

Research on Teaching Geoscience with Virtual Field Experiences: Paper

Semken, S., Mead, C., Foley, K., Ruberto, T., Bruce, G., & Anbar, A. D.
Annual Review of Earth and Planetary Sciences, 2025, 53, 425-442

Polar Explorer: A place-based virtual learning environment to improve STEM undergraduate education (Invited)

D. Huntzinger, C. Mead, G. Bruce, K. Schaefer, M. Mack, W. Taylor, L. Thompson, R. Logan, V. Leshyk, and A. Anbar.
Session: ED24B Digital Learning Innovation in Earth & Space Science Ed: Promises, Pitfalls, & the Path Ahead.
AGU, 2024, Washington, DC Dec 9-15

Designing Digital Education Outreach for Astrobiology: You Are Not Alone

B. Hasty, D. Hunsley, B. Teece, G. Bruce, C. Mead, and A. Anbar.
Session: ED24B Digital Learning Innovation in Earth & Space Science Ed: Promises, Pitfalls, & the Path Ahead.
AGU, 2024, Washington, DC Dec 9-15

Tour It: Empowering educators with a new user-friendly storytelling medium to create their own virtual field trips

Bruce, G., Swann, J., Kirk, S., Narish, M., Hunsley, D., Tamer, A.J., Rauscher, T., Stummer, C., Mead, C., Anbar, A.,
Session: ED002 Amazing Technologies and Capabilities That Contribute to STEAM
AGU, 2023, San Francisco, California, Dec 11-15

Polar Explorer: A place-based virtual learning environment for STEM undergraduate education

D. Huntzinger, C. Mead, G. Bruce, K. Schaefer, M. Mack, W. Taylor, L. Thompson, V. Leshyk, and A. Anbar.
Session: ED004 Arctic Education & Outreach - Effective ways of engaging diverse learners in Arctic science.
AGU, 2023, San Francisco, California, Dec 11-15

The Value of Training Local Indigenous Educators to Create ESS Virtual Tours

A. Tamer, K. Steward, E. Macalalad, K. Tanaka, T. Kauai, K. Barcase, G. Bruce, D. Hunsley, C. Mead, and A. Anbar
Empowering a Diverse & Global Earth & Space Science Community Through Education & Public Engagement
AGU, 2023, San Francisco, California, Dec 11-15

In The Flow: An Immersive Experience Illustrating How Fluid Dynamics Connects Us Globally and Impacts Our Climate

T. B Oehmke, M. Rollins, A. Tamer, G. Bruce and A. Anbar,
Session ED31B - Amazing Technologies and Capabilities That Contribute to STEAM
AGU, 2023, San Francisco, California, Dec 11-15

Polar Explorer: An interactive virtual field trip-based exploration of Alaska and the changing Arctic

D. Huntzinger, C. Mead, L. Thompson, G. Bruce, A. D. Anbar, M. Mack, K. Schaefer, V. Leshyk, and W. Taylor
AGU, 2022, Chicago, Illinois, Dec 12-16

Tour It: Empowering educators with a new user-friendly storytelling medium to create their own virtual field trips

Narish, M., Kirk, S., Swann, J., Bruce, G., Hunsley, Rauscher, T., Stummer, C., Mead, C., Anbar, A.,
Session: ED003 Amazing Technologies and Capabilities That Contribute to STEAM
AGU, 2022, Chicago, Illinois, Dec 12-16

The importance of digital education

Anbar, A., The ETX Center etal.
AGU, 2022, Chicago, Illinois, Dec 12-16

Learning from the co-development of Earth & Space Science place-based, immersive experiences with native Hawaiian educators

Tamer, J., Barcase, K., Narish, M., Bruce, G., Mead, C., Anbar, A.,
AGU, 2022, Chicago, Illinois, Dec 12-16

Polar Explorer: An immersive virtual learning environment to educate students about the impacts of thawing permafrost

Leveraging Virtual Spaces for Geoscience Education: Exploration & Learning through Augmented & Virtual Reality
L. Thompson, D. Huntzinger, C. Mead, G. Bruce, A. D. Anbar, M. Mack, K. Schaefer, V. Leshyk, and W. Taylor
GSA, 2022, Denver, Colorado, Oct 9-12

Earth Science All Around: Using Immersive Virtual Field Trips with Place-Based Instruction in Earth & Space Science Ed

Ed Robeck, AGI et al.

