Energy Literacy: NARA and Imagine Tomorrow

Liv Haselbach
Associate Professor of Civil and Environmental Engineering,
Washington State University (WSU)
Associate Director of the Center for Environmentally Sustainable
Transportation in Cold Climates (CESTiCC)
haselbach@wsu.edu

Acknowledgments

- NARA is led by WSU and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture. https://www.nararenewables.org/

- Imagine Tomorrow High School Energy Competition is led by WSU and supported by generous contributions from many companies, grants, individuals, etc. http://imagine.wsu.edu/

- Imagine Tomorrow Assessment is funded by EcoWorks, BofA, CESTiCC (US DOT University Transportation Center for Environmentally Sustainable Transportation in Cold Climates), etc. http://ine.uaf.edu/cesticc/ , http://www.ecoworksfoundation.org/

Outline

- NARA Overview
- NARA Education Overview
  - Facing the Future
  - MOSS
- Imagine Tomorrow
  - Energy Literacy
  - Bioenergy Literacy
  - Other Assessments
  - Historical Demographics

Wood to Wings

Envisioning an Aviation Biofuels Industry from Forest Residuals

NARA: Northwest Advanced Renewables Alliance

USDA National Institute of Food and Agriculture
Agriculture and Food Research Initiative
Coordinated Agriculture Project

August, 2011 – July 2016

USDA

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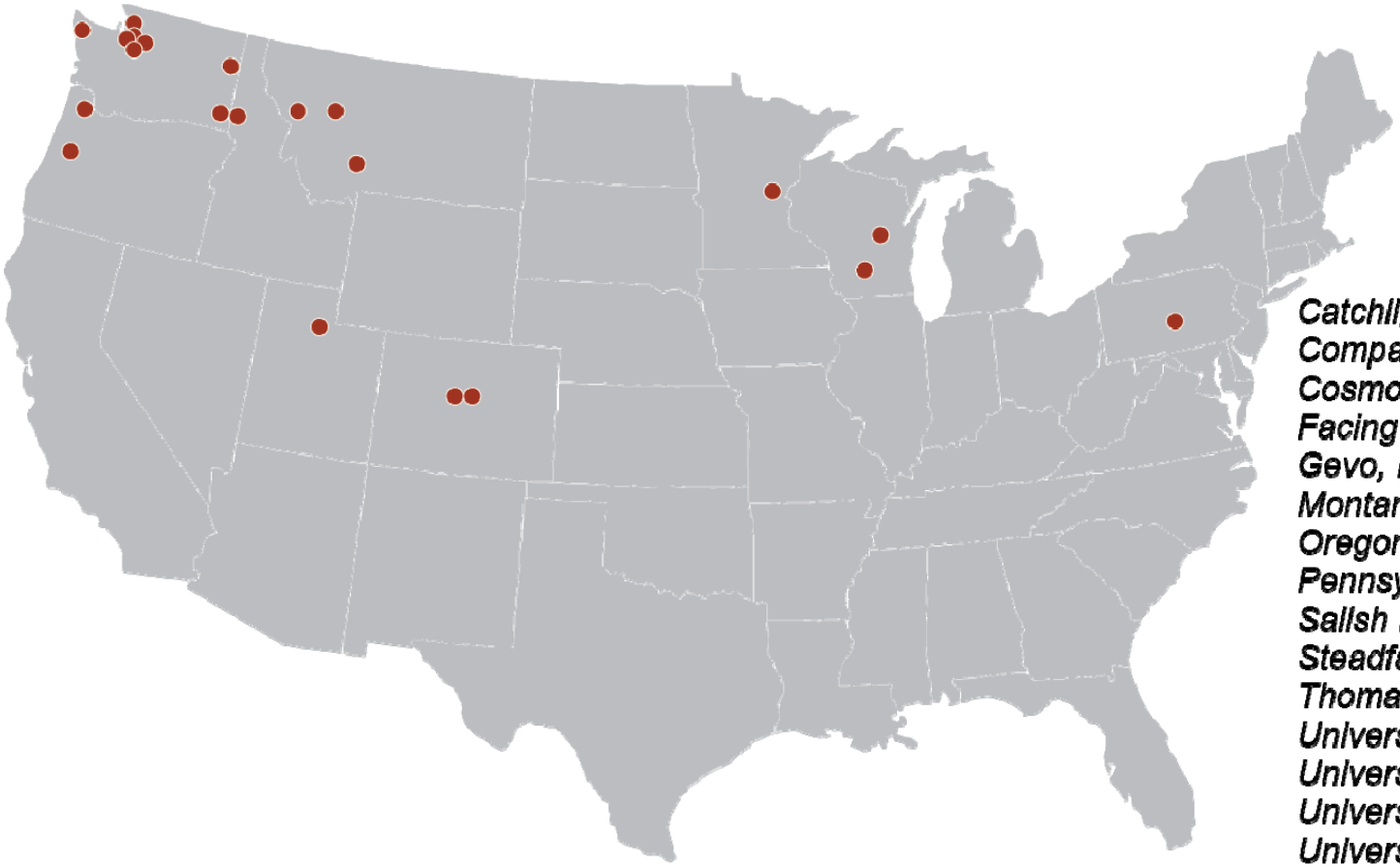
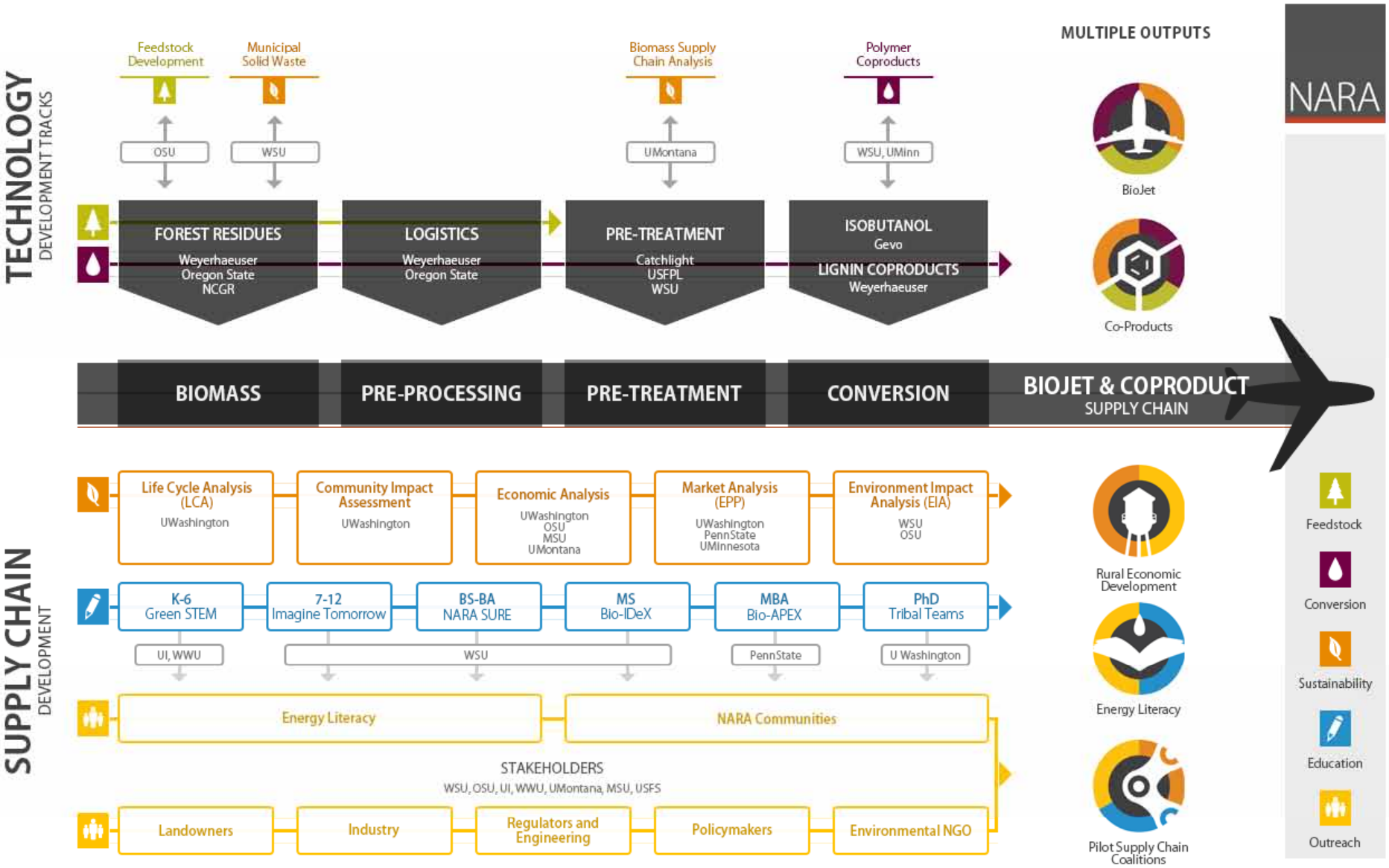
NARA Team



