

# The Case for Coordinating Earth & Space Science Education Worldwide

William H. Waller 

Rockport Public Schools, Endicott College, and *The Galactic Inquirer*,  
IAU/OAE US National Astronomy Education Coordinator  
243 Granite Street, Rockport, MA 01966 USA  
email: [williamhwaller@gmail.com](mailto:williamhwaller@gmail.com)

**Abstract.** Despite the many amazing advances that have occurred in the space sciences (planetary science, heliophysics, astronomy, and cosmology) these subjects continue to play minor roles in pre-collegiate science education. Similarly, the Earth sciences are woefully under-represented in most school science programs – despite their vital relevance to our physical well-being. Some countries have educational standards that formally prioritize the Earth & space sciences as much as the physical and life sciences, but even they fail to actualize their mandated priorities. I contend that better coordination and advancement of Earth & space science education at the national, state, society, and educator levels would lead to better educational outcomes worldwide.

**Keywords.** astronomy education, Earth and space science education

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## 1. Introduction

The Earth sciences address processes within and among the rocky Earth, its ice caps, oceans and atmosphere. The space sciences consider Earth as a planet among other planets in the Solar System and the greater cosmos - what is commonly called astronomy. Together, the Earth and space sciences span what we know - and what we would like to know - about our place in space and moment in time. The Earth & space sciences, in concert with the life sciences, comprise what is commonly known as the natural sciences. Herein, I argue in support of teaching the Earth & space sciences together, so that students can attain a more holistic understanding of their planetary environment, how it came to be, and where it is headed. Such teaching (and teachers) should receive the same priority as in the teaching of physics, chemistry, and biology. My reasoning for bundling and advancing Earth & space science education has pedagogical, scientific, and cultural underpinnings. These will be discussed along with ideas for enhancing the interaction, cooperation, and coordination of Earth & space science educators worldwide.

## 2. Pedagogical Underpinnings

Some countries have educational standards that prioritize the Earth & space sciences as much as the physical and life sciences. These include the U.S. Next Generation Science Standards (NGSS) which have a separate Earth and Space Science track that spans the K-12 grades. Other countries don't explicitly feature Earth & space science education but rather include it as small parts of courses in physics and geography, if at all. Even where Earth & space science education is formally prioritized, relevant courses and teaching at the high-school level are often under-represented. This shirking of educational mandates is apparent as a clear deficit of teaching opportunities in the Earth & space sciences, amounting to only 8% of available science teaching openings in a recent survey.

At the collegiate level, astronomy is strongly linked to physics. Indeed about 83% of all astronomy programs listed in the AAS's directory are parts of physics departments, or physics & astronomy departments. This vital link can explain why astronomy and the space sciences are typically taught in many high schools as small parts of physics courses, if at all. Similarly, the Earth sciences often appear as small parts of high school geography courses, if ever. Clearly, we could and should do better to advance both Earth & space science education at both the collegiate and secondary school levels.

### 3. Scientific Underpinnings

Earth & space science education is vital to our collective well-being, as it is the best way towards understanding the photochemical process of atmospheric warming by greenhouse gases – and for tracking our industrialized society's increasing contributions to this warming. Proper coordination of Earth and space science education also helps students better understand their place in space and moment in time as beneficiaries of incredible cosmic transformations that have transpired over the past 14 billion years. From fundamental particles to atoms, stars, planets, complex molecules, life, and spacefaring cultures, the Earth & space sciences tell a compelling tale of being and becoming. What better way to understand our complete natural history and to ponder our possible future as emergent citizens of the Milky Way galaxy??

### 4. From Awareness to Action

How best to coordinate and advance Earth and space science education worldwide?? Astronomy on its own is too vulnerable to being neglected as an essential topic of study!! The same goes for the Earth sciences, especially at the high-school level.

- We need to communicate with and learn from our Earth Science education counterparts, perhaps through an IAU working group on Coordinating Earth & Space Science Education. This endeavor will involve the IAU partnering with the AGU, AAS, ASP, AMS, NAGT, NSTA, and their international peers.

- We need to advocate for state and national departments of education to make Earth & space science education a greater priority at the high-school level – and to actualize this priority!!

- At the collegiate level, we need to advocate for integrated degree programs in the Earth & space sciences that will be attractive to pre- and post-service science educators.

- We need to promote the development of coordinated curricula, textbooks, and other resources in Earth & space science education.

- We need to do a better job of communicating our coordinated assets for widespread use by educators. Hopefully, the IAU's Office of Astronomy Education (OAE) will make significant progress addressing this goal. No doubt, professional certificate courses and workshops in the Earth & space sciences will be necessary to engage and coach educators in effective use of these resources.

⇒ So, let's get going!! To provide input and track further progress in these regards, please contact me at [williamhwaller@gmail.com](mailto:williamhwaller@gmail.com).

### 5. Related Article

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