K-12 Environmental Education Needs Assessment for the Hampton Roads, Virginia Region

Final Report Submitted to the Estuarine Reserves Division
of the National Oceanic and Atmospheric Administration.

Submitted By:

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This project was funded by the Estuarine Reserves Division of the National Oceanic and Atmospheric Administration through grant # NA10NOS4200072.

December 2012

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Introduction

The Chesapeake Bay Research Reserve in Virginia (CBNERRVA or Reserve) is one of 28 protected areas that make up National Oceanic and Atmospheric Administration's (NOAA) National Estuarine Research Reserve System (NERRS). At the state level, CBNERRVA is administered by the Virginia Institute of Marine Science (VIMS), College of William and Mary. The Reserve was established for long-term research, education and stewardship in support of informed management of our Nation's estuaries and coastal habitats. The Reserve's Education and Outreach Program strives to increase awareness, understanding, appreciation and wise-use of coastal resources through formal Kindergarten through twelfth grade (K-12) education programs, teacher training, participation in college intern programs and implementation of family/community oriented programs.

In 2011, as part of a coordinated national reserve-wide effort to evaluate program effectiveness and identify gaps and needs in coastal education, CBNERRVA conducted a K-12 Environmental Education Needs Assessment for the Hampton Roads, Virginia region. A complimentary K-12 Environmental Education Market Analysis was also conducted at the same time. Objectives of the CBNERRVA Needs Assessment were three-fold:

(1) identify gaps in existing educational programs in the Virginia Hampton Roads study region;

(2) determine informational needs of K-12 teachers and desired format; and

(3) incorporate information and findings into CBNERRVA and partner planning efforts to better meet the needs of students and teachers in the study region.

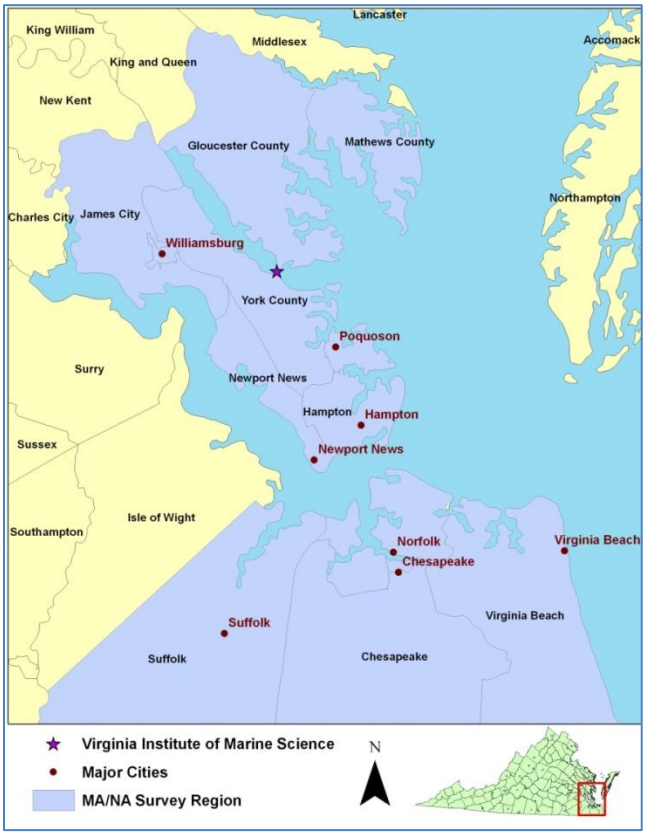

Figure 1. Geographic focus area for the CBNERRVA K-12 Environmental Education Program Needs Assessment.

Study Area

Our study area for the Needs Assessment was K-12 education providers in the Hampton Roads area of Virginia, with an emphasis on Gloucester, Mathews, and York Counties (Figure 1). The current geographic focus area for Reserve education programs is concentrated within these three counties, with some students from surrounding cities such as Williamsburg, Newport News, Hampton, and Virginia Beach attending certain programs. Given the interest in these surrounding cities by project partners, there was an attempt to include these regions in this analysis to the greatest possible extent. Selected

geographic and demographic information, by jurisdictional area, is provided in Table 1. Population density is highly diverse within the study region. The extremes include Mathews County which is characterized by a low population density and rural landscape to the highly developed City of Norfolk located at the core of the Hampton Roads metropolitan area. Typical income level for the region, expressed as median household income, varied by a factor of two (2).

