Enhancing Student Understanding of Estuarine Dynamics Using an Orientation Research Cruise Experience

Mike Allen1, Tom Jones2, Jenna Clark1, and Fredrika Moser1

INTRODUCTION
Students join Maryland Sea Grant’s (MDSG) REU program from across the country and all types of institutions, often with limited exposure to the marine sciences. To introduce students the REU program, estuarine science, and the Chesapeake Bay in particular, we host a week-long orientation that includes three days on Chesapeake Bay science and a research cruise on the R/V Rachel Carson.

On the cruise, students carry out numerous sampling procedures, including:
• Conductivity, Temperature, and Depth (CTD) measurements
• Water quality measurements (dissolved oxygen [DO], salinity)
• Light measurements (Photosynthetically Active Radiation [PAR] and Secchi depth)
• Biotic sampling (oysters, fish, plankton)

R/V RACHEL CARSON
R/V Rachel Carson, christened in 2008, is 81 foot vessel used by the research community to conduct marine and estuarine sampling in the Chesapeake Bay. Prior to 2009, the orientation cruise was conducted on the R/V Aquarius.

STUDY AREA
The cruise starts in the mainstem of the Chesapeake Bay (Station 1) and stops at four additional stations along the Patuxent River (Stations 2-5). This allows students to compare biological and chemical changes along a salinity gradient.

SUMMARY
• MDSG REU students often come from landlocked institutions or have limited marine science coursework, so the material introduced in orientation is often new.

• We combine lecture, hands on field research, data analysis, and discussion to introduce students to estuarine science in the Chesapeake Bay. Field collected data reinforce the concepts of thermal and chemical stratification and provide first hand exposure to the complexities of estuarine dynamics. The concepts discussed during the process are often foundational for student summer research projects.

• By incorporating long-term monitoring data into the interpretation, students gain further understanding of how the measurements they collect can be influenced by larger-scale processes that operate at different spatial and temporal scales.

• In the future, we hope to further modify and improve our orientation and research cruise by including more reflection and analysis of historical data to further help students understand the temporal dynamics of the Bay.

RESEARCH AS A TEACHING TOOL
Data collected on orientation cruises provide a good teaching tool to introduce REUs to estuarine dynamics and principles.
• Data provide real world examples of the physics and chemistry leading to complex estuarine dynamics.
• Students develop basic understanding of traditional sampling and analysis techniques.
• 12-years of historical cruise data allow students to hypothesize reasons for year-to-year variations.
• This allows for an in-depth, interactive discussion on influential factors that have effects on the data sets, both on individual components (i.e. salinity, light, DO) and on the Chesapeake Bay as a whole, past and present.

DISSOLVED OXYGEN
• Dissolved oxygen is measured with CTD and YSI probes at each site
• Exposes students to the concepts of oxic, hypoxic, and anoxic areas of the water column
• Historical data allow students to hypothesize about interannual differences in oxygen available above and below the pycnocline
• Prompts discussions of regionally relevant topics such as the Chesapeake Bay dead zone and its impact on biota

SALINITY
• Salinity is measured with CTD and YSI probes at each site
• Introduces concepts of pycnocline and salinity impacts on biota
• Multi-year variation and comparisons with local monitoring data broaden discussions to include factors impacting local conditions such as tides and weather

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1Maryland Sea Grant, College Park, MD, mallen@mdsgrant.org
2Salisbury University, Department of Biological Sciences
R/V Rachel Carson Image Credit: R/V Rachel Carson’s Facebook page
Map Credit: Map data ©2014 Google
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Data provided by the students and used with their permission.

REU Familiarity with Marine Science Topics and Equipment Prior to Orientation

1Very familiar
2Slightly familiar
3Familiar with some concepts
4Familiar
5Very unfamiliar, no new knowledge

Comparison of Light Attenuation at 5 Stations

Temporal comparisons between mainstem (1) and upper river (4) stations show estuarine gradients in turbidity as well as historical variation in light availability

Leads to student discussion of interactions between water discharge and turbidity, light availability, and algal bloom dynamics

Comparison of Secchi depth vs. Kd

Leads to student discussion of interactions between light availability and other factors influencing visibility

Dissolved Oxygen at Station 1 vs. Monthly Discharge

Leads to student discussion of interactions between water discharge and DO concentration

Surface Salinity at Station 1 vs. Monthly Discharge

Leads to student discussion of interactions between water discharge and salinity

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