Catchlight Energy
Compañía Logística de Hidrocarburos
Cosmo Specialty Fibers
Facing the Future
Gevo, Inc.
Montana State University
Oregon State University
Pennsylvania State University
Salish Kootenai College
Steadfast Management
Thomas Spink International
University of Idaho
University of Minnesota
University of Montana
University of Utah
University of Washington
University of Wisconsin-Extension
USFS - Forest Products Lab
USFS - PNW Research Station
Washington State University
Western Washington University
Weyerhaeuser

Feedstock | Conversion | Sustainability | Stakeholders | Education

NARA Team & Goal Diagram

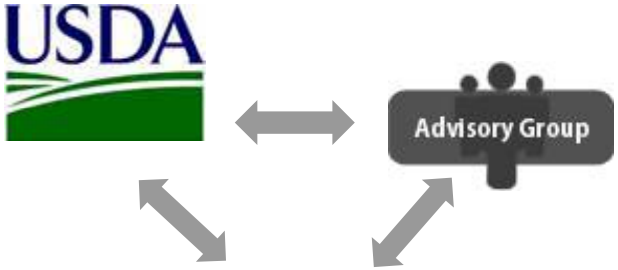


IMPROVE: Step-by-Step Efficiencies

IMPROVEMENTS THROUGHOUT THE SUPPLY CHAIN

NARA

Northwest Advanced Renewables Alliance



Active Stakeholders

Pilot Supply Chain Study Regions

Project Team

Leadership Team

Co-PIs

Engagement Mechanisms

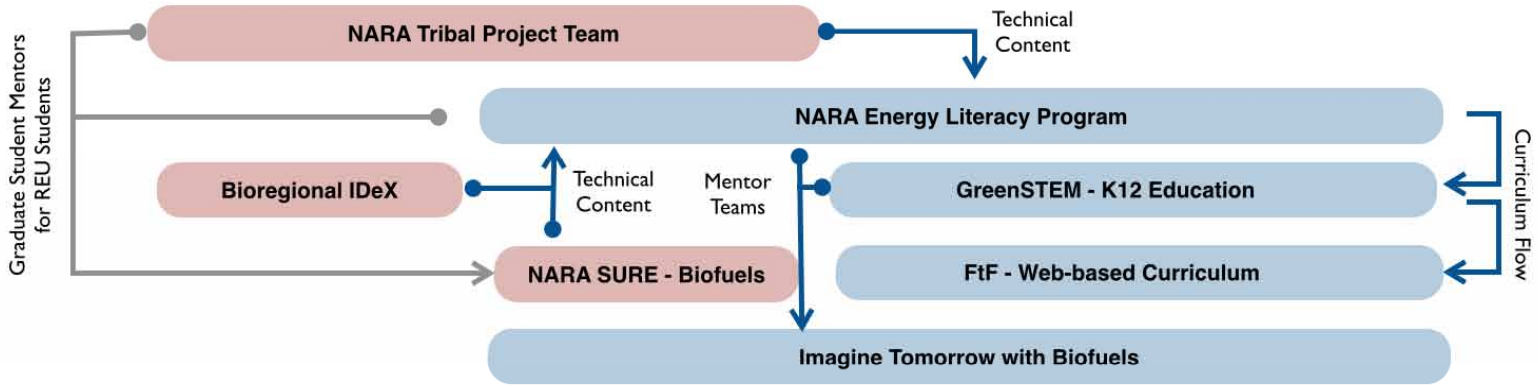
Progress Reports
Website
Newsletters
Social Media
Workshops
Conferences
Site Visits
Displays & Posters
Surveys/Interviews
Briefings
Meetings
Public Meetings
Brochures
Fact Sheets
News Releases

STAKEHOLDERS

National	4-State	Local
Elected Officials/ Policymakers		
Trade & Consumer Associations		
General Public		
Wholesale/Retail		
Aviation Industry		
Petroleum Refineries		
Chemical Industries		
	Harvesters/Haulers	
	Forest Landowners	
	Pilot Supply Chain Study Regions	
	Primary FP Industry	
	Secondary FP Industry	
	Tribes	
	NGOs	
	Environmental Community	
	Storage/Distribution/Trans.	
		SAFN
		Advisory Group