Table 1. Selected geographic and demographic information by jurisdictional area within the study area. Note: (1). James City County and the City of Williamsburg are listed as one jurisdiction as the school district in that area is also combined. (2) Data sources: US 2010 Census.

Jurisdictional Area	Land Area km^2	Population 2010 Census	Population Density people/km^2 (by land area)	% Population Under 18	Median Household Income $ (US) 2006-2010
Chesapeake (city)	883	222,209	252	28.8	67,855
Gloucester (county)	562	36,858	66	26.2	59,331
Hampton (city)	134	137,436	1,026	24.2	49,815
James City County and Williamsburg (county/city)	392	81,407	207	20.9	70,760
Mathews (county)	222	8,978	40	19.9	47,435
Newport News (city)	177	180,719	1,021	27.5	49,562
Norfolk (city)	139	242,803	1,747	24.0	42,677
Poquoson (city)	40	12,150	304	26.8	84,315
Portsmouth (city)	86	95,535	1,111	25.7	45,488
Suffolk (city)	1,036	84,585	82	27.8	65,104
Virginia Beach (city)	643	437,994	681	27.5	64,618
York (county)	270	65,464	242	29.1	81,055

Survey Process

An on-line survey, distributed through Survey Monkey, was used to collect information for use in the K-12 Environmental Education Needs Assessment. The survey was initially developed by Reserve General Education Program staff along with required questions developed by the Estuarine Reserves Division (ERD) of NOAA. The Reserve's Education Advisory Committee (see Appendix I for member list) reviewed all required and optional questions, while also generating additional questions. The finalized needs assessment survey, consisting of 32 questions, is provided in Appendix II. The Reserve's Education Advisory Committee also compiled a list of providers that would be requested to participate in the survey. Survey questions were designed to provide information on teaching approaches, interactions with CBNERRVA and partner organizations, and teacher's needs for professional development and curriculum.

Members of the National Science Teachers Association (Region 2), including school science supervisors for each county within the Hampton Roads study region, were informed of the CBNERRVA K-12 Environmental Education Needs Assessment project at their March 16, 2011 quarterly meeting.

Following the quarterly meeting, surveys were sent to the science supervisors and were distributed from them to their elementary, middle and high school teacher contact lists. The open period for survey response was March 21, 2011 through May 13, 2011. Due to the number of jurisdictions and distribution method, CBNERRVA was unable to determine the number of individuals that were solicited for the survey. CBNERRVA received a total of 208 survey responses. Survey results were tabulated, analyzed, and presented to the Reserve's Education Advisory Committee for review and discussion prior to the writing of this report.

Results

Survey results were analyzed based on specific grade levels and binned by K-5th grade (elementary), 6th-8th grade (middle) and 9th-12th grade (high school) responses. Survey results based on binned grade level information is provided when noticeable differences between full (pooled) survey and binned grade level results were noted.

Background Teacher Related Information

School Setting and Grade Level

Of the 208 individuals that participated in the survey, 95 percent taught in the public school system, 3 percent taught in private schools, with the remaining 2 percent serving in other education support roles (e.g., science supervisor). Due to the fact that respondents could and in some cases did select multiple grade levels, data categorized by grade level was compiled by filtering respondents' school name. A total of 190 respondents were able to be categorized into elementary, middle, or high school, with the remaining 18 responses removed from all analyses. As stated, none of the 18 responses were used in pooled analyses. Comprising 41% percent of the survey response, high school grade level teachers provided the highest response rates. Response rates by middle school and K-elementary grade level teachers were 19 and 40 percent, respectively.