The Earth Scientist Volume XXXVI Issue 1, National Earth Science Teacher association, 2021

Gamifying Virtual Exploration of the Past 350 Million Years of Vertebrate Evolution

G. Bruce, W. Taylor, C. Mead, S. Buxner, S. Semken, A. D. Anbar
Frontiers Manuscript, 2021

Giving Local Experts the Tools to Create Their Own Place-based, Digital Learning Experiences: A Case Study

Tamer, A, Bruce, G., Narish, M., Smith-Konter, B., Patao, L., Anderson, Traub, P., Kaupiko, K., Gomes, N., Anbar, A.,
AGU, 2021, New Orleans, LA, Dec 13-17

Tour It: Empowering educators to create their own virtual field trips with user-friendly technology

Narish, M., Swann, J., Bruce, G., Tamer, A.J., Rauscher, T., Stummer, C., Mead, C., Anbar, A.,
AGU, 2021, New Orleans, LA, Dec 13-17

Indigenous Voices Provide Context in Kilauea Virtual Tours

Tamer, A.J., Bruce, G., Narish, M., Smith-Konter, B., Anderson, A., Rowland, S., Gomes, N., Anbar, A.,
AGU, 2021, New Orleans, LA, Dec 13-17

Gamifying virtual exploration of the past 350 million years of vertebrate evolution:

Presenting effectiveness data from Surviving Extinction: Advances in Virtual Field Experiences

G. Bruce, W. Taylor, C. Mead, S. Buxner, S. Semken, A. D. Anbar
AGU, 2021, New Orleans, LA, Dec 13-17

Evolving concepts in virtual field trips: New capabilities and democratizing VFT creation

Mead, C., Ruberto, T. J., Bruce, G., Semken, S., Aggarwal, R., Anbar, A. D.
ESA, 2021, Long Beach, California, Aug 2-6

ASU Center for Education Through eXploration recognized nationally for innovative and effective student learning in virtual environments.

G. Bruce, W. Taylor, C. Mead, S. Buxner, S. Semken, A. D. Anbar
Arizona State University News, 2021, Tempe, Arizona, Jan 4

Creating virtual tours for environmental storytelling

J. Swann, S. Kirk, G. Bruce

ASU Knowledge Enterprise – Global Institute of Sustainability and innovation workshop

ASU, 2021, Tempe, Arizona, April 21/28

Stakeholder-Produced Virtual Field Experiences Can Contribute to Geoheritage

S. Semken, C. Mead, T. Ruberto, G. Bruce, R. Aggarwal, A. Anbar

GSA, 2020, Online, Oct 26-30

Democratizing Virtual Field Trips: Teaching Learners to Create Their Own Virtual Field Trips for Earth and Space Science and Sustainability

T. Ruberto, C. Mead, R. Aggarwal, G. Bruce, S. Semken, A.J. Tamer, A. Anbar

AGU, 2020, Online, Dec 1-17

Teaching and learning about Earth science and sustainability with student-created virtual field trips

A.J. Tamer, T. Ruberto, C. Mead, G. Bruce, S. Semken, R. Aggarwal, A. Anbar

AGU, 2019, San Francisco, Calif, Dec 9-13

Gamifying Virtual Exploration of the Past 350 Million Years of Vertebrate Evolution

G. Bruce, W. Taylor, C. Mead, S. Buxner, S. Semken, A. D. Anbar

Speaker, AGU, 2019, San Francisco, Oral session, Calif, Dec 9-13

Immersive, interactive virtual field trips promote science learning.

Mead, C., Bruce, G., Taylor, W., Semken, S., Buxner, S., & Anbar, A.

