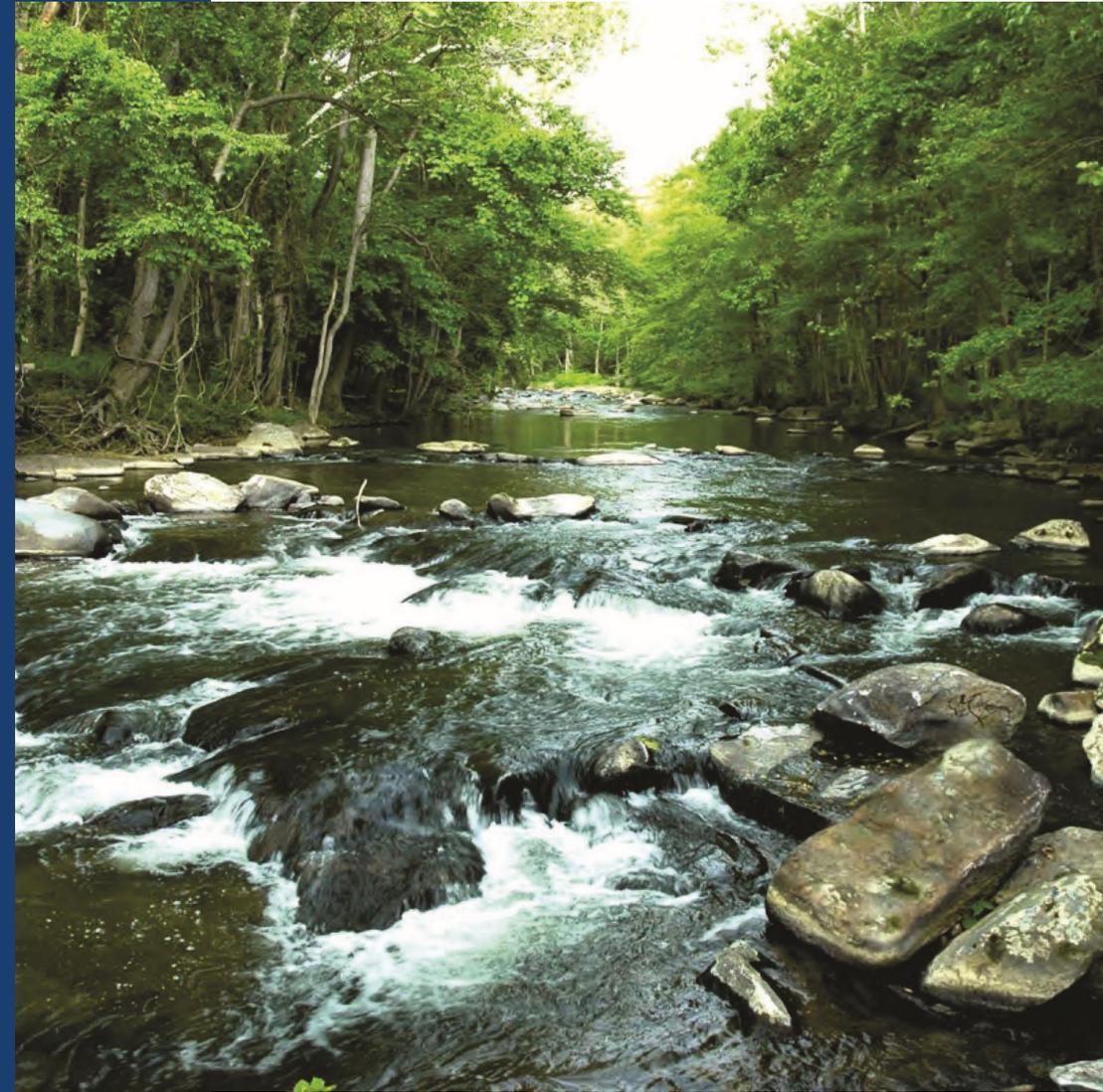
# Modeling How Scientists Study Wetlands in Climate Change

Teacher Guide for  
High School Lessons

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**Lauren Rose & Kelly Van Trieste**

Produced in partnership with ShoreRivers & Stroud Water Research Center.  
Support provided by National Science Foundation Award No. 2049073.



