CULTURALLY RESPONSIVE AND SUSTAINING K-12 EDUCATION AS A METHOD TO DEVELOP "SCIENTIST IDENTITY" IN UNDERREPRESENTED YOUTH. M. R. Pincus[1], S. B. Sylvester[1], A. W. Funk[1], S. Krepski[1], R. M. Sharif[1], K. Tsoi[1], C. H. Tully[1], E. Howes[1], and J. Wallace[1]. [1]American Museum of Natural History (maya.pincus@gmail.com).

Introduction: Recent publications [1,2] have emphasized a long-standing problem in the field of Earth and planetary sciences: Diversity among the scientists in these fields is a poor representation of the diversity within the United States and around the world. Research demonstrates that diversity in science is critical to enhanced innovation and problem-solving [3], by increasing sources of information, strategies, and perspectives [4]. Though many organizations are instituting policies that encourage increased diversity at the professional level [5,6], we propose that the underlying cause of this problem begins, and therefore must be addressed, at the K-12 level.

The diversity pipeline. There is a vast disparity between racial/ethnic representation in America's public schools and in the planetary science workforce. In 2014, students enrolled in American public schools were 50% white, 25% Hispanic, 16% Black, 5% Asian/Pacific Islander, 1% Native American, and 3% mixed race [7]. However, a recent survey [8] shows that the planetary science workforce is 87% white, 7% Asian, 1% Hispanic, and 1% Black. Representation of other groups including Native American was too low to be represented by the survey. These data indicate a barrier preventing most students of color from success in planetary sciences at post-secondary and professional levels.

Science at the K-12 level: This study uses the New York City school system as a proxy for understanding diversity in K-12 science education in the United States. With over 1.1 million students, New York City is the largest school district in the country. It can also be considered highly diverse, with student populations 40.6% Hispanic, 25.5% Black, 16.2% Asian, and 15.1% white [9]. This school system has been criticized as highly segregated; schools that are considered specialized for science and receive funding as such are populated predominantly by white and Asian students [10].

We conducted research reviews as well as systematic surveys and interviews with students to explore the source of this planetary science pipeline problem. One major obstacle preventing students of color from pursuing post-secondary education in the earth and planetary sciences is their lack of opportunity to form an identity as a scientist at a young age. This comes in part from a lack of role models that look like these students, both in schools and in public media. It also stems from a lack of authentic scientific experiences in the classroom. As a result, students *choose* not to pursue these fields, often explaining this with the claim "Earth science is not for me."

Culturally responsive/sustaining education. Culturally responsive and sustaining education (CRSE) is a method of education developed from the understanding that students are more engaged and perform better when they see themselves and their cultures represented in their classroom experiences. Though theoretical perspectives and recommendations for CRSE have existed for decades, there is very little research to date providing methods that specifically address scientific identity in underrepresented groups of students. CRSE is elusive due to dependence on the experiences, assets, and needs of students at an individual and local level, but we offer strategies that we hope will address the disproportionate representation of people of color in the planetary sciences.

CRSE classroom strategies. Superficially, CRSE includes classroom design that incorporates representation of scientists of color in addition to or instead of traditionally featured scientists. Examples of this include hanging a poster to highlight the achievements of Mae Jemison, the first female Black astronaut, and choosing to show videos narrated by Neil DeGrasse Tyson, a Black astrophysicist.

At a more profound level, CRSE involves classroom strategies that engage students in authentic practices that connect their cultural assets to science. Traditional western education methods celebrate learning through the discipline of silent note-taking and memorization, but this norm ignores the varied learning styles of other cultures [11].

Students can build identity as scientists by participating in learning opportunities that invoke real

scientific experiences. This includes meeting diverse scientists, visiting sites of ongoing research (fig.1), and classroom experiences in which students are introduced to real scientific tools and practices, such as using a microscope to investigate different types of meteorites, or a telescope to observe planets and stars. When it is impossible for students to observe phenomena directly, they can leverage assets not typically considered scientific, such as artistic ability, by constructing a model (fig. 2).

One critical component of science that is often overlooked in K-12 education is the importance of oral collaboration. This can be initiated through structured classroom routines, and further developed through regular discourse driven by student choice of topic. When students realize that science is most readily advanced through conversations, they are able to see themselves "doing science" in the classroom, rather than simply learning it.

Students can also develop scientific agency by researching and debating critical social issues, such as potential racial and economic bias in plans to colonize other planets.

Through the culturally relevant and sustaining strategies detailed above, students in groups that have traditionally been underrepresented in Earth and planetary sciences begin to see themselves as scientists. They are therefore more likely to pursue relevant post-secondary education and careers. These strategies can also be effective when applied in higher education classrooms.

What you can do. The greatest barrier between youth of color and scientific advancement is the lack of exposure to real science. You can address this by connecting with local students in your area. Share your research with K-12 teachers, so that their students can see the new and exciting ways scientific investigation is changing our understanding of the universe. Invite students into your lab so that they witness what science really looks like, and connect it to what they do in school and at home. Culturally responsive and sustaining educators are constantly seeking new, authentic ways to engage their students in science. The best source of this information are the scientists themselves, who can serve as role models for our next generation of diverse scientists.

Figure 1. Students visit a solar panel array.

Figure 2. Students analyze a model of the Sun's path through the year.

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