Subject Matter

Response rates for subject area taught by binned grade levels are provided in Figure 2. Survey participants were allowed to select multiple answers and therefore summed response rates are greater than 100 percent for each binned grade category. For elementary and middle school grade levels, the top four response rates by subject area were life science, followed by earth science, physical science and environmental science (Note: earth and physical science were similar for middle school grade responses). Top four high school responses were in descending order, biology, earth science, marine science and other. The "other" subject category represented a relatively large percentage of responses for each binned grade category, 21% for elementary grades, 8% for middle school grades, and 26% for high school grades. Common "other" responses for elementary grades included elementary science, general science, and all subjects, 6th grade science and forensics for 6th-8th grades, and oceanography, astronomy, and anatomy for high school grade levels. In Virginia, the following subject categories are typically represented as high school level: biology, chemistry, physics, environmental science and marine science. The following subject categories are typically represented as middle school level: physical science (6th grade), life science (7th grade), and earth science (8th or 9th grade). Elementary school science teachers may cover a variety of these subject categories as their curriculum is broader (Virginia Department of Education, www.doe.virginia.gov/testing).

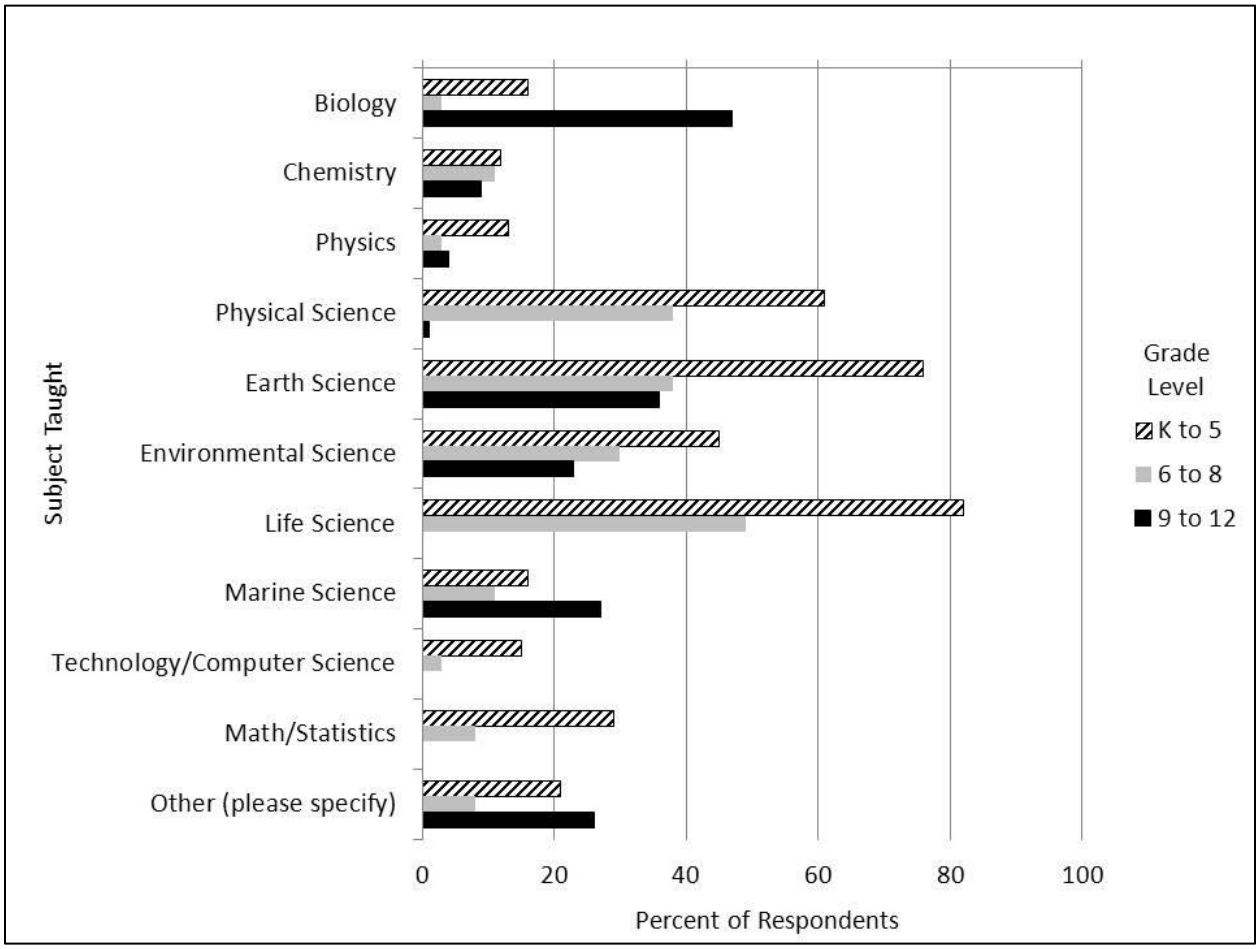

Figure 2. Percent response rate, by binned grade levels, for subject areas taught by respondents.