NARA Educational Programs

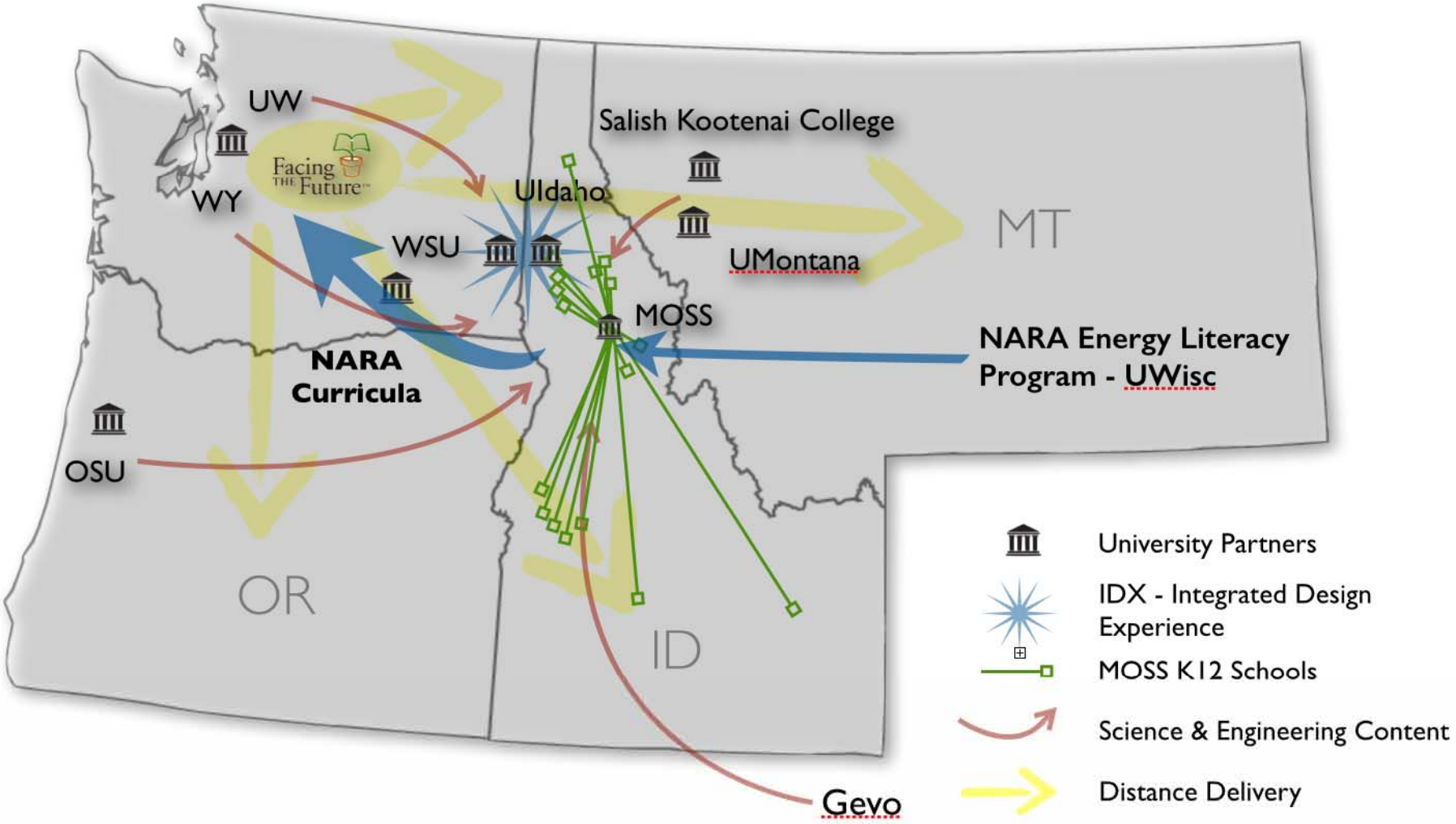
Who	Graduate and Undergraduate Students		K12 Teachers	K12 Students
Need	Broad Understanding of Issues	Improved Communication Skills	Science Curriculum and Knowledge	Importance of Science in their Lives
Solution	Integrative Educational Experiences ----- that include ------ multiple disciplines diverse communities shared problems	Opportunities to Explain Expertise to Diverse Groups ----- audience ------ teachers and students K12 and undergrads	Science Training and Curriculum ----- through ------ collaboration with research professionals of different disciplines	Exposure to Research Professionals and Relevant Problems ----- through ------ teachers and students K12 and undergrads



Outcomes

Trained Workforce	Tomorrow's Leaders	Educated Public
workforce development	leadership development	science literacy

NARA Educational Programs



Northwest Advanced Renewables Alliance (NARA) Education Overview

- Higher Education:
  - Summer Undergraduate Research Experience (SURE) program (10 weeks each summer)
  - The Bio-IDeX program. The effort combines graduate programs at University of Idaho (bioregional planning and land use policy) with the Integrated Design Experience (IDeX) at WSU.
  - University of Washington's IGERT program, focused on bio-resource based energy.

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Northwest Advanced Renewables Alliance (NARA) Education Overview

- K-12 Education:
  - Development of bioenergy and biofuel education curricula
    - Facing the Future (FtF)
    - McCall Outdoor Science School (MOSS)
  - Imagine Tomorrow with BioFuels

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College of Natural Resources

