

RECOMMENDATIONS

For Researcher Related Resources

Resources for researchers should support increasing general knowledge of K-12 standards and effective communication of data to different audiences.

1) Professional Development Opportunities (Meeting & Webinar Format)

Future professional development opportunities could be valuable for not only researchers at OSU, but other researchers and those coming to utilize the R/V Taani in their research efforts. This professional development could be useful if designed as a “one stop shop” for outreach information. This PD should focus on introducing researchers to what level of language and attention is appropriate for a variety of audiences. For example, introducing researchers to a variety of outreach techniques including utilizing social media, informal engagements like pub talks, as well as teaching in a formal learning environment. This could potentially lead into coverage of the Next Generation Science Standards, giving researchers a background on what students should theoretically already know by the time they have reached a certain grade, as well as education goals for various grade levels. It is also essential that researchers understand the three key themes for “good data” identified by teachers so they can design data-focused learning activities in a format that tells a story while being easy to utilize.

Once a foundation has been established, researchers could then work collaboratively with each other and potentially other education professionals to design activities based around their own work. In speaking with professional development providers, it was clear that these opportunities are most effective when spread out over a few days, providing a large amount of time for collaboration and reflection from participants. A 2004 study identifying best practices for communication workshops angled toward scientists utilized the following structure, which they call OPERA. Opening a question of interest, Prior knowledge discussion or assessment, Exploration through experiments/experiences, Reflection on results, Application of learned concepts to new situations (Morrow & Dusenberry, 2004). Using a similar four-day design structure, a potential professional development meeting schedule could be,

- Day 1: Welcome, Introduction to Outreach Efforts, Assessing Misunderstandings
- Day 2: Informal Learning and Formal Learning Environments
- Day 3: State Standards
- Day 4: Applying Skills: Designing Activities Using Your Research

Since researchers expressed a lack of time as one of their key barriers, it may be difficult for them to find space in their schedules to attend professional development meetings. In order to provide the same critical information, but in a format that is easier to access, compiling the same information into a webinar series is another potential route of communication.

Webinars focused on science communication are a commonly used method for programs, such as the American Geophysical Union, American Water Resources Association, Materials Research Society, National Oceanic and Atmospheric Administration (NOAA), and the University-National Oceanographic Laboratory System (UNOLS). Webinars could be

focused on a variety of topics surrounding K-12 outreach, and be posted to a website to allow researchers to watch when they can. In a 2015 study regarding the way scientists could achieve broader impacts through K-12 collaboration, researchers identified the importance of supporting knowledge regarding K-12 in scientists, as well as encouraging scientists to collaborate with teachers (Komoroske et. al., 2015). These findings help to inform this list of possible topics:

- Week 1: Overview of Topics & Introduction to Outreach Techniques
- Week 2: Focus on Informal Learning
- Week 3: Focus on Formal Learning
- Week 4: Introduction to NGSS
- Week 5: Working with Teachers
- Week 6: Designing Your Own Activities

2) Outreach Quick Guides

For researchers who are already confident in outreach, interested in a particular outreach topic, or just don't have the time for a meeting or webinar, providing a series of short guides via a website is a third option for providing the information. Each guide would need to be a compilation of information on each topic mentioned above, albeit in a condensed format. Providing additional resources in the guide such as example activities, FAQ's, videos, and "how to" information could be provided in order to supplement the condensed information. The University Navigation Satellite Timing and Ranging Consortium (UNAVCO) offers a similar resource to this, offering a series of worksheets and handouts covering topics such as planning for a social media strategy, tips for communicating their science broadly, and assistance in mapping how scientists research may connect with a potential audience (*Science Communication / Education*).

For Teacher Related Resources

Resources for teachers also should be aimed at increasing knowledge and support, and decreasing the amount of time they need to devote to implementing RTD in their classroom.

1) Professional Development Opportunities

Data-focused professional development opportunities for educators are crucial to the success of the data-focused education and outreach efforts. There are few existing data-focused PD opportunities for Oregon teachers, with the most recent being the 2018 MBARI EARTH Workshop, which rotates its location each year. Interviews with professional development providers identified topics that would make a successful PD experience including duration, incentives and content. The review of eight years of MBARI EARTH pre surveys, as well as the 2018 post surveys provided additional insight on what was attractive about the workshop, how their comfort levels using data changed over the course of the workshop, and how their perceived knowledge about oceanographic topics changed over the course of the workshop. These two data-sets combined with teacher interviews support the following recommendations for a data-focused PD event:

- The event ideally would take place in late June, when teachers are finishing their current school year, or August, as they prepare for a new school year

- The duration of the event should last over multiple days, preferably lasting from 3-5 days.
- The attendance should be kept to an average of 20 teachers, in order to provide them with equal support
- To attract teachers to the event some sort of incentive should be offered, such as
 - Stipends
 - Take-home Materials (lesson plans, contact information and branded materials, like stickers)
 - Provided Meals
 - Opportunities to Collaborate (with researchers and/or other teachers)
 - Field Trips or excursions (for example, touring a research vessel)
- Introduce teachers to oceanographic research, particularly focusing on local topics
- Teach between 1-3 data-focused lesson plans step-by-step with teachers, walking them through each activity and allowing them to ask questions as you go. Step by step instructions on where to locate data and navigate any websites should be included
- Following up with teachers “learning cohort” post workshop to answer any questions, request feedback on the workshop and provide additional support