General and Specific Topic Teaching Experience

Respondents exhibited a wide range of teaching experience, 26 percent of the respondents had greater than 20 years of teaching experience, 14 percent between 16-20 years, 19 percent between 11-15 years, 24 percent between 6-10 years and 18 percent with five or less years experience. Approximately 60 percent of the respondents for each binned grade category had greater than ten years of teaching experience. This broad level of experience provides a good mix of information and insight from well-established teachers to those that are in the more beginning stages of their career.

Respondents were also asked specifically about their experience teaching watershed, estuary, and ocean related topics; response rates are presented in Figures 3-5 for K-5th, 6th-8th and 9th-12th grades, respectively. Response rates exhibited some differences in both topic and grade levels. For the binned K-5th grade category, "no" years of teaching experience received the highest response rate (range: 33-61%) for all three topics. While response rates were low, new teachers ($\leq$ 5 years) had more teaching experience related to watersheds as compared to more senior teachers (>7 years experience) that

indicated a higher response rate for ocean related topics. This trend may be due to teaching initiatives relating to their local environment that focus on watersheds rather than oceans.

Teaching experience among middle school teachers was relatively similar across subject topics (watersheds, estuaries, and oceans) and years teaching categories. Middle school teachers provided a moderate response rate, on the order of 20 percent, as of having "no" years of teaching experience across the three subject topics. While not as pronounced as elementary grade levels, new teachers (≤ 5 years) had more teaching experience related to watersheds as compared to more senior teachers (>7 years experience) that indicated a higher response rate for ocean related topics. Both estuaries and watersheds subject topics are part of the 6th grade curriculum standards of learning.

A moderate to low response rate (approximating 15%) were observed for no teaching experience in the subject areas of watersheds, estuaries and oceans among high school level teachers. In contrast to elementary and middle school, the majority of high school level respondents had greater than seven years of teaching experience for the three subject areas of watersheds, estuaries and oceans. It should be noted that these subject topics are not specifically mentioned in any of the standards of learning for high school grades.

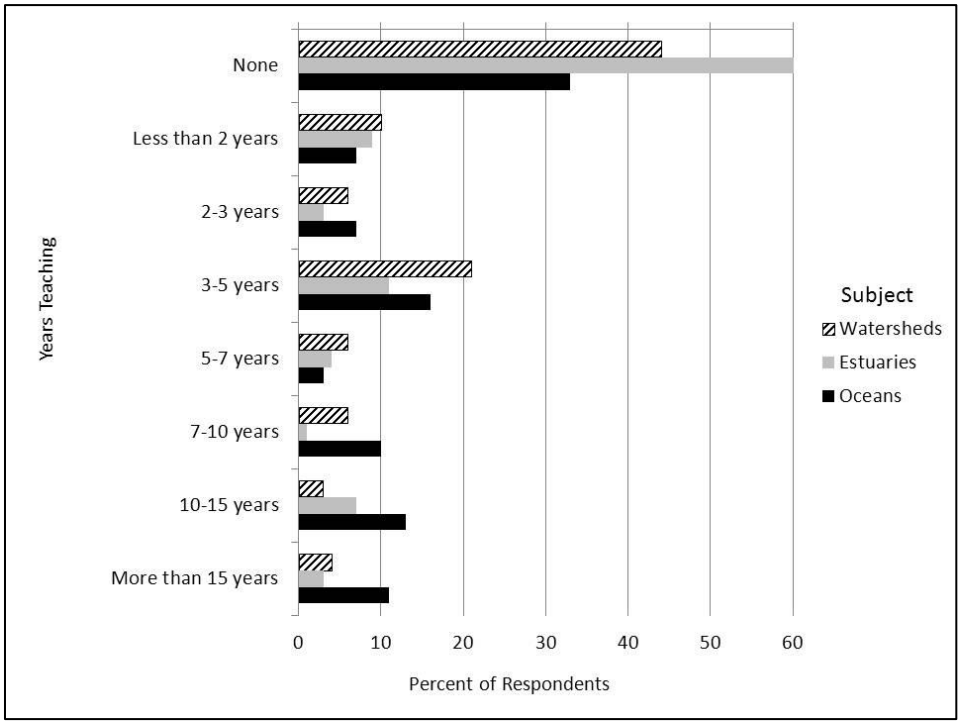

Figure 3. K-5th grade teacher response rates for years of teaching experience related to watersheds, estuaries, and oceans.