Journal of Geoscience Education, 67, 2019, DOI: 10.1080/10899995.2019.1565285.

Digital innovations in gamification, adaptivity, and rich learning design to virtually explore the past 350 million years.

G. Bruce, W. Taylor, C. Mead, S. Buxner, A. Anbar,

Invited Speaker Pardee Keynote, GSA, 2019, Phoenix, Arizona, Sept 22-25

Advancing 25 years of digital innovation - Exploring the evolution of 360° virtual field trips from Apple's human interface group to modern gamification and beyond.

G. Bruce, C. Oliver, W. Taylor, C. Mead, S. Semken, R. Summons, A. Anbar,

Invited Speaker Pardee Keynote, GSA, 2019, Phoenix, Arizona, Sept 22-25

Gamifying Virtual Environments to Explore the past 350 million years

G. Bruce, W. Taylor, C. Mead, A. D. Anbar

Invited Speaker, Future of Education for Virtual and Augmented Reality, 2019, Phoenix, Arizona, Sept, 19

Using game-based learning to explore the evolutionary pathways over the last 350 million years

G. Bruce, W. Taylor, C. Mead, S. Buxner, S. Semken, A. D. Anbar

Keynote Invited Speaker, North American Paleontological Convention, 2019, Riverside, Calif, June 23-27

Gamification using 360° spherical environments

G. Bruce, W. Taylor, A. Anbar

Speaker, IVRPA 2019, Belfast, Ireland, June 10-14

Immersive Interactive VFTs: Research Design and Implementation

C. Mead, G. Bruce, S. Buxner T. Ruberto, S. Semken, A. D. Anbar

Univ. of Michigan, 2019, Ann Arbor, Michigan, June

Immersive, interactive virtual field trips promote science learning

C. Mead, G. Bruce, W. Taylor, S. Semken A. Anbar,

Issue Journal of Geoscience Education, 2019 May (Vol 67, No. 2)

Implications of Learning Outcomes of In-Person and Virtual Field-Based Geoscience Instruction at Grand Canyon National Park

T. Ruberto, G. Bruce, S. Semken, K. Karlstrom, L. Crossey, T. Stoeberl, J. Calhoun, A. D. Anbar

Public Symposium, 2019 GCNP, Arizona, April 18-20

Mixed-Methods Research On The Implications Of Learning Outcomes For In-Situ And Virtual Geological Field Trips

C. Mead, G. Bruce, S. Buxner T. Ruberto, S. Semken, A. D. Anbar

GSA, 2019, Phoenix, Arizona, Sept. 22-25

**The Future Of Geoscience Education At Grand Canyon: More And More Diverse
Learners Will Experience It By Place-Based And Digital Means**

T. Ruberto, G. Bruce, S. Semken, K. Karlstrom, L. Crossey, T. Stoeberl, J. Calhoun, A. D. Anbar
GSA, 2019, Phoenix, Arizona, Sept. 22-25

The Cutting Edge of Personalized Learning

G. Bruce, M. Lerner, J. Tamer, A. Siddiqui
Speaker, Learning Innovation Summit 2018, NASA Ames Mt. View, Calif. June 15

Education Through Exploration: Lessons From Digital Active Learning At Scale

L. Horodyskyj, G. Bruce, D. Bratton III, C. Mead, T. Ruberto, S. Semken, A. D. Anbar
GSA Annual Meeting in Indianapolis, Indiana, USA - 2018

Game based learning using adaptive virtual field trips to explore the Mesozoic

W. Taylor, G. Bruce, S. Semken, C. Mead, L. Horodyskyj, A. Anbar
5th International Paleontological Congress, Poster, 2018, Paris, France, July 9-13

Virtual field trips that can teach by using 360° adaptive non-linear interactive environments

G. Bruce, W. Taylor, A. Anbar
Speaker, IVRPA 2018, Tokyo, Japan, May 28-31

Learning outcomes of in-person and virtual field-based geoscience instruction at Grand Canyon National Park: complementary mixed-methods analyses.

