The Language of Amateur Radio; A Paradigm Shift For Survival

Amateur Radio is often referred to as a "hobby." A better word might be "Enterprise." Some claim this is a misnomer because it refers to business. A broader view of the word enterprise includes synonyms like courageous act, initiative, undertaking, voluntary action, etc.

Radio Amateurs take for granted the technical and scientific aspects of our "Enterprise." To survive Amateur Radio needs young adults who enthusiastically embrace our form of radio communication. To appeal to this youthful demographic and replenish our ranks we must communicate all of the Science, Technology, Engineering and Math (MATH) learning opportunities inherent in Amateur Radio.

In other words we need to expand our vocabulary to encompass ideas that fit into teaching curriculum, particularly in Middle School and High School classes.

Research shows that mainstream education in the U.S. seldom embraces Amateur Radio as a feature-rich mode of STEM learning. ARRL's School Club Roundup contest reveals an extremely small participation rate in such populous states as California, Texas and Florida. Literature searches of education databases confirm the lack of Amateur Radio activities in schools.

There are notable, even excellent examples of local Amateur Radio groups making inroads into classrooms helping students learn STEM topics using Amateur Radio as a teaching tool. These efforts need to be documented and widely published to influence decisionmakers within the K-12 education community to adopt Amateur Radio as a core teaching tool in STEM learning.

Conference Theme: "The Auroral Connection: How does the aurora affect amateur radio, and what can we learn about the aurora from radio techniques?"

1

Conference Implication: Amateur Radio contributes to Science, proving just one aspect of "Ham" Radio's applicability to STEM education curriculum and it's value to society.

2

This paper is just one example of several hundred+ references returned by a Google Scholar allintitle: "amateur radio" search

Ionospheric Sounding Using Real-Time Amateur Radio Reporting Networks
All authors are licensed Amateur Radio Operators

Nathaniel A. Frissell	W2NAF	Currently: HamSCI Lead, Asst. Prof., Dept. of Physics and Electrical Engineering, **University of Scranton**
Ethan S. Miller	K8GU	Member of the professional staff at **JHU/APL.**
Stephen Kaeppler	AD0AE	Center for Geospace, Postdoctoral Fellow at **SRI International**
Felipe Ceglia	PY1NB	Businessman with interest in information technology and ham radio
Dave Pascoe	KM3T	Avid ham radio operator and independent computer consultant with a keen interest in radio propagation research.
Nick Sinanis	F5VIH SV3SJ	Engineer in the Radio-communication Bureau of the **International Telecommunication Union**.
Pete Smith	N4ZR	**Retired NASA** official, long-time amateur radio operator and co-founder of the Reverse Beacon Network.
Richard Williams	W3OA	**Retired Air Force Colonel and NASA official** who wrote and maintains the software that forwards station received information from CW Skimmer to the Reverse Beacon Network server.
Alex Shovkoplyas	VE3NEA	Owner of **Afreet Software, Inc.**

Space Weather, Volume12, Issue12, December 2014, Pages 651-656

3

Overview of Possible STEM Curriculum Topics Derived From Amateur Radio

- Antennas and Propagation
- Computers, Software and Internet Linking
- Digital Data and Voice Modes via Radio
- Discipline and Rigor of Radio Operations
- Electromagnetic Spectrum
- Electronic Components, Circuits and Functions
- Governance (FCC Rules and Regulations et al.)
- Human Communications Skills
- Mathematics (Ohm's Law to Maxwell's Equations, etc.)
- Radio Frequencies (LF to Microwave) Characteristics
- Satellite Orbits, Tracking and Communication
- Space Communications (EME, ISS, etc.)
- Space Weather and Solar Effects

4

A Sampling of QEX Technical Topics

ARRL's QEX publication is "The Forum for Communications Experimenters."

- Automated Method for Measuring Quartz Crystals
- Baseband Quadrature Multi-Band Modulator
- Broadband HF Antenna Designs
- Digital Transceiver as a Vector Network Analyzer
- Drive Level Sensitivity of Quartz Crystals
- Finding Signals in the Noise Using Two Antennas
- Frequency Dependence of Equivalent Series Resistance Measurement
- Frequency Synthesis and Impacts on Receiver Performance
- GPS to Fine-Tune a Rubidium Frequency Standard
- Half Wavelength versus Quarter Wavelength Vertical Antennas
- High Speed Conversion in SDR
- Line-of-Sight Signal Path Analysis Using Google Earth
- Mathematical Stability Problems in Modern Nonlinear Simulation Programs
- Microwave Transverter Controller
- Model for Sporadic E: Meteors + Wind Shear + Lorentz Force
- Multi-Element End-Fire Arrays of Loops
- Novel Impedance Measurements
- Octave for T- and Pi- Networks
- Pi Networks With or Without Inductor Loss
- Precision DDS for Frequency Measurement
- SDR Noise Reduction & Adaptive Filters
- TDOA System for Transmitter Localization
- Unusual Multi-Band WSPR Transmitter
- Using Time Domain Reflectometry for Transmission Line Impedance Measurement
- Versatile Double Balanced Mixer
- Wide Dynamic Range Field Strength Meter

5

Applied Research Performed by Amateur Radio Manufacturers?