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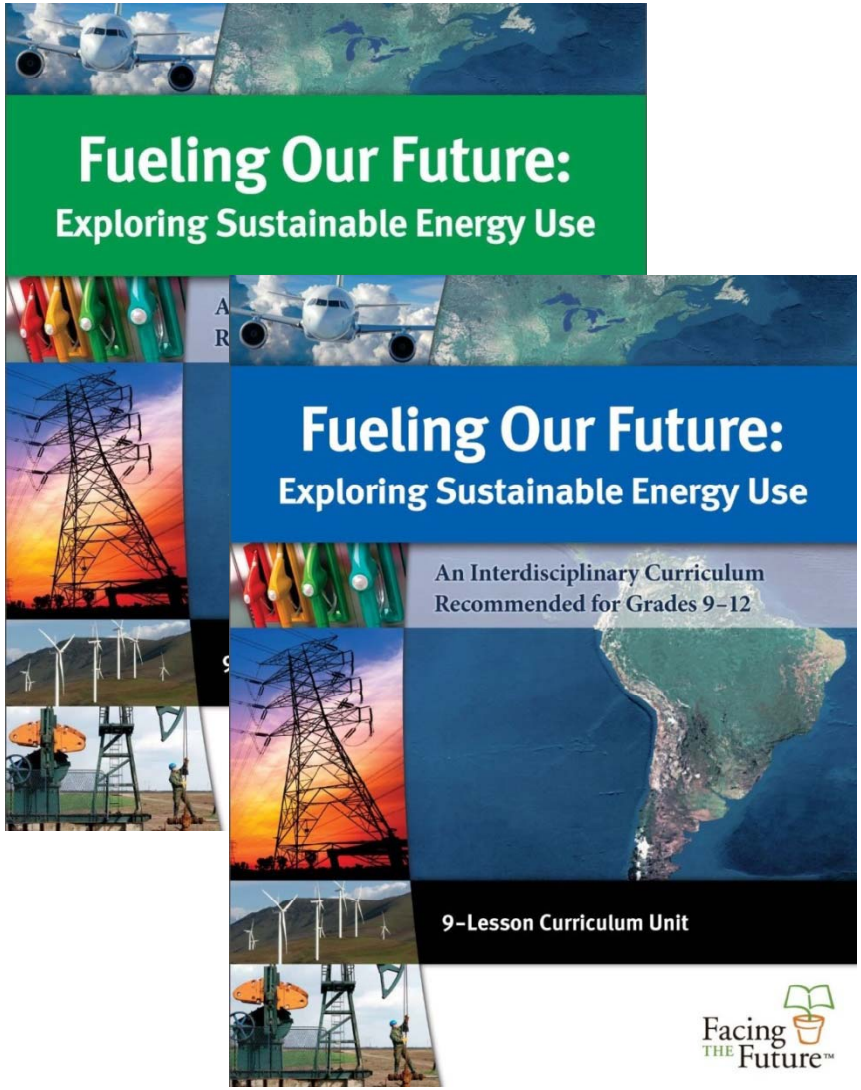
Fueling Our Future:
Exploring Sustainable Energy Use



- Middle and High School
  9-lesson curriculum units
- Aligned to national standards and Energy Literacy Framework
- Performance-based Assessment modeled after the NARA project
- Elementary Curriculum in Development

Facing THE Future™

For more information:

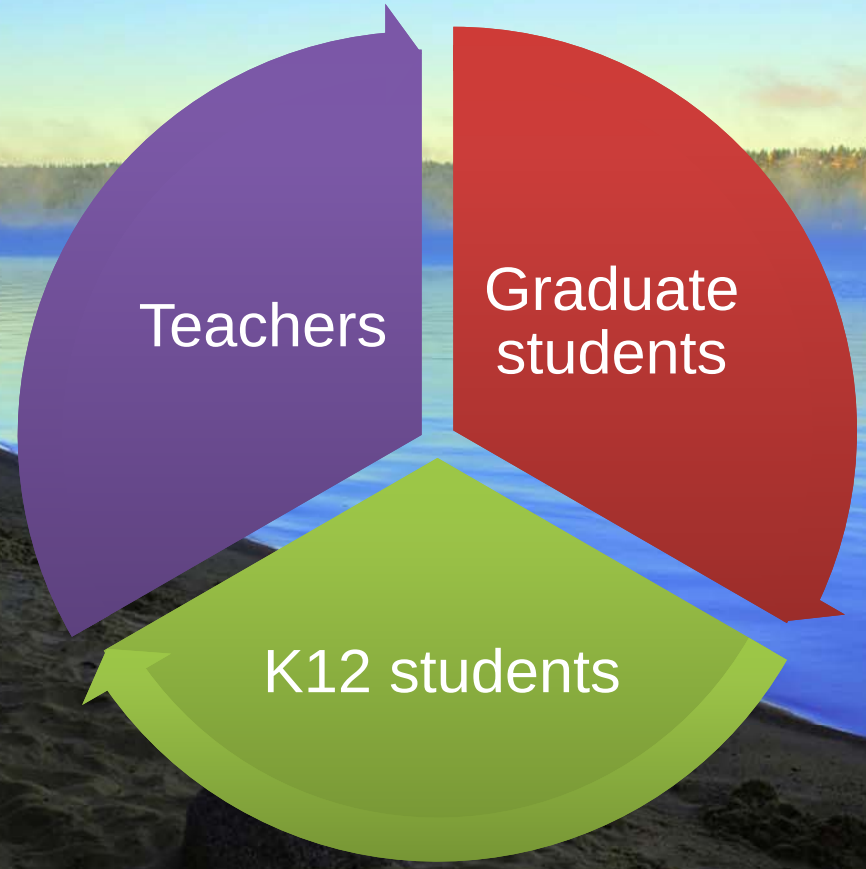
Danica Hendrickson

Curriculum Developer

danica@facingthefuture.org

www.facingthefuture.org

Building Energy Literacy Through Place-based Science Education



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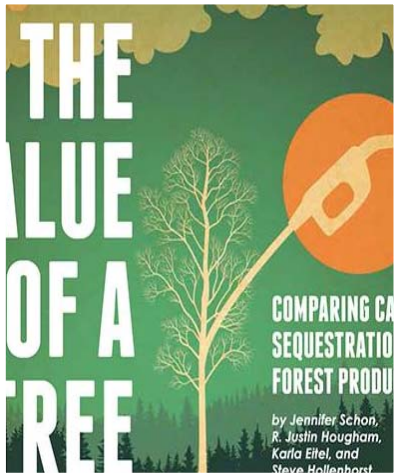
Graduate and K12 Education

Learning to communicate bioenergy science to a broad audience

- 16 - 20 graduate students per year
- Learn about the “big ideas” in bioenergy through interviews, field trips and review of the literature
- Develop communication and curriculum products for

Hands-on Energy Literacy

- 2500 students per year
- In partnership with Facing our Future
- Broad-based lessons in energy topics with a focus on bioenergy
- Residential outdoor science curriculum



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Teacher Professional Development

MOSS Imagines Tomorrow Webinar Series

- 20 teachers coaching “Imagine Tomorrow” teams
- Connects teachers to scientists, teaching resources and support through the coaching process
- Monthly meetings throughout school-year

Adventures in Bioenergy Intensive Workshop

- 20 onsite participants, 20 online participants
- Provides teachers with content resources and problem-based learning pedagogical model
- Connects teachers to scientists and current bioenergy research
- 4-day intensive curriculum with school-year follow-up

