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What's a Data Nugget?

Data Nuggets are free classroom activities, co-designed by scientists and teachers, designed to bring contemporary research and authentic data into the classroom. Each activity consists of a research background, a scientific question, a graphing exercise, questions about how to interpret the graph, and an open-ended questions about what should come next. Data Nuggets gives students practice working with “messy data” and interpreting quantitative information, as well as learning about scientific inquiry. The goal of these activities is to build data literacy for K-12 students.

Our Data Nugget: Are forests helping in the fight against climate change?

Research Background: In this section we introduce Bill and the idea of Net Ecosystem Exchange, which Bill has measured with the Harvard Forest eddy covariance tower since 1991.

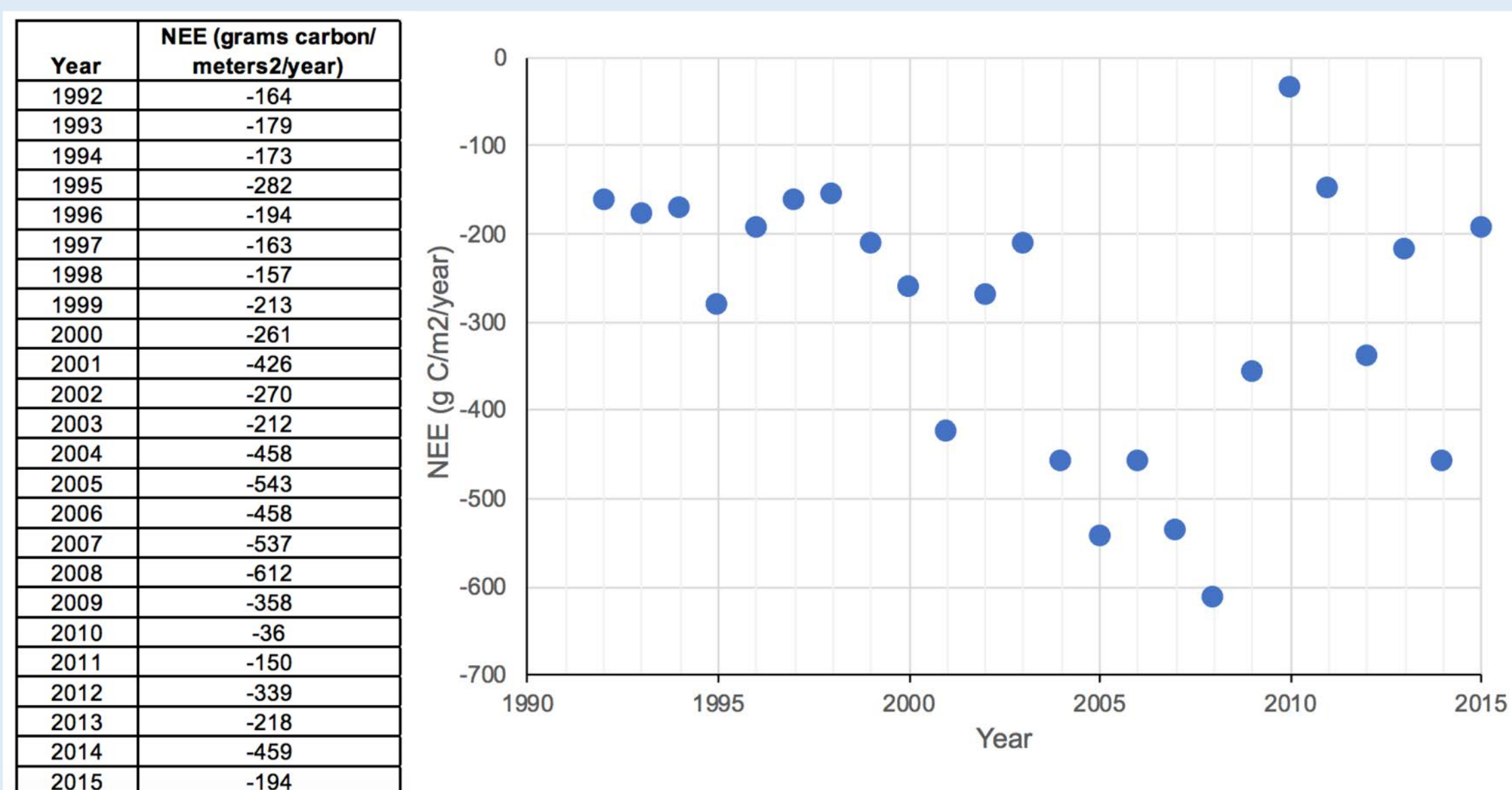


Then and now: photos of Bill setting up the eddy covariance tower in 1991 (left), and what the tower looks like now (right).

Research question: Is the Harvard Forest a carbon source or a carbon sink, and how has the net ecosystem exchange (NEE) changed over time?

Forest processes	Forest is a carbon source or sink?	Net Ecosystem Exchange (NEE) is positive or negative?
More carbon given off by respiration and decomposition than is taken in by photosynthesis.		
More carbon taken in by photosynthesis than is given off by respiration and decomposition.		