- ABR Industries
- ACOM Amplifiers
- Alinco
- Alpha Delta Radio Comm. LLC
- Ameritron
- Anderson Power
- Arcom Communications
- Array Solutions
- Belden
- Bird RF Products & Solutions
- BridgeCom Systems
- Comm. Concepts, Inc.
- Cutting Edge Enterprises
- Diamond Antenna
- Diawa/Comet et al.
- Doppler DF Instruments
- DX Engineering
- Elecraft
- Elk Antennas
- Expert Linears America, LLC
- FlexRadio Systems
- Hammond Manufacturing
- ICOM America
- Intuitive Circuits, LLC
- Kenwood Communications
- LDG Electronics
- MFJ Enterprises, et al.
- Morgan RF Systems
- OCI-Olds Comm. Inc.
- Pacific Antenna
- Palomar Engineers
- PolyPhaser Corporation
- preciseRF
- Rig Expert
- RF Parts Company
- RT Systems
- Samlex America
- Synthetic Textiles Inc.
- SteppIR Comm. Systems
- Tigertronics
- Times Microwave
- Timewave Technology, Inc.
- West Mountain Radio
- Yaesu USA

6

Why aren't FCC, NIST or NTIA included here?

GOALS FOR AMERICAN STEM EDUCATION
* Build Strong Foundations for STEM Literacy *
* Increase Diversity, Equity, and Inclusion in STEM *
* Prepare the STEM Workforce for the Future *

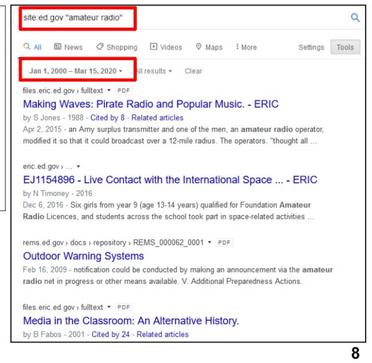
Pathways	Objectives	DOC	DOD	DOE	DOI	DOL	DOS	DOT	ED	EPA	HHS	NASA	NSF	SI	USDA
Develop and Enrich Strategic Partnerships	Foster STEM Ecosystems that Unite Communities	●	●	●	●		●	●	●	●	●	●	●	●	●
	Increase Work-Based Learning and Training through Educator-Employer Partnerships	●	●	●	●	●		●	●	●	●	●	●	●	●
	Blend Successful Practices from Across the Learning Landscape	●	●	●			●	●	●				●	●	●

Progress Report on the Federal Implementation of the STEM Education Strategic Plan
A report by the Office Of Science And Technology Policy, October 2019

7

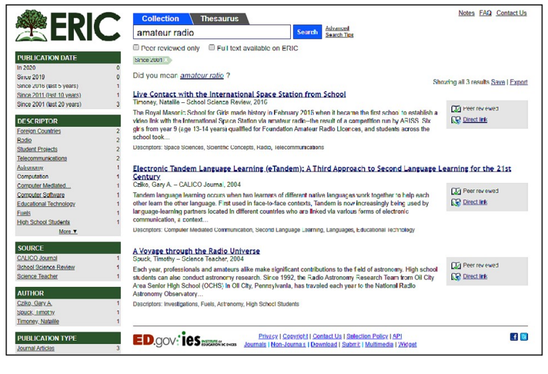
Is mainstream education IGNORING a highly relevant STEM teaching tool?

A highly targeted Google search of the entire ed.gov web site limited to the the past 20 years did not uncover any directly relevant results related to the use of Amateur Radio as a teaching tool.



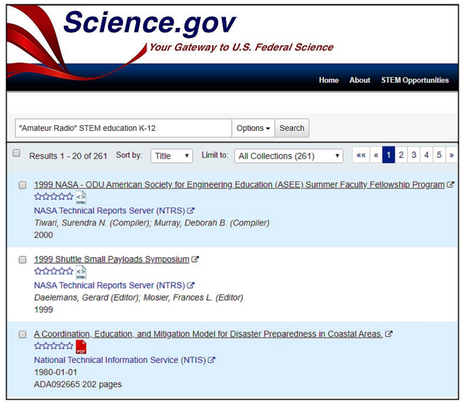
8

U.S. Dept. of Ed. EXCLUDING a highly relevant teaching tool for STEM learning?



9

Additional evidence of NEGLECT?



10

Conclusion:

Wider Incorporation of Amateur Radio in STEM Curriculum Will Enhance U.S. Education and Increase Participation in Ham Radio

Science Citizen Investigation (HamSCI)

11

Path Forward:

1-Locate and document the best local school programs using Amateur Radio as a core component of STEM education in the classroom.

2-Consolidate and publish a controlled circulation bimonthly magazine (Amateur Radio STEM Education) directed toward local school board executives.

3-Use ARRL's organizational power to lobby state education officials to incorporate Amateur Radio STEM education programs.

12