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Building Energy Literacy Through Place-based Science Education
To learn more, please contact:
Dr. Karla Bradley Eitel
Director of Education
University of Idaho
McCall Outdoor Science School
kbradley@uidaho.edu

Energy Literacy Assessment

- Energy literacy is important to a secure and sustainable energy future as an informed public is likely to make better:
  - Policy decisions about generation and efficiency mandates
  - Personal decisions about energy use
- Assessment allows researchers to:
  - Determine the need for more energy education
  - Assess the effectiveness of educational approaches
- Knowledge tests are used for energy literacy assessment. They require interaction with the subjects. Other NARA groups are developing based on DOE Energy Literacy Principles
- A rubric approach for assessing artifacts is being developed as an additional tool. Information follows:

Imagine Tomorrow Overview

- *Imagine Tomorrow* challenges 9th through 12th graders to seek new ways to support the transition to alternative energy sources…….
- Regional Four States:
  - Washington (established)
  - Idaho (growing)
  - Montana (developing)
  - Oregon (developing)
- Monetary and Certificate Awards
- Teams do not pay for housing, food or registration
- Four Challenges Approach: Attracts Diverse Group of Students, Mentors, Judges, etc.
  - Technology
  - Design
  - ***Behavior***
  - Specialty: ***Biofuels***

Imagine Tomorrow: Rubric Approach

- Rubric assessment approach is different than test approach because it:
  - Can be applied to past works
  - Requires no effort by the subjects
  - May measure a more *applied type* of comprehension

Energy Literacy Rubric

	Points			
Topic	0	1	3	5
Issue	Not addressed	Identify the issue	Frame the issue	Professionally frame the issue
Solution	Not addressed	Identify solution to the issue	Discuss a solution	Develop appropriate solution
Impacts	Not addressed	Identify broader impacts	Discuss broader impacts	Examine broader impacts
Stakeholders	Not addressed	Identify stakeholders	Consider stakeholder perspectives	Understand and address stakeholder perspectives
Technical Concepts	Not addressed	Identify technical concepts	Discuss technical concepts	Examine technical concepts as they relate to the project
Literature	Not addressed	Identify that there is outside information	Use information from outside sources	Examine information as it relates to the project

Langfitt, Q., Haselbach, L. and Hougham, R.J. (2014): *Paper under Development*

Application of Rubric Assessment

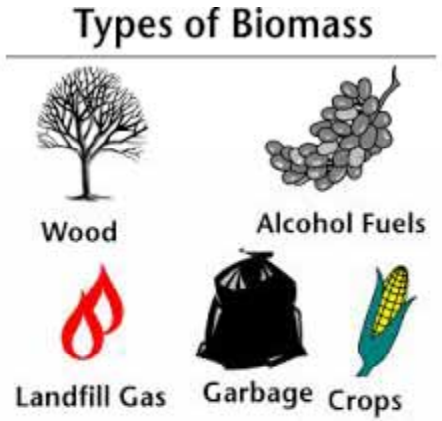
- Correlated to DOE Energy Literacy principles
  - *Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education*, 2013.

  http://www1.eere.energy.gov/education/pdfs/energy_literacy_1_0_high_res.pdf
  - e.g. sub-principle 6.2, “One way to manage energy resources is through conservation”, was identified as a solution
- Applied to Imagine Tomorrow energy competition deliverables
- Producing reliable results with identifiable trends between multiple raters
- Could be used in other settings such as energy course assessment

Preliminary Energy Literacy Rubric Assessment 2014 Imagine Tomorrow HS Energy Competition

- Both abstracts and posters most likely to address solution, then issue
- Teams with average grade around 10-11 show the most energy literacy
- Energy literacy scores generally higher in more technical categories, *as expected, particularly with inclusion of technology in scoring*
  - Highest to lowest: *Biofuels,* Technology, Design, Behavior
- **Males and females *score similarly***
- Projects done in classes versus extracurricular score higher on average, especially for posters
- Teams with *mostly repeat competitors* score higher on average
- Projects from repeat schools or those from repeat advisors scored better on abstracts, but similar on posters
- **Scores versus 'advisor subject taught' (STEM vs. not) were *similar for both***

Biofuels Literacy



- Rubric adapted to biofuels
- Energy literacy principles connected to biofuels
- Ratings being done on Imagine Tomorrow based on this rubric as well
- *Trends not apparent yet*

- Biofuels category entrant teams increasing!!!
  - 11 in 2012 (9%), 18 in 2013 (12%), **30 in 2014 (16%)**

Biofuels Literacy

	Points			
Topic	0	1	3	5
Issue	Not addressed	Identify an issue related to biofuels	Frame an issue related to biofuels	Professionally frame an issue related to biofuels
Solution	Not addressed	Identify solution to the issue	Discuss a solution	Develop appropriate solution
Impacts	Not addressed	Identify broader impacts	Discuss broader impacts	Examine broader impacts
Stakeholders	Not addressed	Identify stakeholders	Consider stakeholder perspectives	Understand and address stakeholder perspectives
Technical Concepts	Not addressed	Identify feedstock, processing, or distribution/collection	Discuss feedstock, processing, or distribution/collection	Examine feedstock, processing, or distribution/collection
Literature	Not addressed	Identify sources	Use information from outside sources	Examine information as it relates to the project

Image Tomorrow enrollment and STEM major/minors

- 879 Imagine Tomorrow participants (2009-2013) enrolled in U.S. colleges
- 156 (18%) Declared a STEM major or minor
- 659 (75%) Undeclared major

STEM Majors/Minors Declared

- ACCOUNTING
- AERONAUTICAL
- AEROSPACE ENGINEERING
- ANIMAL SCIENCES
- BEHAVIORAL NEUROSCIENCE
- BIOCHEMISTRY
- BIOENGINEERING
- BIOINFORMATICS
- BIOLOGICAL SCIENCES
- BIOLOGY
- BIORESOURCE SCIENCE
- CELLULAR AND MOLECULAR BIOLOGY
- CHEMICAL & BIOMOLECULAR ENGINEERING
- CHEMICAL ENGINEERING
- CHEMISTRY
- CIVIL ENGINEERING
- CLINICAL LABORATORY SCIENCE
- COMMUNITY, ENVIRONMENT, AND PLANNING
- COMPUTER SCIENCE
- ELECTRONICS ENGINEERING
- ENGINEERING
- ENVIRONMENTAL SCIENCE
- GEOLOGY
- HEALTH SCIENCES
- INDUSTRIAL ENGINEERING
- LIFE SCIENCE
- MATHEMATICS
- MECHANICAL ENGINEERING
- NETWORK SYSTEMS ADMINISTRATION
- NEUROBIOLOGY
- NURSING
- OCEANOGRAPHY
- PETROLEUM ENGINEERING
- PHYSICS
- PHYSIOLOGY
- PRE-MEDICINE
- RADIOCHEMISTRY
- SCIENCES
- SOCIAL SCIENCES
- WILDLIFE BIOLOGY

8+ year college graduation cycle

(usually major undeclared until final year)

Some IT participants were H.S. freshman, sophomore, etc. So, it could be 8+ years before a student graduates from college. And, many college students don't declare a major until their final year.