This table after the research background is a check to see whether students understand the main concepts before moving on to the graphing activity.



Graphing activity: Students are then asked to graph NEE over time, and interpret their graph. Student notice that 1. The data is messy. 2. NEE is always less than 0, meaning that this forest consistently acts as a carbon sink 3. NEE seems to be getting more negative over time. These interpretations lead to a final section of further hypothesis development and inquiry.

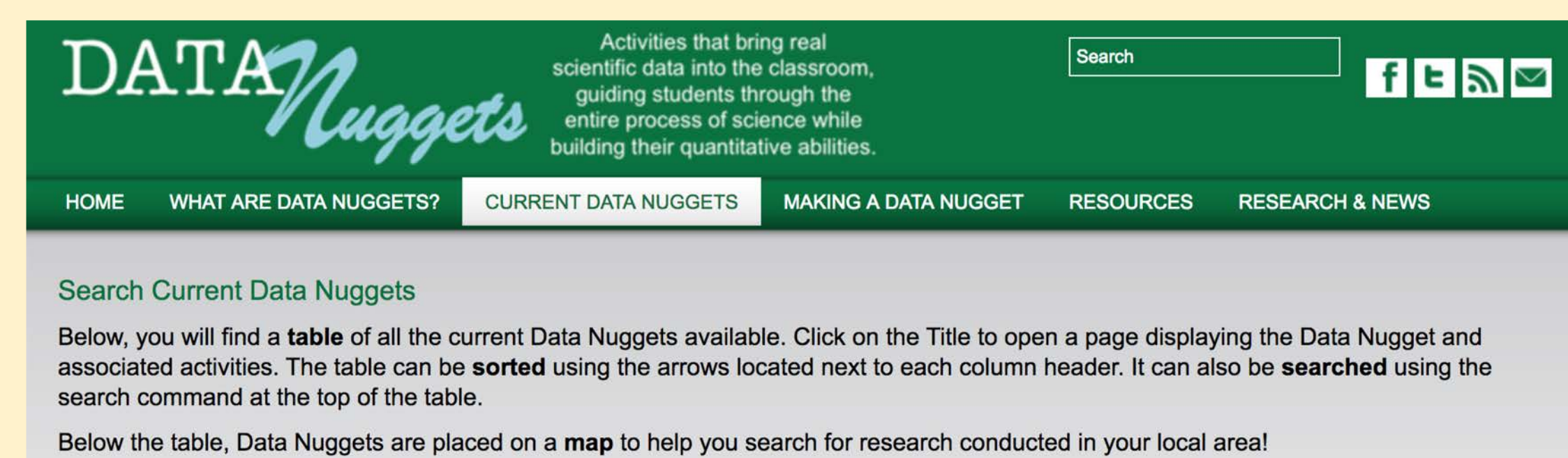
Acknowledgements

In addition to the contributions of the authors, thanks to the many teachers who took the time during our Spring Workshop to provide feedback on an early draft of our Data Nugget.

7 Lessons we learned about bringing real scientific datasets into classrooms using a Data Nugget:

1. Look at previous Data Nuggets for inspiration

You can find lots of great examples at <http://datanuggets.org/>. Datasets from LTERs provide excellent foundations for Data Nuggets. There are templates for both **experimental** and **observational** datasets.



2. Get a diversity of eyes on your drafts

Getting iterative feedback from a combination of scientists and teachers is key. Try to alternate between different types of readers.

3. Microsoft Word has helpful accessibility statistics.

We struggled getting our text to an appropriate grade level. One tool we found useful is freely available in MS Word:

Go to Word → Preferences → Authoring and Proofing Tools → Spelling and Grammar

Under “Grammar”, check “show readability statistics”

Now, when you use the spellcheck function (Tools → Spelling and Grammar), MS word will also assess the “readability” of your document (see example at right).

Readability Statistics	
Counts	
Words	746
Characters	3,574
Paragraphs	8
Sentences	34
Averages	
Sentences per Paragraph	6.8
Words per Sentence	21.5
Characters per Word	4.6
Readability	
Flesch Reading Ease	59.1
Flesch-Kincaid Grade Level	10.3
Passive Sentences	14.7%

Readability tool in Microsoft Word helps you track the accessibility of your writing; this is the output from our Data Nugget. Our first draft had a Flesch-Kincaid grade level >13.

4. Tell a story about the featured scientist

Build a connection between the person doing the science and the students by using narrative language and personal stories about why the researcher cares about the science.



5. Follow the outline, but don't be afraid to incorporate new ideas

During early drafts, use the outline as a guide. As you continue to develop your Data Nugget, listen to the feedback you are getting: we were asked to provide a glossary with definitions for some of the key words and concepts.

