Science Outreach: Findings and Best Practices

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The Importance of Community Engagement

“Public scholarship is central to the mission of land–grant universities and colleges of agriculture... the future of public higher education institutions increasingly will depend on strong institutional commitment to engagement with the community.”

(Bagdonis & Dodd, 2010)

Broader Impacts: Extending Scientific Knowledge

"NSF values the advancement of scientific knowledge and activities that contribute to the achievement of societally relevant outcomes."

Including…

"improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science"

(National Science Foundation, 2013)

Addressing Agricultural Literacy

- Increasing complexity of agricultural production
- Disconnection of public from agriculture/urbanizing population
- Declining public support for agricultural research
- More positions available in agriculture than youth pursuing them

(Doerfert, 2011; National Academy of Sciences, 2009; Virginia Cooperative Extension, 2010, USDA 2013)

Improving Higher Education

"USDA recognizes the importance of recruiting, cultivating, and developing the next generation of scientists, leaders, and a highly skilled workforce for food, agriculture, natural resources, forestry, environmental systems, and life sciences."

(UDSA, 2013)

- Incorporate agriculture into core curricula
- Improve recruitment & retention in agriculture majors
- Better prepare faculty for innovative teaching & course development
- Strengthen collaboration between academia and other sectors

(Doerfert, 2011; National Academy of Sciences, 2009; Myers & Washburn, 2008).

Increasing K-12 Outreach

"Colleges and universities should reach out to elementary-school and secondary-school students and teachers to expose students to agricultural topics and generate interest in agricultural careers"

(National Academy of Sciences, 2009)

- Engage more youth in agriculture, especially at the elementary level
- Update curriculum to connect to current research, address modern socio-scientific issues, and integrate applications of STEM content
- Incorporate agricultural applications into science and math classes

(Doerfert, 2011; Spindler & Greiman, 2013; Myers & Washburn, 2008; Williams, 1998, USDA, 2013, 2015).

What is Outreach?

"Efforts by colleges, universities, research centers, museums, or science centers to provide technical, material, or personnel resources to precollege education settings, both formal (in classrooms with teachers) and informal (in museums, science centers, and science clubs)."

(Dolan, 2004)

Table 1.1 The continuum of university-based K-12 education outreach and engagement activities

Table 1.1

Outreach Activities					
	Providing materials	Guest lectures	Teacher professional development workshops	Research experience for teachers	Ongoing collaborations
	Providing information	Ask-a-scientist	Equipment loan	Research experience for students	Teacher / scientist exchange programs
	Judging science fairs	Advising on / providing materials for science fairs	Co-teaching Mentoring students in science fairs	Support for teachers making conference presentations	Outreach training for scientists (e.g., GK-12)
	Awareness	**Involvement**	**Support**	**Sponsorship**	**Strategic Partnership**

(Dolan, 2008)

Benefits of Outreach

Youth

- **Opportunity to participate in engaging, hands-on science activities**
- **New views about nature of science & scientists' work**
- Access to scientists as role-models
- Potential increases in student achievement
- Improvement in student attitudes about science
- Increased interest in & likelihood of pursuing a science career

Educators

- **Access to current science**
- **Deeper knowledge & coverage of science content**
- Energy/enthusiasm added to classroom environment by visitor
- Understanding/coverage of new material to the teacher
- Increased confidence with scientific inquiry
- Access to faculty expertise, scientific technology & resources