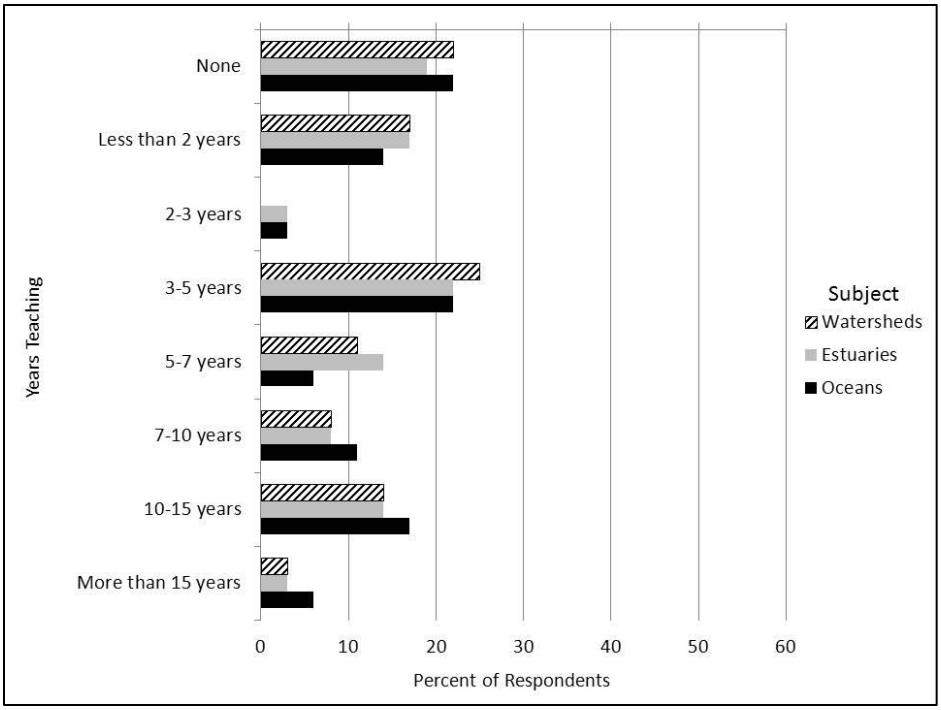

Figure 4. 6th-8th grade teacher response rates for years of teaching experience related to watersheds, estuaries, and oceans.