## About Lauren Rose



**Talbot County  
Public Schools**

I graduated from Shippensburg University in 2008 with a bachelor's degree in biology and then went on to earn a master's degree in chemical and life sciences from the University of Maryland. After graduation, I began working as a science teacher at Easton High School where I taught a variety of science classes for 16 years, serving as department chair for five of those years. Halfway through the academic school year 2023-2024, I stepped in to fill a vacancy at in our school's music department and now I am currently the director of bands at Easton High School. I assist with Easton High's extracurricular activities by serving as a class advisor, the Spirit Committee chair and the Ecology Club advisor. I also coached varsity girls' basketball for 5 years and junior varsity and varsity cheer for 9 years. In 2023, I received the Environmental Protection Agency Region 3 Presidential Innovation Award for Environmental Educators. In 2024, I received the Outstanding Young Alumni Award from Shippensburg University.

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# About Kelly VanTrieste



I am a science teacher at Easton High School in Easton Maryland. I currently teach freshmen biology, AP biology, and a sheltered Earth Systems class for newcomer students. I went to West Chester University where I earned my degree in Biology education, Go RAMS!, and I earned my masters in Teaching English to Speakers of Other Languages (TESOL) at Salisbury University. Growing up in southeastern Pennsylvania I was not exposed to the Chesapeake Bay region and its wonders. Since moving to Maryland I have developed a deep appreciation for the Chesapeake Bay region and all it has to offer. Experiencing the wonders of the region has opened my eyes to the importance of environmental education and getting students outside to foster their love for nature as well.



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# Maryland Standards Alignment

## Next Generation Science Standards:

- HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
- 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.
- HS-PS1-5. 5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

## Maryland Environmental Literacy Standards:

- Standard 5: Environmentally literate students construct and apply understanding of individual, collective, and societal responses to human-induced environmental change.

## In this unit, students will be able to...

- Explain the value that wetlands provide our ecosystems and communities
- Conduct experiments and analyze data to understand how wetlands are impacted in climate change
- Investigate how wetlands can be saved by sediment moving downstream by modeling a stream survey and sediment settling experiment

# Part 1 - The Importance of Place, Particularly Wetlands

1. It is said in Maryland, that no matter where you are, you are always less than a mile away from a body of water - whether it be the Chesapeake Bay, a river, or a stream. Have students think about a favorite memory of theirs on, or by, the water. Give students 30 seconds to image this in their head and ask students to take 90 seconds to draw this memory.
2. Ask students to consider what they drew and turn to a partner to discuss: Where are they in this memory? What about this place makes it meaningful to them? What did they include in their drawing that helped show that this place is important to them? Students may have drawn themselves kayaking in Maryland's Coastal Bays, or eating crabs at a riverside restaurant, or they might have drawn a family beach house.
1. Have a few students share out their memories of meaningful places and what features they included in their drawings. As a group, try and identify if there are any patterns to what make these places meaningful - for example: spending time with family or friends, recreating or exercising, plants and animals, or the history of a place.

Tidal wetlands provide resources and experiences we value.



Explain to students that they will be learning about tidal wetlands, which are threatened by climate change and sea-level rise. Emphasize that tidal wetlands are important places for so many reasons included in the graphic above, and likely drawn and represented in their images.

## Part 1 - The Importance of Place, Particularly Wetlands



Have students watch this video about Blackwater National Wildlife Refuge in Maryland and answer the questions on [this worksheet](#).

## Part 2 - Understanding One Aspect of Sea-Level Rise

Climate change is a vast and complicated topic to cover with students, but there are great resources to help breakdown the causes and effects of climate change. Visit the Global Climate Dashboard for climate data and more resources. <https://www.climate.gov/climatedashboard>

Explain to students that they are going to investigate one of the causes of sea-level rise that is decimating marshes like Blackwater - warming oceans. Have students complete this [warm-up activity](#) as individuals, or as a class. You can print worksheets, or display these images on the board and have students write their observations and questions on sticky notes.