Scientists

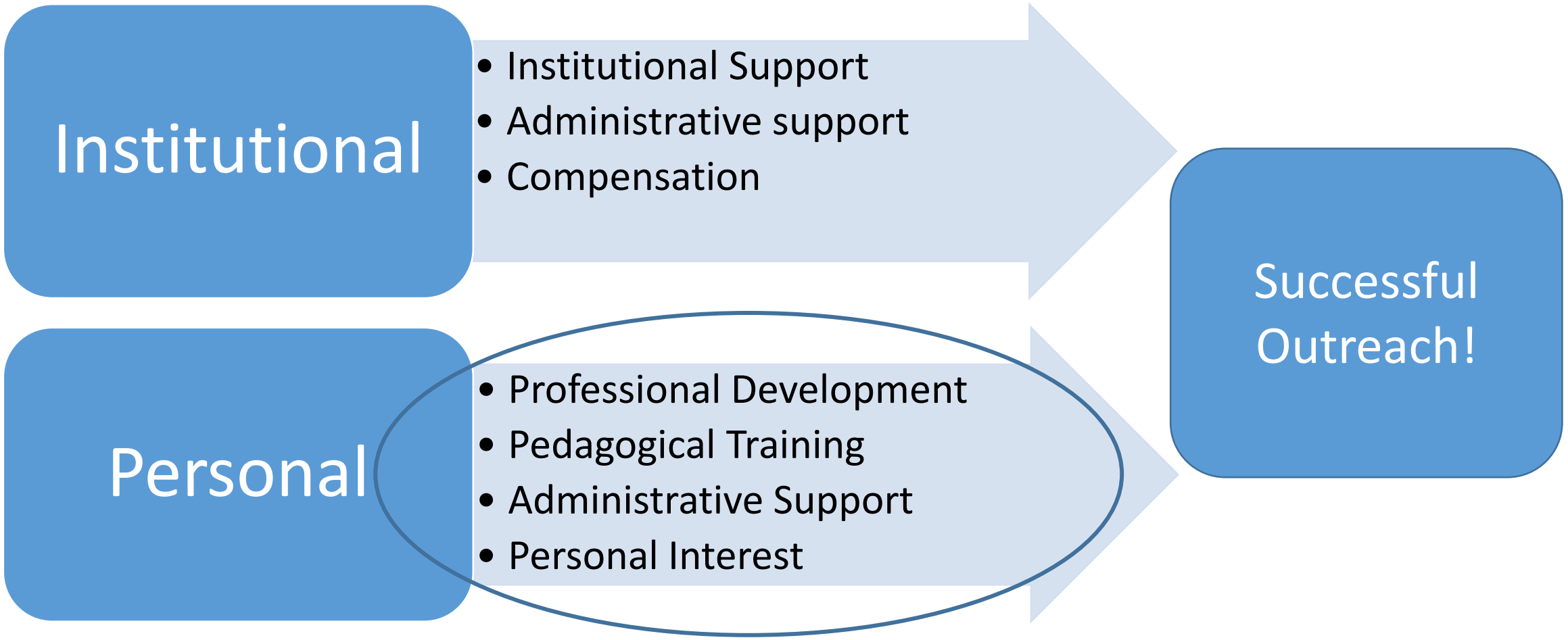
- **Increased comfort communicating to non-scientists**
- **Increased comfort working with stakeholders**
- **Renewed energy/interest in their own scientific work**
- Deeper understanding of teaching, learning, & education
- Improved university teaching: use of inquiry-based methods

Challenges to Effective Outreach

Institutional	Personal
• Time • Resources • Priorities • Communication • Trust	• Simplifying scientific language • Differentiating instruction • Incorporating inquiry-based learning and other student-centered pedagogy • Managing time

(Dolan et. al., 2004; Dolan, 2008; Foster et. al., 2010; Montano, 2010; Zhang et. al., 2011; National Academy of Sciences, 2009)

Overcoming Challenges



(Burrows et. al., 2009; Bouwma-Gearhart et. al., 2014; Dolan et. al., 2004; Dolan, 2008; Zhang et. al., 2011)

Training Graduate Students

"Particular attention should be paid to preparing the next generation of faculty [to teach/communicate effectively] by providing appropriate training to graduate students and postdoctoral researchers."

(National Academy of Sciences, 2009).

"Graduate students in life science programs [in a major land grant college of agriculture] were significantly less likely to know about the land–grant mission, as well as significantly less likely to participate in extension and outreach activities, than graduate students in social science programs."