100% Exposure

100% of Imagine Tomorrow participants exposed to STEM and environmental concepts

Disappearing students: *Where did they go?!*

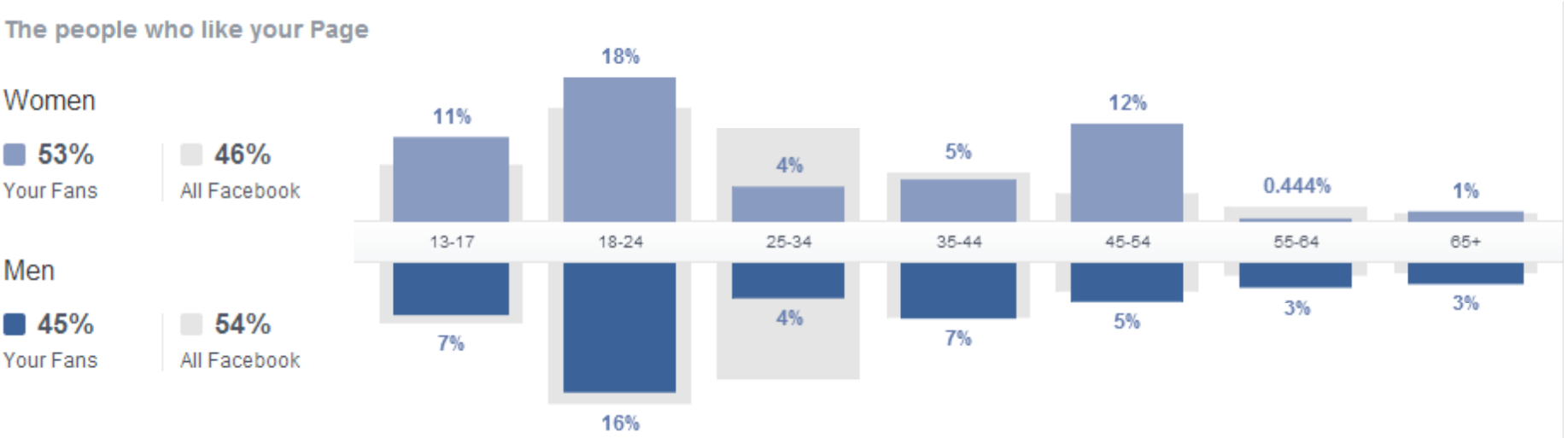
If a student gets married and changes her/his last name, we generally have no way to track them. So these numbers, particularly for females in STEM majors, can be a bit low.

Imagine Tomorrow Outreach: Social Media

Engagement: number of people who our post was served to
Reach: number of people who were served any activity e.g. likes, comments, etc.

- March 1 – May 31:
  - Highest Engagement → 296, May 16
  - Highest Total Reach → 815 on June 1.
- June 2 – July 11:
  - Highest Engagement → 1961 on July 2
  - Highest Total Reach → 1969 on July 2

225 page likes



Website Traffic (07/01/2013-06/30/2014)

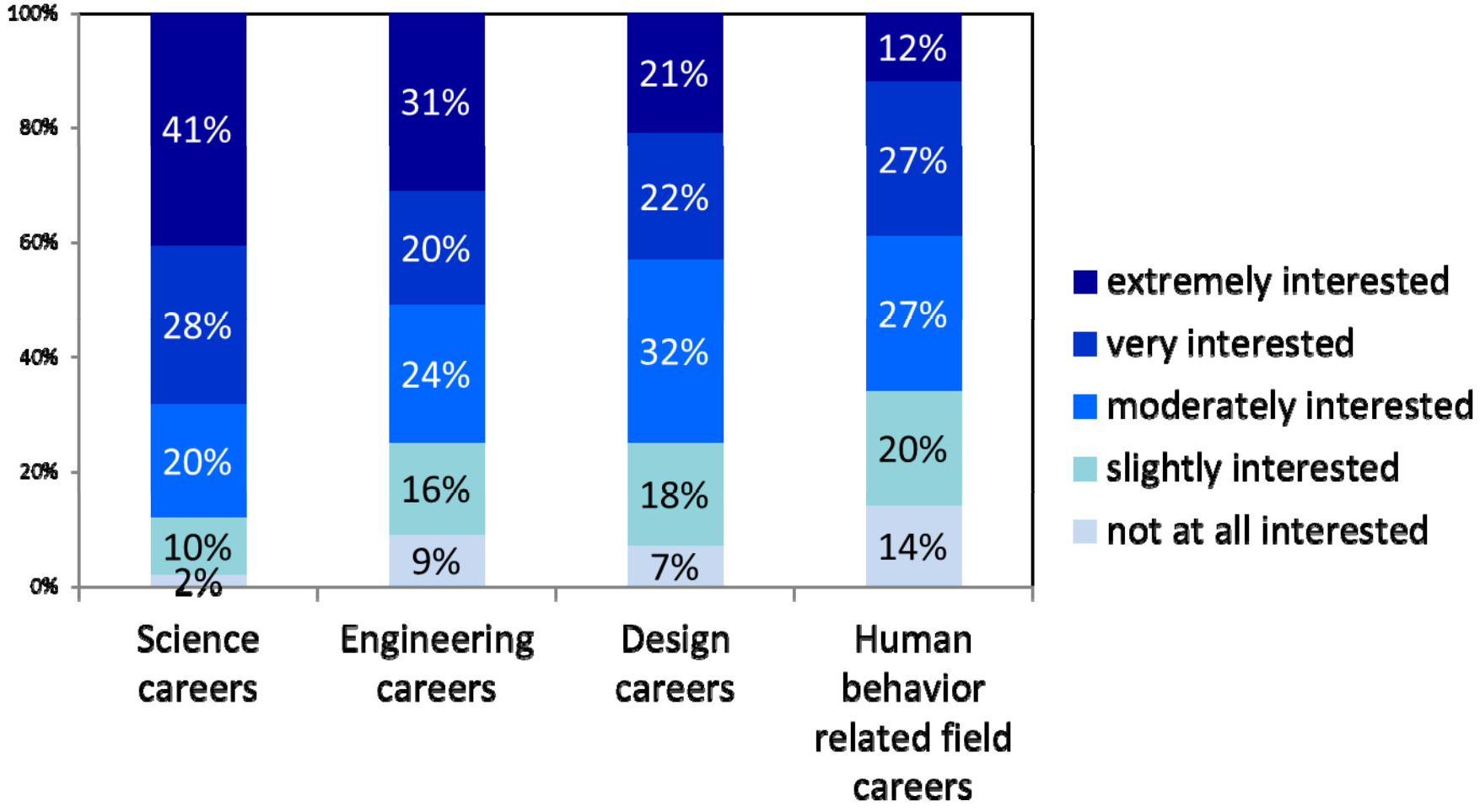
Sessions
17,135
% of Total: 100.00% (17,135)