S. Semken, T. Ruberto, C. Mead, G. Bruce, S. Buxner, A. D. Anbar
AGU Fall Meeting, 2017 New Orleans, LA, Dec. 11-15

Online Geoscience Offline

L. Horodyskyj, G. Bruce, S. Semken, A. D. Anbar, and L. Hosman
Abstract, AGU, Fall Meeting, 2018, Washington, DC, Dec 10-14

Translating digitally immersive environments into meaningful learning experiences

J. Tamer, G. Bruce, C. Mead, S. Semken, A.D. Anbar
Virtual Worlds Conference, 2017 Melbourne, Florida, June 5-8

Bringing active field-based learning to scale in astrobiology: virtual field trips and adaptive courseware.

D. D. Bratton III, J. Hayes, D. Sarno, G. Bruce, L. Horodyskyj, C. Mead, D. Ben-Naim, A. D. Anbar
Abstract, Astrobiology Science Conference 2017, April 24-28, Mesa, Arizona.

Contrasting complementary learning outcomes of in-person and virtual field-based geoscience instruction at Grand Canyon National Park

Ruberto, Thomas, C. Mead, S. Semken, G. Bruce, S. Buxner, A.D. Anbar
GSA 2017 Seattle, Washington, Oct. 22-25

Online Geoscience Offline

L. Horodyskyj, G. Bruce, L. McAllister, S. Semken, A.D. Anbar, L. Hosman,
Abstract, Goldschmidt 2017 Paris, France, Aug. 13-18

Linking Immersive Virtual Field Trips with an Adaptive Learning Platform

G. Bruce, W. Taylor, A.D. Anbar, S. Semken, S. Buxner, C.Mead, E. El-Moujaber, R. Summons, C. Oliver
Abstract, AGU 2016 San Francisco, California, Dec. 12-16

Immersive, interactive virtual field trips promote learning

G. Bruce, C.Mead, S. Buxner, W. Taylor, S. Semken, J. Sundstrom, A.D. Anbar
Abstract, AGU 2016 San Francisco, California, Dec. 12-16

Complementary research on student geoscience learning at Grand Canyon by means of *in-situ* and virtual modalities

Ruberto, Thomas, S. Semken, C.Mead, G. Bruce, S. Buxner, A.D. Anbar
Poster, AGU 2016 San Francisco, California, Dec. 12-16

Reinvigorating the traditional “Historical Geology” Curriculum with Immersive Virtual Field Exploration of the History of Earth and Life

S. Semken, G. Bruce, C. Mead, S. Buxner, W. Taylor, T. Ruberto, A. Anbar.
Digital Poster, GSA 2016 Denver, Colorado, Sept. 25-28

Assessing STEM Learning and Engagement Through Virtual Field Trips and Experience Boxes

Taylor, W., Minitti, M., Buxner, S., Bruce, G., Hufford, M., Anbar, A. D.

47th Lunar and Planetary Science Conference, 2016, Woodlands, Texas, March 21-25

Interactive technology enabling a virtual exploration of our evolving planet

G. Bruce, A. Anbar, S. Semken, R. Summons, L. Horodyskyj, B. Kotrc, S. Buxner, J. Swann, S.K. Boonstra, C. Oliver

Digital Poster, AbSciCon 2015 Chicago, Illinois, June 15-19.

Complementary (not comparative) research on geoscience teaching and learning in virtual and in-situ field environments

S. Semken, G. Bruce, A. D. Anbar, S. Buxner, K. Karlstrom, and L. Crossey,

Abstract, GSA 2015 Denver, Colorado, Sept. 25-28.

iVFTs immersive virtual field trips for interactive learning about Earth's environment

Bruce, G., Anbar, A., Semken, S., Summons, R., Buxner, S., Oliver, C., Abstract / Oral,

AGU Fall Meeting. 2014 San Francisco, California. Dec. 15-19.

Virtual exploration of Earth's Evolution

Anbar, A., Bruce, G., Semken, S., Summons, R., Buxner, S., Horodyskyj, L., Kotrc, B., Swann, J., Klug-Boonstra, S., Oliver, C.,

AGU Fall Meeting. Abstract / Oral, 2014 San Francisco, California. Dec. 15-19.