Next, have students complete the NASA [How Warming Water Causes Sea-Level Rise](#) activity that we have created this [protocol and data sheet](#) for.

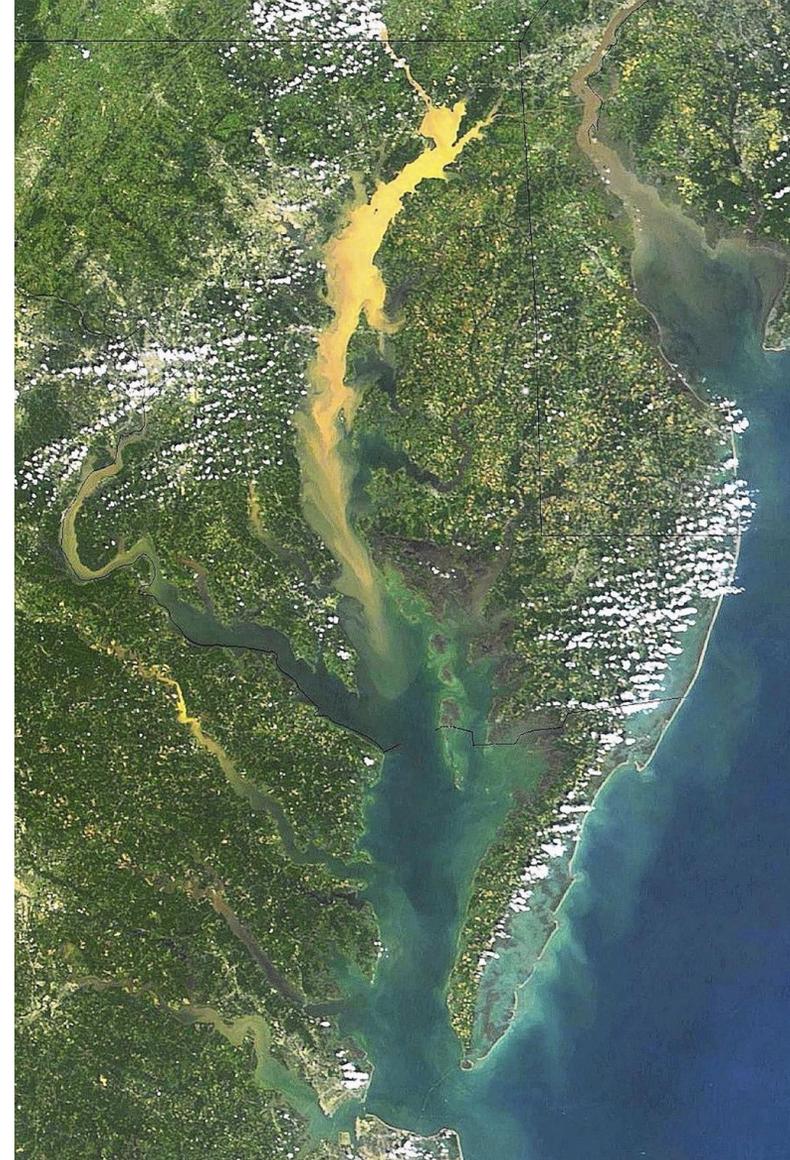
Finally, use [this data](#) to have students answer “so what”? Climate change is happening and it’s impacting humans, the environment, our economies, and our cultures. Have students work in groups to analyze data and information, but with the purpose of thinking of how this data shows up and impacts us in our daily lives.

# Part 3 - Understanding the Upstream Role Sediment Plays in Saving Wetlands

In order to understand how sinking wetlands can be saved, students will conduct a stream survey to determine how much water is flowing downstream. If you know how much sediment is in that water flowing downstream, you can understand how much sediment might build up and accumulate in a wetland or marsh like Blackwater.