2) Data-Focused Lesson Plans

Effective lesson plans are a valuable resource for Oregon teachers, and should be designed to accommodate a variety of subjects, knowledge levels and state standards. Currently, the lesson plans offered by the RCRV education and outreach team are single activities aligned to the Next Generation Science Standards, and range across a variety of topics such as marine mammals, ocean acidification, ship engineering and the axial seamount. All lesson plans are listed together, so to provide a level of cohesion and simplify the selection process for teachers, the lesson plans available should be organized be either subject or topic/issue, similar to NOAA’s Data in the Classroom Portal. For example, organizing them by subject could be,

- Biology – *In the Belly of the Whale, Plastic Soup, Voices from the Deep, You Are What You Eat, The Secret Life of Plankton*
- Chemistry – *Taking the Temperature of the Ancient Oceans, Mystery of the Disappearing Shells: Dude Where’s my Shell?*
- Engineering – *Engineering a Solution to Marine Debris, Build a Boat for Scientific Research, Mission Submersible*
- Geology – *Volcanoes: The Ring of Fire in the Pacific Northwest, The Axial Seamount; Life on a Vent*

Alternatively, lesson plans could be organized by topic or issue.

- Ocean Acidification - *Taking the Temperature of the Ancient Oceans, Mystery of the Disappearing Shells: Dude Where’s my Shell?*
- Plastic Pollution - *Engineering a Solution to Marine Debris, Plastic Soup, You Are What You Eat*
- Marine Mammals - *In the Belly of the Whale, Voices from the Deep*
- Plankton – *The Secret Life of Plankton*
- Geology of Oregon - *Volcanoes: The Ring of Fire in the Pacific Northwest, The Axial Seamount; Life on a Vent*

- Research Vessels - *Build a Boat for Scientific Research, Mission Submersible*

Once current lesson plans have been organized, there should also be considerations taken into account when designing future activities. To fully support data literacy of Oregon students, the RCRV team could be successful in implementing lesson plans that foster learning using both canned data and real-time data. Activities should be first run using the canned data to allow teachers to assess existing levels of data literacy, and then through a second activity or through an extension, incorporate real-time data. This way, students get used to working with data that is consistent and predictable, and are better prepared to work with real-time data.

An example of a potential data-focused activity could be utilized with water quality data from a CTD. Using canned data, students could learn about how water quality affects the ecosystem, practice graphing temperature and salinity against depth, infer the relationship between the three measurements, and learn about water quality research. Once students had finished this activity, real-time water quality data from the R/V *Taani* could then be incorporated and allow students to explore deeper.

Once lesson plans have been finished, they should be tested and evaluated with local teachers for effectiveness. Currently, lesson plans are piloted with SMILE teachers, who potentially have a higher interest and use of data in the classroom. Other teachers outside of SMILE should be included in the review process, to accurately reflect the broader teacher population.

3) Educator Portal

The best way to provide teachers with lesson plans and information about PD opportunities is through a web portal. Ideally, this portal would be linked off of the main RCRV website, to reduce clicks to content (1-2 clicks) and time spent locating lesson plans or data. If and when the educator portal is completed, a focus group or survey should be conducted on its effectiveness with local teachers. Overall, effective educator portals would have,

- A link for teachers when they require additional help, such as “need help?” or “more help here” link
- Step by step instructions on how to navigate the website, as well as how to locate and download data (if possible, this would be especially helpful in video format)
- Lesson plans organized and searchable by topic, subject or state standard
- Contact information for someone to answer teacher questions (“connect with us”)
- Contact information for researchers interested in classroom participation (“connect with a researcher”)
- Information on upcoming professional development opportunities
- Video resources including: vessel building efforts, research efforts, or videos of researchers talking about their work
- Links to any social media pages or blogs
- An email list, where teachers receive information on upcoming events, lesson plans, etc.

4) Increased Presence at Educator Conferences & Events

Since many teachers were not aware of either the RCRV project or where to locate data to use in their classrooms, it could be valuable to have an increased RCRV presence at educator conferences such as the National Science Teacher Association (NSTA) meeting and the

Oregon Science Teacher Association (OSTA) meeting, as both of these were identified by MBARI EARTH participants as valuable events for dissemination of materials. PD providers identified the value in bringing incentives for educators during outreach, thus, there could be an “educator conference kit” with lesson plans, stickers, RCRV pamphlets, links to websites and other materials prepared in advance for these sorts of events.

Other Recommendations

To best assist this data-transfer process, there are two additional recommendations;

1) Taking Advantage of Social Media

To reach an even wider audience and spark interest in the RCRV project, social media channels should be utilized.

- Instagram can be used to share exciting pictures of the vessel building process, and research aboard the vessel once it is fully operational
- Twitter can be used to share links to research involving the RCRV project, as well as sharing links to blogs and providing general updates
- Facebook could be used to also share pictures and links, but could also be updated with information about educational resources
- Selecting a hashtag to use across all social media channels provides cohesion and makes it so audiences can search for the project with one cue. For example, “#RVTaani”

2) Education and Outreach Liaison(s)

Having a permanent, designated employee(s) to oversee the education and outreach efforts would be a valuable asset. Ideally, this liaison would have experience in local marine science as well as both formal and informal learning. The liaison would be the central point person for all R/V Taani education and outreach efforts, once the current education and outreach team has concluded their work. The idea of an education liaison or an outreach contact is used by other research vessel programs such as the Nautilus, or the educator at sea program on the JOIDES Resolution. In this scenario, the primary responsibilities of a liaison(s) could include:

- Managing social media accounts
- Assisting researchers in their outreach efforts both onboard and onshore
- Answering any teacher questions regarding the website or lesson plans
- Helping to design and pilot lesson plans
- Attending educator conferences
- Running professional development opportunities
- Reporting education and outreach effort information to the other stakeholders.