Pageviews
73,019
% of Total: 100.00% (73,019)

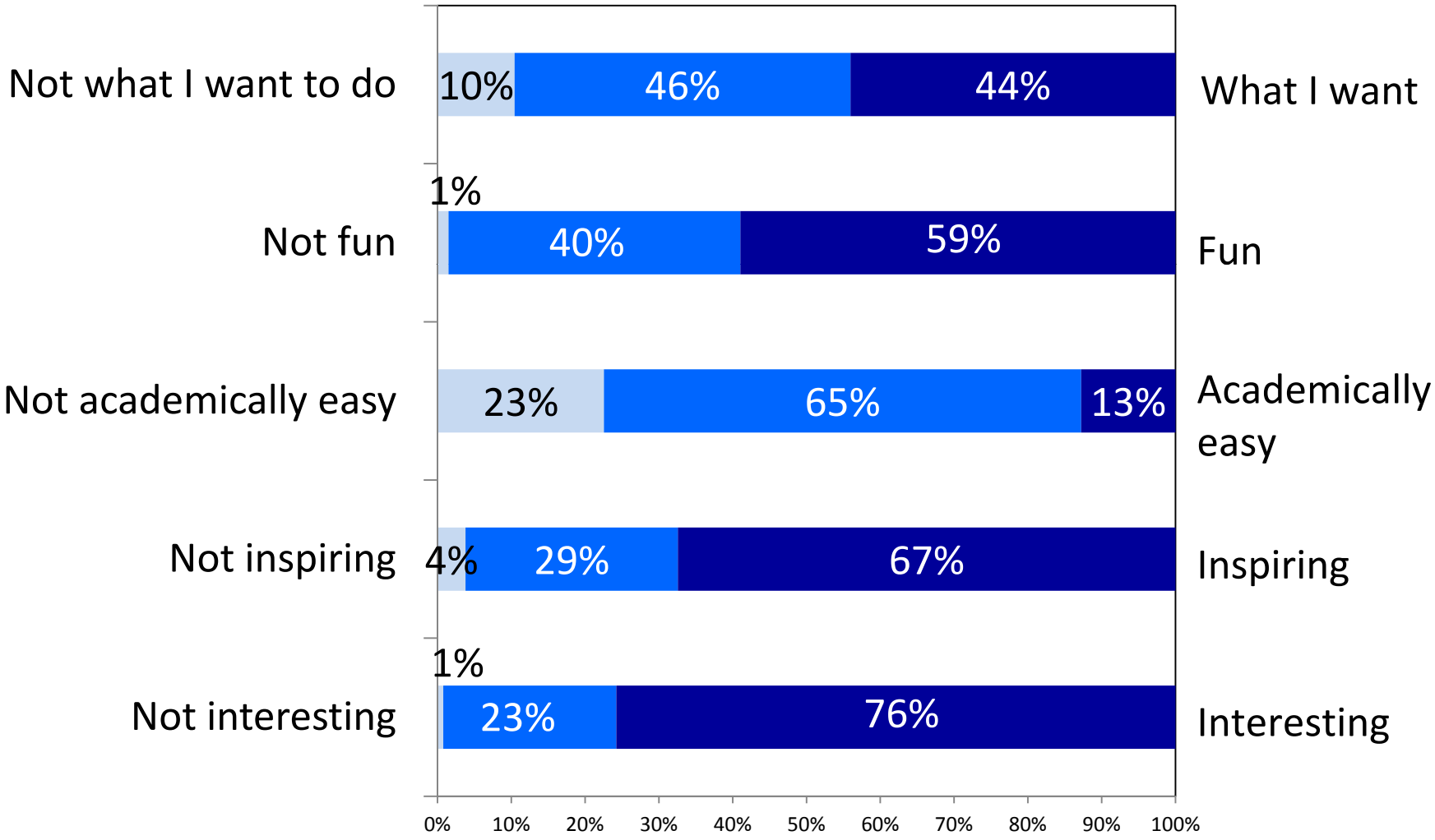
Count of Sessions	Sessions	Pageviews
1	10,447	38,417
2	2,251	10,145
3	1,010	4,829
4	601	3,029
5	410	1,925
6	293	1,390
7	221	1,204
8	176	994
9-14	639	4,080
15-25	474	2,985
26-50	405	2,314
51-100	194	1,632
101-200	14	75

Frequency of Visits (07/01/2013 – 06/30/2014)

Imagine Tomorrow Student Survey 2014



Imagine Tomorrow Student Survey 2014



Imagine Tomorrow Historical Information

	2008	2009	2010	2011	2012	2013	2014
Teams	86	89	94	114	112	133	140
Schools	32	33	32	45	46	51	45
Students	296	302	332	363	433	502	542
% Female	48	45	54	55	48	48	45
% Male	52	55	46	45	52	52	55

Imagine Tomorrow Historical Information

2013 Challenges	Total Students	% Male	% Female
Behavior	21%	33	67
Biofuels	14%	59	41
Design	34%	52	48
Technology	31%	62	38
Student Winners	104	50	50

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Imagine Tomorrow Summary

- Regional Four States:
  - Washington (established)
  - Idaho (growing)
  - Montana (developing)
  - Oregon (developing)
- Interested in National Reach
- Four Challenges Approach: Attracts Diverse Group of Students, Mentors, Judges, etc.
  - Technology
  - Design
  - ***Behavior***
  - Specialty: ***Biofuels***

Thank you!