Use [this slideshow](#) to introduce these concepts to students. Use these [protocol and data sheets](#) to conduct your stream survey.

We **highly recommend** finding a community partner who could help you do this like a state park, nature center, environmental nonprofit or an environmental consulting firm.



# Part 4 - Settling Sediment

In this experiment, students will determine how long it takes different types of sediment to settle in water. This contributes to understanding how long it would take for different types of sediment to travel downstream and settle in a wetland - this leads to accumulating sediment helping to grow wetlands in height, which would help combat impacts of sea-level rise.

## Warm- up Activity:

Place samples of different sediment you collected from places in your community. You can provide students with magnifying glasses or scopes. Give students 3 minutes to answer: what is in my soil sample?

Follow-up with a discussion of their thoughts. Sediment can contain sand, clay, soil, organic matter, living organisms, bacteria, minerals and so much more depending on where it came from.



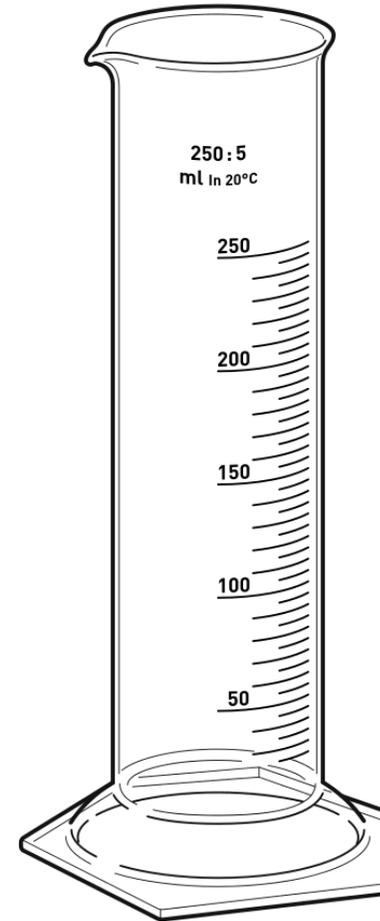
Credit: Alaska ShoreZone Program NOAA/National Marine Fisheries Service (NMFS)/Alaska Fisheries Science Center (AKFSC), courtesy of Mandy Lindeberg, NOAA/NMFS/AKFSC, CC BY 2.0

**Lab Activity:** Use this [lab protocol and data sheet](#) to determine settling rates of samples in your local area. You can provide the samples or have students bring in their own. The following slides can help explain the activity.

