

## Using Authentic Data from the Ocean Observatories Initiative in undergraduate teaching

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> Greengrove et al., 2020, Oceanography

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# A team effort: Leaders in using OOI data in education



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# Why use authentic data in undergraduate teaching?

• Modeling the scientific process using real-world data is a high-impact educational practice

(e.g. Rubin and Abrams, 2015; O'Reilly et al., 2017; Soule et. al., 2018; Deslauriers et al., 2019)

- Facilitates knowledge retention
- Development of more sophisticated cognitive skills

# **Bloom's Taxonomy**



# **The Ocean Observatories Initiative**

- NSF-funded source of open access, continuous, long-term digital data
- Co-located measurements of physical, chemical, geological, and biological properties





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# Many other presentations on OOI data & use in research & teaching throughout this week!

https://oceanobservatories.org/2020/02/ooi-at-ocean-sciences-meeting/

- 2 Coastal Arrays
- 4 Global Arrays (2 still ongoing)
   Over 800 different instruments
   Over 200 unique data products

(Reduced to Surface Mooring in 2017)

# **OOI** as an educational resource: **Opportunities and challenges**

Wealth of data illustrating core oceanographic concepts included in undergraduate curricula!

...however, finding & curating data poses a significant barrier for instructors.

OCEANOGRAPHIC CONCEPT	OCEAN REGION (OOI SITE) SHOWCASING THE CONCEPT	OOI INFRASTRUCTURE	EDUCATIONAL RESOURCES AND LITERATURE EXAMPLES
Physics & Water Mov	rement		
Seasonal variations in temperature & salinity	<ul> <li>» Coastal ocean that receives seasonal runoff (Endurance)</li> <li>» Offshore station with strong seasonal gradient (Station Papa)</li> <li>» Differences in Northern vs. Southern Hemispheres (Irminger Sea vs. Southern Ocean)</li> </ul>	<ul> <li>» Surface CTDs</li> <li>» CTD data throughout the water column at discrete depths</li> </ul>	<ul> <li>Properties of Seawater Data Exploration Collection</li> <li>Seasonal Variation of Surface Salinity</li> <li>Processes that Change Salinity</li> <li>https://datalab.marine.rutgers.edu/explorations/</li> <li>chemistry/</li> </ul>

See Greengrove et al., 2020 for the full table of resources!

# **OOI** as an educational resource: **Opportunities and challenges**

**Our goal:** Summarize and share existing resources – and invite YOU to use what has already been created, and to develop new resources for the community.

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# **OOI-driven teaching activities: Resources and opportunities**

	INTRODUCTORY	UPPER LEVEL	RESEARCH
OCEANOGRAPHY CONCEPTS Bloom's Understand/Remember	<ul> <li>» Primary Productivity</li> <li>» Submarine Volcanism</li> <li>» Salinity/Stratification</li> </ul>	» Primary Productivity	» Opportunity
<b>DATA SKILLS</b> Bloom's Apply/Analyze	<ul> <li>» Primary Productivity</li> <li>» Submarine Volcanism</li> <li>» Salinity/Stratification</li> </ul>	» Primary Productivity	» Opportunity
INTEGRATED APPLICATIONS Bloom's Evaluate/Create	» Opportunity	» Opportunity	» Opportunity
reengrove et al 2020 <i>Oceanoara</i>	Well Developed S Activities N	ome Teaching Oppor Iaterials Developed Develo Activit	rtunity to op Teaching ies, Resources, est Practices

# **Example Applications: Classroom activities**

- Primary productivity
- Submarine volcanism
- Salinity/stratification



#### All lesson plans and student worksheets: https://datalab.marine.rutgers.edu/tos-lesson-plans/

More in the OOI Data Explorations in the next talk, by Sage Lichtenwalner

# **Classroom Activities: Primary productivity**

Textbook example: Phytoplankton biomass seasonal cycle



Greengrove et al., 2020, Oceanography

Interactive Data Exploration: OOI chlorophyll-a data from three different arrays



Note, the graph will O Northern Hemisphere Pacific Ocean (Station Papa)

Southern Hemisphere Pacific Ocean (Southern Ocean)

late summer season.

# **Classroom Activities: Primary productivity**

- Student engagement with data through guided worksheets
- Pilot tested in Intro Oceanography courses at a regional public university, research-focused university, & small liberal arts college



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 Southern Hemisphere Pacific Ocean (Southern Ocean mer season.
 Show All

#### Student learning goals spanning a range of cognitive skill levels:

Formulate hypotheses about factors controlling primary production in different ocean regions

Identify relationships among different parameters

Analyze and interpret "messy" real data

Identify, describe, and explain controls on primary production

nary create evaluate analyze apply understand remember

Greengrove et al., 2020, Oceanography

Vanderbilt University Center for

# Adapting Classroom Activities for Different Course Levels:

Data Exploration extension: chlorophyll and nitrate

- Washington Chl-a 30.62 35 Vashington Nitrate 30 25.62 Chlorophyll-a Concentration (µg/L) 25 20.61 20 15.6 15 10.6 ration (µMol/L 5.59 Oct 2019 Jul 2018 Oct 2018 Jan 2019 Apr 2019 Jul 2019 Washington Shelf Chlorophyll Include datasets: Washington Shelf Nitrate Irminger Chlorophyll Irminger Nitrate

(c) Washington Shelf Chlorophyll-a and Nitrate

Jigsaw activity comparing trends in temperature, chlorophyll, and dissolved oxygen



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## Beyond the Classroom: Using OOI data in undergraduate research projects

- Reach top levels of Bloom's Taxonomy
- Free online data enables authentic research experiences even without resources of a large research institution



- Key challenge: Students need data science skills to process and interpret data
- **Opportunity** to develop transferable materials for teaching data science skills



## Beyond the Classroom: Using OOI data in undergraduate research projects

Opportunities for research students to go to sea with OOI:





## **Our invitation to you:** Use existing resources & join us in creating new ones!

	INTRODUCTORY	UPPER LEVEL	UNDERGRADUATE RESEARCH
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INTEGRATED APPLICATIONS Bloom's Evaluate/Create	» Opportunity	» Opportunity	» Opportunity
	Well Developed Activities	Some Teaching Materials Developed	Opportunity to Develop Teaching Activities Resources

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Greengrove et al., 2020, Oceanography – open access article online at: https://doi.org/10.5670/oceanog.2020.103

Lesson plans for classroom activities: https://datalab.marine.rutgers.edu/tos-lesson-plans/