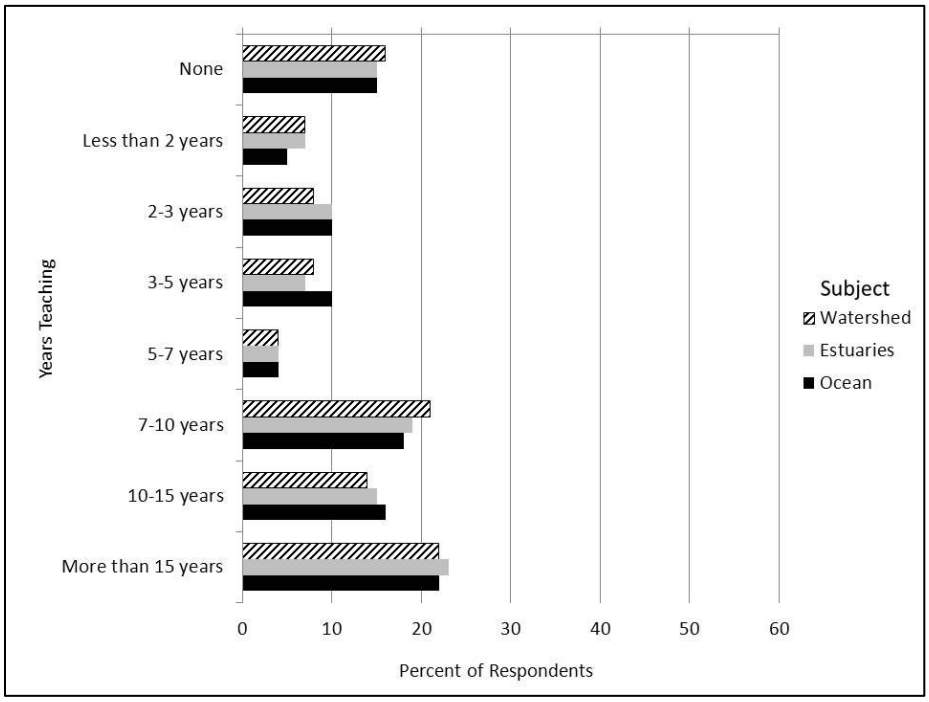

Figure 5. 9th-12 grade teacher response rates for years of teaching experience related to watersheds, estuaries, and oceans.

General Class Structure

Class Size and Number of Students

Class size and time available for instruction are two important determinants when developing classroom curriculum and/or other instructional materials. Response rates for students taught on an annual basis, by binned grade levels, are provided in Figure 6. There are clear differences in class structure between K-5th grades and the higher grade levels. Class size was smaller for the K-5th grade levels, where the greatest response rates were for the 1-25 and 26-50 student classroom size categories. Small class sizes would be expected given that most students at this level are assigned to a single teacher. In higher grade levels, where teachers are assigned to teach specific disciplines to rotating classes, the highest response rates for the number of students engaged by a single teacher were 101-125 for middle school and 126-150 for high school grade levels.