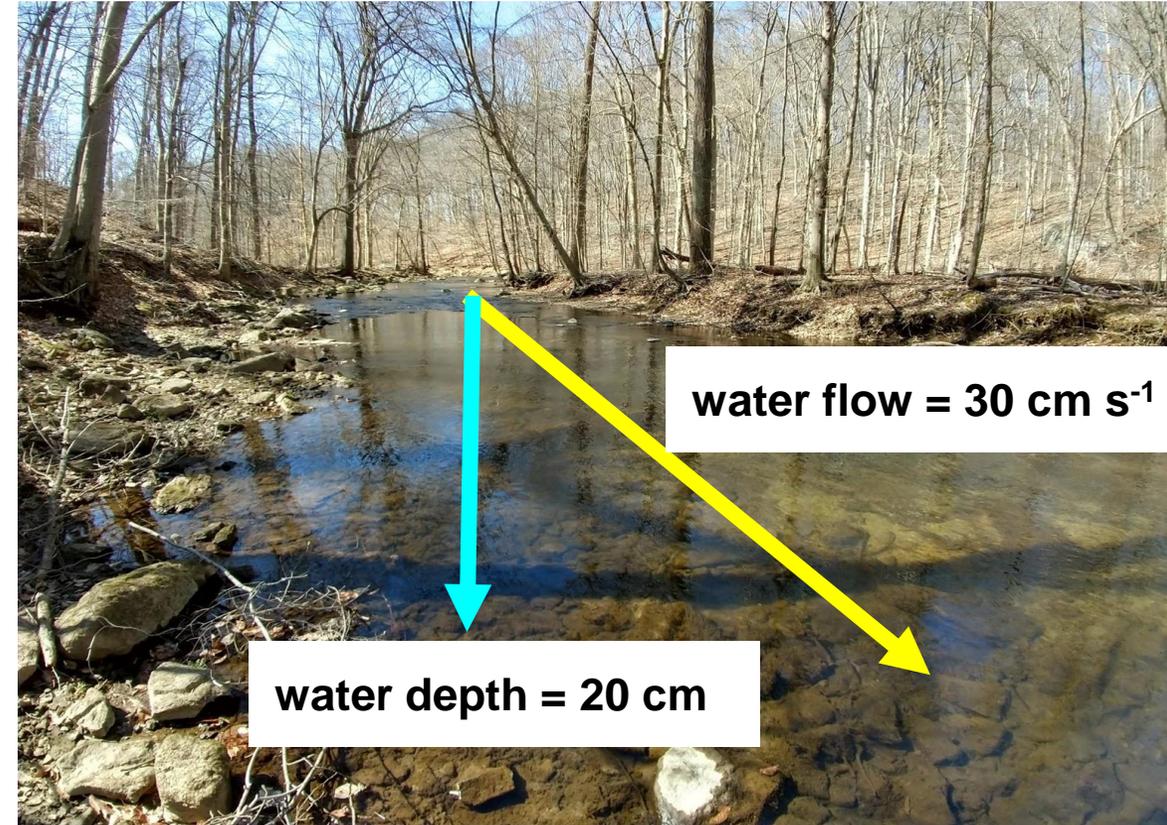


How long does it take sand to settle?

1. fill cylinder with water
2. measure depth of water (centimeters)
3. dump in sediment and stir vigorously
4. stop stirring and start your timer
5. stop timer when the last sand grains settle
6. report your answer



How far would sand grains travel until they settle?