Liv Haselbach
haselbach@wsu.edu

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Extra Slides: Correlation of DOE Principles to Rubric

Issue	
2.7	The effects of changes in Earth's energy system are often not immediately apparent.
3.6	Humans are part of Earth's ecosystems and influence energy flow through these systems.
5.2	Energy infrastructure has inertia.
6.3	Human demand for energy is increasing.
6.4	Earth has limited energy resources.
6.7	Products and services carry with them embedded energy
7.1	Economic security is impacted by energy choices.
7.2	National security is impacted by energy choices.
7.3	Environmental quality is impacted by energy choices.
7.4	Increasing demand for and limited supplies of fossil fuels affects quality of life.
7.5	Access to energy resources affects quality of life.
7.6	Some populations are more vulnerable to impacts of energy choices than others.

Extra Slides: Correlation of DOE Principles to Rubric

Solution

4.1	Humans transfer and transform energy from the environment into forms useful for human endeavors.
4.4	Humans transport energy from place to place
4.5	Humans generate electricity in multiple ways.
4.6	Humans intentionally store energy for later use in a number of different ways.
5.3	Energy decisions can be made using a systems-based approach.
6.2	One way to manage energy resources is through conservation.
6.5	Social and technological innovation affects the amount of energy used by human society.
6.6	Behavior and design affect the amount of energy used by human society.
6.8	Amount of energy used can be calculated and monitored.

Extra Slides: Correlation of DOE Principles to Rubric

Stakeholders

4.2	Human use of energy is subject to limits and constraints.
5.1	Decisions concerning the use of energy resources are made at many levels.
5.5	Energy decisions are influenced by political factors.
5.7	Energy decisions are influenced by social factors.
7.4	Increasing demand for and limited supplies of fossil fuels affects quality of life.
7.5	Access to energy resources affects quality of life.
7.6	Some populations are more vulnerable to impacts of energy choices than others.

Extra Slides: Correlation of DOE Principles to Rubric

Technical

1.1	Energy is a quantity that is transferred from system to system.
1.2	The energy of a system or object that results in its temperature is called thermal energy.
1.3	Energy is neither created nor destroyed.
1.4	Energy available to do useful work decreases as it is transferred from system to system.
1.5	Energy comes in different forms and can be divided into categories.
1.6	Chemical and nuclear reactions involve transfer and transformation of energy.
1.7	Many different units are used to quantify energy.
1.8	Power is a measure of energy transfer rate.
2.1	Earth is constantly changing as energy flows through the system.
2.2	Sunlight, gravitational potential, decay of radioactive isotopes, and rotation of the Earth are the major sources of energy driving physical processes on Earth.
2.5	Movement of matter between reservoirs is driven by Earth's internal and external sources of energy.
3.1	The Sun is the major source of energy for organisms and the ecosystems of which they are a part.
3.2	Food is a biofuel used by organisms to acquire energy for internal living processes.
3.3	Energy available to do useful work decreases as it is transferred from organism to organism.
3.4	Energy flows through food webs in one direction, from producers to consumers and decomposers.
4.1	Humans transfer and transform energy from the environment into forms useful for human endeavors.
4.3	Fossil and biofuels are organic matter that contain energy captured from sunlight.
4.4	Humans transport energy from place to place.
4.5	Humans generate electricity in multiple ways.
6.1	Conservation of energy has two very different meanings

Extra Slides: Correlation of DOE Principles to Rubric

Impacts

2.3	Earth's weather and climate are mostly driven by energy from the Sun.
2.4	Water plays a major role in the storage and transfer of energy in the Earth system.
2.6	Greenhouse gases affect energy flow through the Earth system.
3.5	Ecosystems are affected by changes in the availability of energy and matter.
4.7	Different sources of energy and the different ways energy can be transformed, transported, and stored each have different benefits and drawbacks.
5.4	Energy decisions are influenced by economic factors.
5.6	Energy decisions are influenced by environmental factors.
7.1	Economic security is impacted by energy choices.
7.2	National security is impacted by energy choices.
7.3	Environmental quality is impacted by energy choices.

Device Category	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	17,135 % of Total: 100.00% (17,135)	60.97% Site Avg: 60.96% (0.02%)	10,447 % of Total: 100.02% (10,445)	46.65% Site Avg: 46.65% (0.00%)	4.26 Site Avg: 4.26 (0.00%)	00:03:37 Site Avg: 00:03:37 (0.00%)
1. desktop	13,595 (79.34%)	60.95%	8,286 (79.31%)	42.02%	4.76	00:04:06
2. mobile	2,796 (16.32%)	61.05%	1,707 (16.34%)	65.84%	2.21	00:01:38
3. tablet	744 (4.34%)	61.02%	454 (4.35%)	59.01%	2.87	00:02:33

Device Use 07/01/13 - 06/30/14

Primary Dimension: User Type

Plot Rows | Secondary dimension | Sort Type: Default

User Type	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	17,135 % of Total: 100.00% (17,135)	60.97% Site Avg: 60.96% (0.02%)	10,447 % of Total: 100.02% (10,445)	46.65% Site Avg: 46.65% (0.00%)	4.26 Site Avg: 4.26 (0.00%)	00:03:37 Site Avg: 00:03:37 (0.00%)
1. New Visitor	10,447 (60.97%)	100.00%	10,447 (100.00%)	51.54%	3.68	00:03:01
2. Returning Visitor	6,688 (39.03%)	0.00%	0 (0.00%)	39.01%	5.17	00:04:35

New vs. Returning Visitors 07/01/13 – 06/30/14

Social Network	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	355 % of Total: 2.07% (17,135)	47.04% Site Avg: 60.96% (-22.83%)	167 % of Total: 1.60% (10,445)	41.13% Site Avg: 46.65% (-11.83%)	4.73 Site Avg: 4.26 (10.92%)	00:03:43 Site Avg: 00:03:37 (2.64%)
1. Facebook	286 (80.56%)	45.80%	131 (78.44%)	41.26%	4.88	00:03:48
2. Twitter	30 (8.45%)	36.67%	11 (6.59%)	43.33%	5.10	00:02:07
3. Blogger	21 (5.92%)	66.67%	14 (8.38%)	33.33%	4.10	00:02:50
4. Google+	7 (1.97%)	28.57%	2 (1.20%)	42.86%	3.00	00:11:44
5. LinkedIn	5 (1.41%)	100.00%	5 (2.99%)	40.00%	2.40	00:00:26
6. Weebly	4 (1.13%)	75.00%	3 (1.80%)	75.00%	1.50	00:00:19
7. WordPress	2 (0.56%)	50.00%	1 (0.60%)	0.00%	2.00	00:11:34

Social Media Sources 07/01/13 – 06/30/14