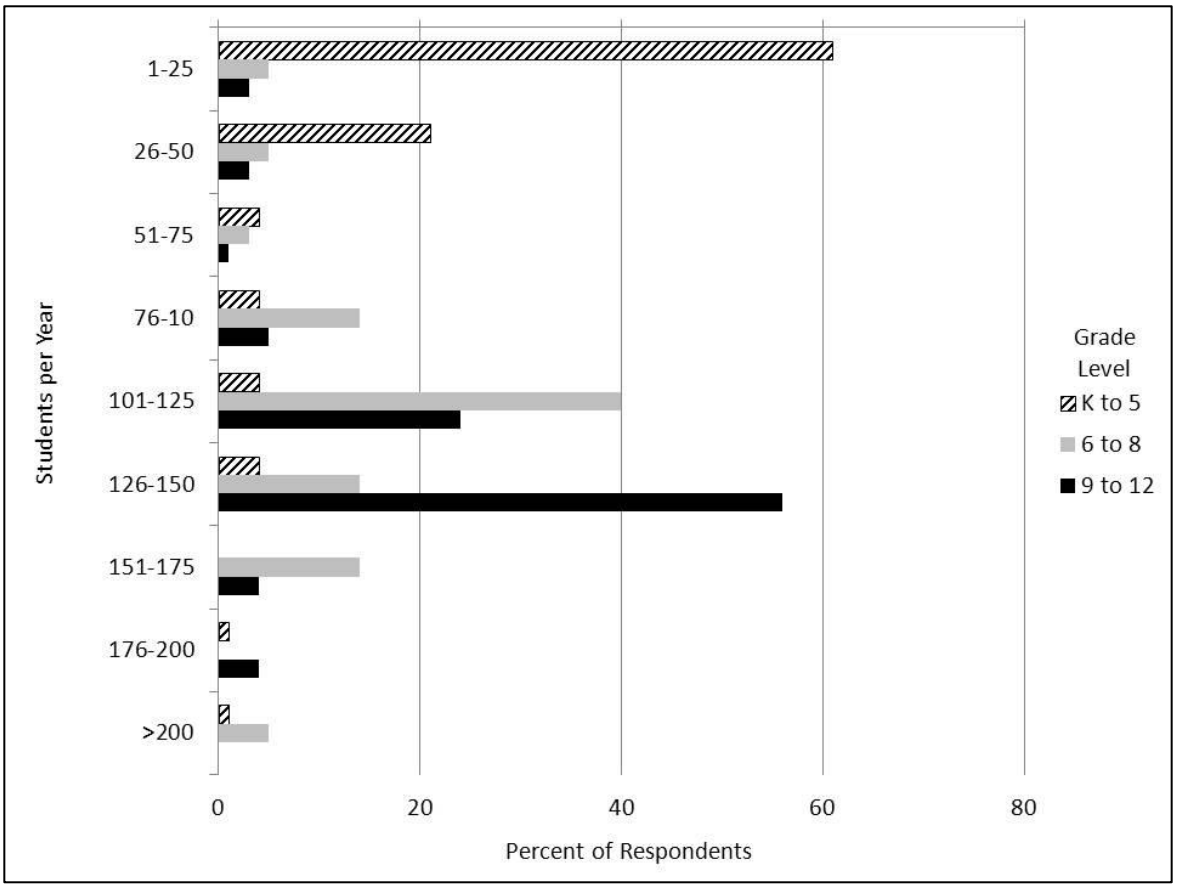

Figure 6. Annual number of students taught by individual teachers by binned grade level category.

Instruction Time

Regarding time duration for class instruction, there was a general trend of increasing time available for science instruction with increasing grade categories (see Table 2). Combining the top two response rates, for a total of 89 percent of the K-5th grade level respondents, classroom time for science

instruction varied between 20-60 minutes. Middle school (6-8 grade levels) responses were somewhat evenly split between 40-60 and >80 minutes. Ninety percent of the high school (9-12 grade levels) respondents indicated that classroom time for science instruction was >80 minutes.

Table 2. Percent response rates for daily time duration for science instruction by binned grade levels; top two time categories are highlighted by shading.

Grade Levels	**< 20 minutes**	**20-40 minutes**	**40-60 minutes**	**60-80 minutes**	**>80 minutes**
Elementary (K-5)	3	34	55	7	1
Middle (6-8)	0	0	46	11	43
High (9-12)	0	0	5	5	90

Course Planning and Mode of Instruction

Based on pooled response rates across grade categories, general course planning placed a heavy emphasis on the development of scientific inquiry skills (Table 3). Research indicates that students being taught in effective inquiry-based learning environments improve skills (Mattheis & Nakayama 1988) and exhibit more positive attitudes about science (Kyle et al. 1985; Rakow 1986). Data collection and analysis, components of scientific inquiry skills, received moderate emphasis. Outdoor experiential activities, including stewardship projects, received less emphasis.

Table 3. Full survey percent response rates as related to activities emphasized by respondents in course planning.

Activities in the Classroom	Little or no emphasis	Moderate emphasis	Heavy emphasis	N/A
Outdoor experiential activities	52	36	9	3
Lab or Field Work/data collection	30	48	19	3
Stewardship projects or activities	46	37	11	6
Data analysis, statistics, and probability	27	54	15	4
Scientific inquiry skills	4	46	50	0

Respondents were also asked about their mode of instruction during the course of the school year. Response rates, binned by grade level categories, for some forms are provided in Table 4. Dominant (based on “always” and “often” response options) modes of instruction by all teachers included hands-on activities/inquiry –based activities and lecture/direct instruction. Web quests/online activities response rates were intermediate while responses for field studies indicated that a very limited use for this mode of instruction.

Table 4. Percent response rates, binned by grade level categories, as related to mode of instruction utilized by respondents in course development and implementation.

		Response				
Option	**Grade Category**	**Always**	**Often**	**Sometimes**	**Rarely**	**Never**
Lecture/Direct Instruction	K-5	5	46	42	7	0
	6-8	5	59	30	5	0
	9-12	9	57	31	3	0
Web-quests /Other online activities	K-5	3	28	41	21	8
	6-8	0	32	41	24	3
	9-12	0	27	47	25	1
Hands-on/Inquiry-based activities	K-5	5	64	28	1	1
	6-8	8	51	38	3	0
	9-12	8	44	42	6	0
Field Studies	K-5	0	1	24	54	21
	6-8	3	14	32	30	22
	9-12	1	8	31	47	13

Course Content

SOL Requirements by Grade Level

The Standards of Learning (SOL) describe the Commonwealth's expectations for student learning and achievement in grades K-12 in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health and physical education, and driver education. The Science SOL for Virginia public schools identifies academic content for essential components of the science curriculum at different grade levels. Standards are identified for K-5th grade, for middle school, and for a core set of high school courses including earth science, biology, chemistry, and physics. Throughout a student's science schooling from K-6th grade, content strands, or topics are included. The SOL in each strand progress in complexity as they are studied at various grade levels in K-6th grades, and are represented indirectly throughout the high school courses. These strands are:

- Scientific Investigation, Reasoning, and Logic;
- Force, Motion, and Energy;
- Matter;
- Life Processes;
- Living Systems;
- Interrelationships in Earth/Space Systems;
- Earth Patterns, Cycles, and Change; and
- Earth Resources.