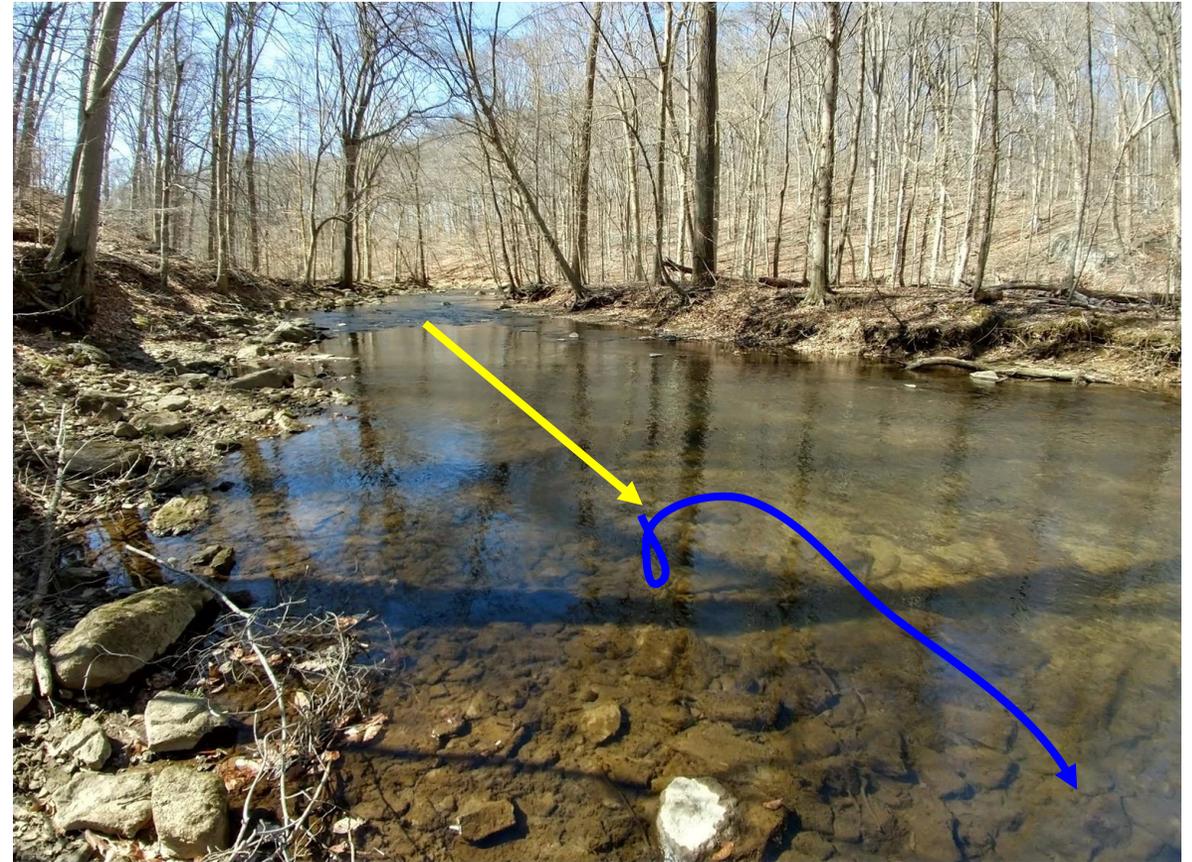


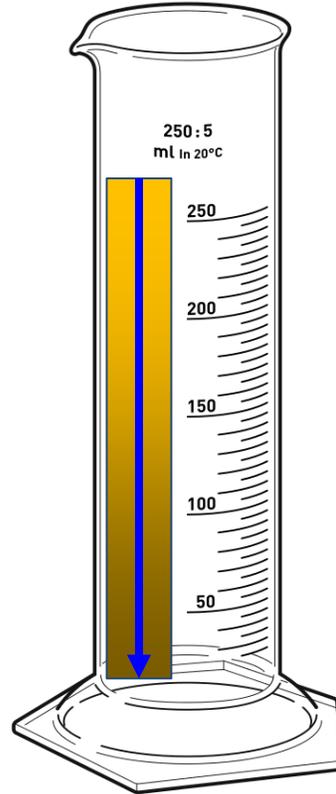
$$\begin{array}{ccccccc}
 \text{travel distance} & = & \text{river depth} & \div & \text{settling velocity} & \times & \text{flow velocity} \\
 \text{cm} & & \text{cm} & & \text{cm s}^{-1} & & \text{cm s}^{-1}
 \end{array}$$

Once sediment settles, it requires a critical **shear stress** to lift it back into the water column.

This can take seconds for small particles and centuries for large particles.