Virtual field geological exploration in the Grand Canyon and beyond

Semken, S., Bruce, G., Anbar, A., Karlstrom, K., Crossey, L.,
Abstract / Oral, GSA Joint Rocky Mountain/Cordilleran Section Meeting. 2014, Bozman, Montana. May 20.

Virtual Field Exploration in Geoscience

Bruce, G., Semken, S., Anbar, A., Karlstrom, K., Crossey, L.,
Speaker / Oral, GSA Joint Rocky Mountain/Cordilleran Section Meeting. 2014 Bozman, Montana. May 20.

Explore and study Grand Canyon by immersive virtual field trip

Bruce, G., Semken, S., Anbar, A., Karlstrom, K., Crossey, L.,
Abstract / Digital poster, GSA Annual meeting 2014 meeting, Vancouver, British Columbia. Oct 19-20.

Virtual field exploration of Grand Canyon geology and geologic history

Bruce, G., Anbar, A., Semken, S., Karlstrom, K., Crossey, L.,
NSF-TUES grant VFT project comparing traditional classroom education with virtual geologic exploration,
Speaker, Australian Astrobiology 2013 meeting, Sydney, AU. July 1-2.

Virtual field exploration of Grand Canyon geology and geologic history

Bruce, G., Anbar, A., Semken, S., Karlstrom, K., Crossey, L.,
Speaker, GSA 2013 Abstracts with Programs 45: 399, Denver, Colorado, Oct. 27-30

Exploring the next generation of Virtual Field Trips in Astrobiology education

Bruce, G., Anbar, A., Summons, R., Oliver, C.A., (2013)

The ASU, MIT, Univ. of New South Wales, NASA VFT Education Project: Innovative technology behind the next generation of Virtual Field Trips in Astrobiology Education,

Invited speaker, Australian Astrobiology 2013 meeting, Sydney, AU. July 1-2.

Innovative technology behind the next generation of Virtual Field Trips in Astrobiology education

Bruce, G., Anbar, A., Summons, R., Cohen, P., Taylor, W., Oliver, C.A.,

The ASU, MIT, Univ. of New South Wales, NASA VFT Education Project: Innovative technology behind the next generation of Virtual Field Trips in Astrobiology Education

Speaker, Absscicon, Atlanta, GA. 2012, April 17-20.

Connecting the public to 'science in the making' via virtual reality and the Internet

Oliver, C.A., Fergusson, J., Bruce, G., Gaskins, T., Evans, R.

The NASA-Macquarie University Pilbara Education Project: Connecting the public to 'science in the making' via virtual reality and the Internet,

Invited paper, AGU Fall Meeting, San Francisco, CA. 2006 December 11-16.

Hi-tech tools capture astrobiology in the making at Mars analog site in Western Australia

Oliver, C.A., Fergusson, J., Bruce, G., Gaskins, T., Evans, R. (2006) *Hi-tech tools capture astrobiology in the making at Mars analog site in Western Australia,*

UK Astrobiology Conf., University of Kent, UK, April 18-21.

A hi-tech approach to astrobiology education

Oliver, C.A., Fergusson, J., Bruce, G., Gaskins, T., Evans, R.

NASA Macquarie University Pilbara Education Project: A hi-tech approach to astrobiology education,
AbSciCon 2006, Washington DC, March 27-30.

Getting connected to the future: It's virtually here,

Oliver, C.A., Fergusson, J., Bruce, G., Gaskins, T., Evans, R.

Getting connected to the future: It's virtually here,

CONTACT Cultures of the Imagination 2006, NASA ARC, Mountain View, CA, March 17-19.

The NASA-Macquarie University Pilbara Education Project:

Connecting the public to 'science in the making' via virtual reality and the Internet

Oliver, C.A., Fergusson, J., Bruce, G., Gaskins, T.

AGU, 2006, San Francisco, CA, Dec 10-15