Vocabulary

- **Greenhouse gas:** a gas that absorbs infrared radiation, trapping heat near the surface of the earth
- **Photosynthesis:** a process where plants use sunlight to synthesize foods from carbon dioxide and water, which generates oxygen as a byproduct: $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- **Respiration:** a process involving the production of energy from sugars, typically with the intake of oxygen and the release of carbon dioxide: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 = 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$
- **Decomposition:** the general process by which organic (carbon-based) substances, such as dead tissues or organisms, are broken down into simpler pieces. The byproduct of this process is CO_2
- **Eddy flux tower:** a tower used to measure the net carbon balance of an ecosystem. Also referred to as eddy covariance or eddy correlation, it uses wind speed, wind direction and CO_2 concentrations to measure the NEE over a given area. The area measured depends on the height of the tower and the direction and speed of the wind.
- **Net Ecosystem Exchange (NEE):** the net carbon balance of an ecosystem, often measured using eddy flux techniques. Note that natural systems will have both negative (sink) and positive (source) components: the NEE is the total *net* exchange once these are added up.

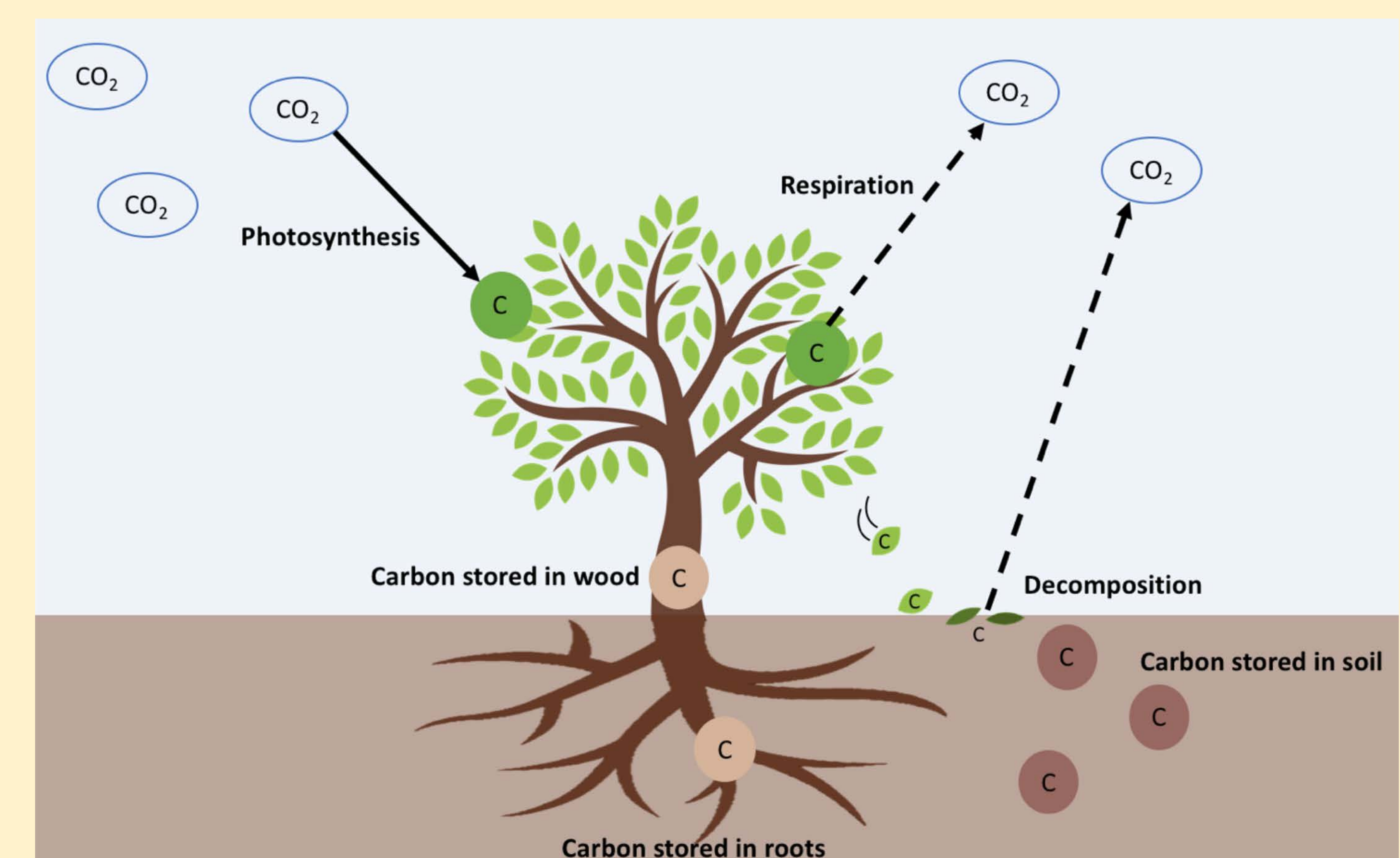
The glossary we created at the suggestion of several of the teachers who edited our Data Nugget

6. Frame your DN thoughtfully

What are students interested in that can provide a hook? What are the science standards for your target grade levels? Teachers told us that their students were interested in climate change and that they wanted new ways to teach about it and talk about it in the classroom.

7. Visuals are key, and simple is best!

We ended up making our own simple diagrams to help explain some of the more complex concepts in our Data Nugget. These don't need to be fancy: just clear!



A simplified diagram of the forest carbon cycle, illustrating how carbon moves between the air, the vegetation, and the soil.