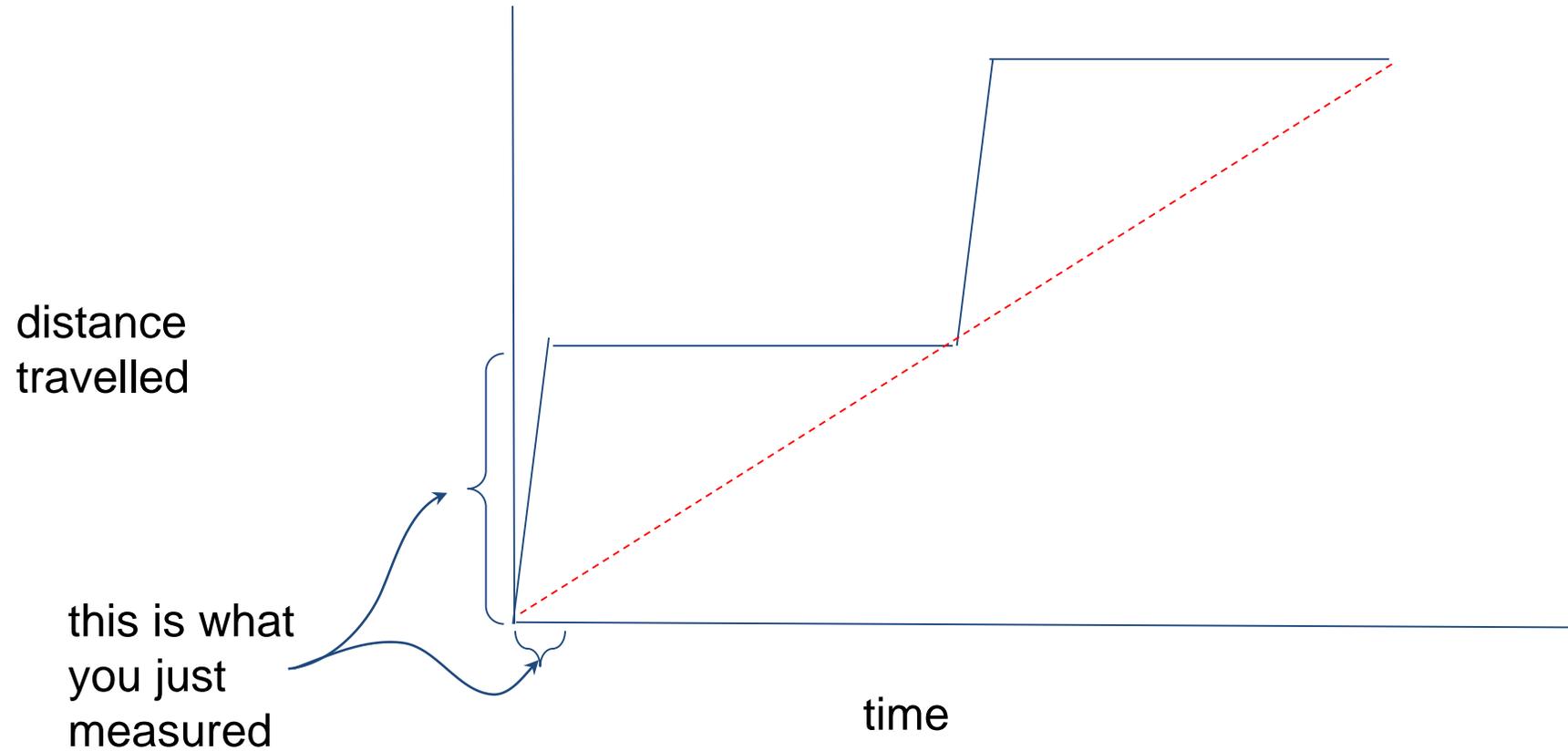
Assume sand remains deposited for 400 years before being resuspended.





1. Stir ONLY THE TOP of your graduated cylinder
2. wait for resuspension to occur
3. stop stirring and clock settling
4. recalculate your travel distance

$$\begin{array}{ccccccc}
 \text{travel distance} & = & \text{river depth} & \div & \text{settling velocity} & \times & \text{flow velocity} \\
 \text{cm} & & \text{cm} & & \text{cm s}^{-1} & & \text{cm s}^{-1}
 \end{array}$$



sand particles travel at the slope of this line! (distance per time)

# Part 5 - Synthesis & Conclusion

Science is really only valuable when it's shared with other people for a purpose. World Wetlands Day is in February - this could be a chance for students to draw attention to the importance of wetlands and advocate for policies and actions that can protect them.

**Option 1:** Local and state regulations govern how communities can grow and develop in ways that can take environmental impacts into account.

Students can write a letter to a town or county council explaining the importance of wetlands in our communities. Students can offer 2-3 recommendations to policy makers on how to preserve wetlands in climate change.

**Option 2:** Lots of outreach and education campaigns include artwork that helps convey the importance of places through images. For example, [National Parks Posters](#), feature notable landmarks, iconic animals, and activities that entice people to visit those places.

Students can create artwork about a wetland in their region. The artwork must include 2-3 features that are unique to that wetland and convey the importance of that place.