(Bagdonis & Dodd, 2010)

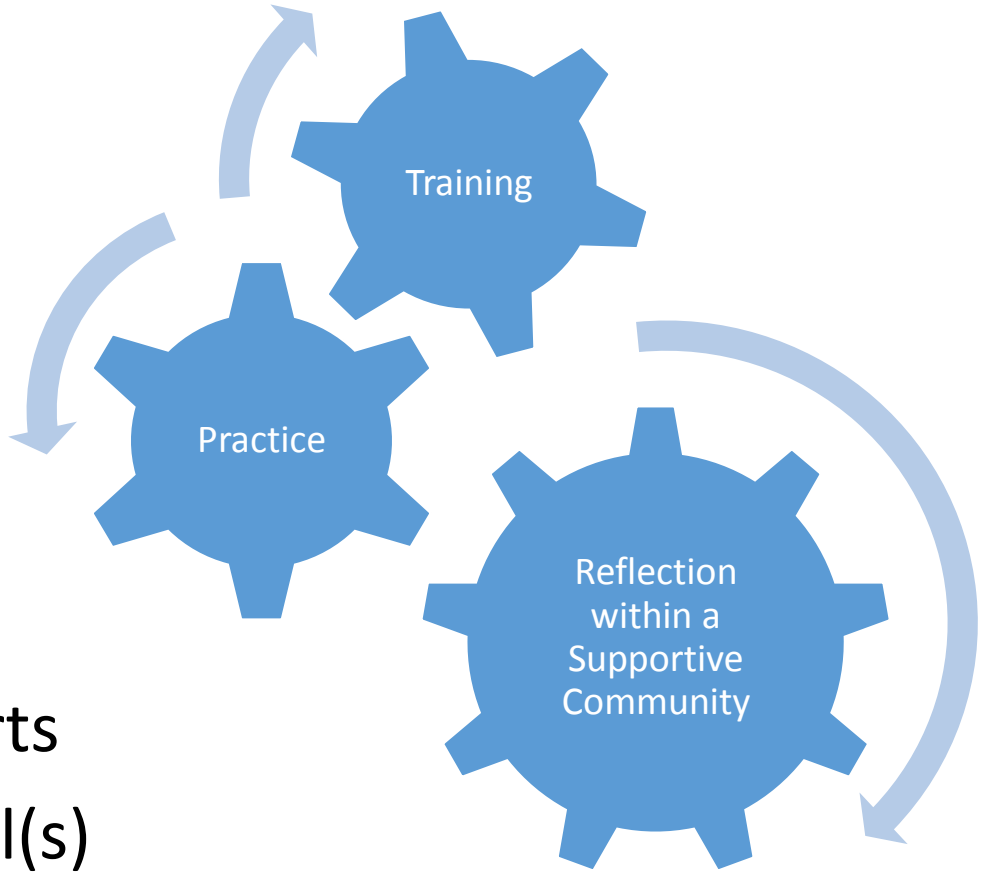
Training Graduate Students

Benefits	Challenges
• Better preparation for full range of future responsibilities • Enhanced time-management, communication, & teaching skills • Enhanced undergraduate teaching • Interest in persisting with outreach	• Simplifying scientific language • Employing effective pedagogy • Time management • Advisor support

(Austin, 2002, Burrows et. al., 2009; Crone et. al. 2007; Burrows et. al., 2009; Montano, 2012; Bruce et. al., 1997; Collins, 2011; Buck et. al., 2006)

Training Graduate Students

- Cohort/community of practice
- Workshops, seminars, or courses
- Authentic opportunities to practice
- Participation with community partners
- Opportunities to reflect on experience
- Supportive mentoring relationships w/experts
- Availability of engaged resource professional(s)
- Ongoing evaluation for continuous improvement



(Collins, 2011; Crone et. al., 2011; Buck et. al., 2006; Burrows et. al., 2009; Montano, 2012)

Conclusions:

“We have found this course to be engaging for both the students and instructors, as well as providing opportunities for learning about informal science education not available elsewhere. We encourage others to consider ways to enhance informal science education expertise in future senior STEM researchers through training efforts targeting STEM students and young professionals.”

(Crone et. al., 2011)

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