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Climate Smart & Energy Wise (Part 3) [6]

What do ISO 14000 and 4-ESS3-1 have in common? Both are standards. The first is a family of standards from the International Organization for Standardization developed in 1996 to "help organizations...minimize how their operations (processes etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land)..."

The second is a standard being used in some American schools to improve science education. It is a specific performance expectation for fourth grade students from the Next Generation Science Standards (NGSS) on the topic of energy: "Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment." (Excerpt from Chapter 3 of *Climate Smart & Energy Wise* [7]: "Syncing with Standards".)

Standards, in theory and practice, help, well, standardize things. They are like the nuts and bolts of society, ensuring that systems fit together, that nuts and bolts of the same size and style are in fact the same so they work well together. Here in the United States, an entire wing of the Department of Commerce called NIST—the National Institute for Standards and Technology [8]—makes sure there are clear standards for everything from building materials, to atomic clocks, cyber security, and nanotechnology.

The Next Generation Science Standards [9] aim to do the same for science education: to define what are the key concepts that every student should know for each scientific discipline. For the topic of climate, NGSS includes the basics of weather and climate (and how they are related but different), as well as human impacts on climate and the environment, primarily through the burning of fossil fuels. They also give students practice in developing engineering design solutions to minimize impacts and maximize

informed decision-making.

Released in 2012, the NGSS, which build on the National Research Council's "Framework for K-12 Science Education [10]", have now been adopted by eleven states that represent nearly 30% of the students in the nation. Coupled with the Common Core State Standards for Mathematics and Language Arts, which include Literacy in Science and Technical Subjects [11], these new standards can help transform, in theory and practice, how we teach young people about climate challenges and energy solutions in a skillful way.

But implementing the standards in the classroom is a major challenge, which is where Chapter 3 ("Syncing with Standards") from my book *Climate Smart & Energy Wise* comes in. Beginning with standards in Kindergarten, which take advantage of children's inherent curiosity about the world around them, I trace where concepts relating to energy in the Earth system and in our lives are introduced and expanded upon, and how human impacts on the environment are addressed in an age appropriate way throughout the standards. I describe how at every step of the way, the standards encourage learners to consider practical ways that humans can minimize negative impacts and maximize the resiliency of natural and human systems.

Much of the content and context of the standards relates to understanding the natural world and how humans fit in, beginning with establishing foundational knowledge and inquiry skills in the elementary grades, digging deeper and starting to synthesize information in middle school, and then mastering skills by assessing risks and solving problems in high school.

For example, students in the early elementary grades observe local weather and track how seasonal changes alter the plants and animals in their local ecosystems. Students learn through observation and experience about energy in their lives and in the environment around them. In middle school, climate change and the carbon cycle are introduced, and the scope of inquiry is expanded to more regional and global scales. And in high school, the complexities of solving climate, energy, and related environmental and social challenges are examined and analyzed.

Since the Common Core State Standards for mathematics and language arts are already being deployed (and not without issues) in most districts around the nation, I also identify opportunities to weave climate and energy science with calls for use of authentic data in the classroom and other goals of Common Core.

Is NGSS enough to address the growing gap in current climate and energy education? Perhaps not, but it's a great start. Not all states will adopt NGSS, with some preferring to put their own stamp on them, keeping content the same as NGSS. Others may be happy with what they already have.

And it still might be possible for climate and energy to fall through the curricular cracks, especially when educators aren't afforded opportunities for professional development or have their own ideological issues with the topics.

NGSS may not be perfect (I could write a series about missed opportunities, like the Greenhouse effect, which is largely missing!) , but these standards are much better than almost all the existing state science education standards. Most importantly, they are meant for ALL students, not just those who happen to take an Earth Science course, where climate change is most likely to be taught, or a physics class, where energy is often relegated. The goal of Chapter 3 is to help teachers start to bring the science content and skills that are embedded in the standards to life in their classrooms.

Next up: looking at where and how climate literacy can be woven into the curriculum and tied to the standards.

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