Estuaries, oceans, and watersheds are mentioned specifically in the following elementary grade level SOLs, although these themes can be used to address many other SOLs:

- Watersheds – 4th and 6th grade, Earth Science;

- Estuaries – 6th grade; and
- Oceans – 5th and 6th grade, Earth Science.

Even though the word "estuary" is only used in the 6th grade SOL, estuary-related topics were identified as a state teaching requirement with greater response rates associated with the upper binned grades levels (K-5th grade = 56%, 6th-8th grade = 86%, and 9th-12th grade = 80%). There was a wide array of responses regarding the number of days that are spent teaching about estuaries, watersheds, or oceans; see Figures 7-9 for K-5th grade, middle and high school grade level responses, respectively. In general, the number of class periods per year dedicated to watersheds, estuaries and oceans increased with grade levels. For the K-5th grade level category, the "none" response received the greatest percent response rate for all three subject matters, with all other options receiving ≤20 percent response rates. In addition to the relatively high (>20 percent) response rate for "none", middle school grade level respondents indicated that they typically dedicate between 1-5 class periods per year for the three topics. High school level results exhibited reduced "none" responses, on the order of 20 percent, as compared to the other two binned grade categories. Similar to middle school results, high school grade level respondents indicated that they typically dedicate 1-5 class periods per year for the three topics. It should be noted that elevated time was devoted for ocean topics by a significant number (30%) of high school level respondents. The emphasis on oceans over estuaries was somewhat expected given the traditional wide range of topics covered under oceanography or marine science, where estuarine science represents a more specialized field of study.

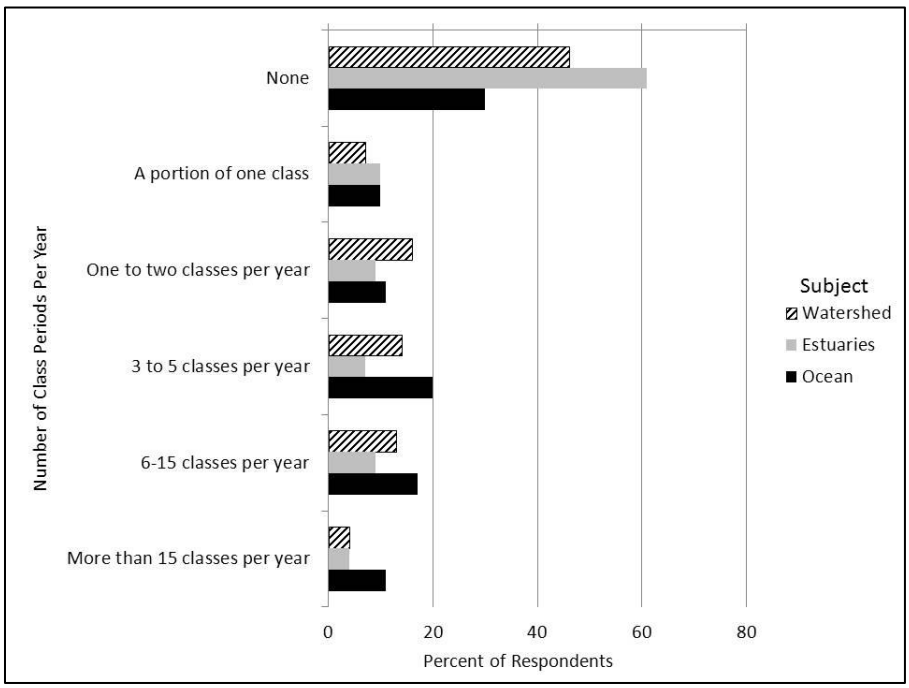

Figure 7. K-5th grade teacher response rates for number of class periods per year focused on watersheds, estuaries, and oceans.

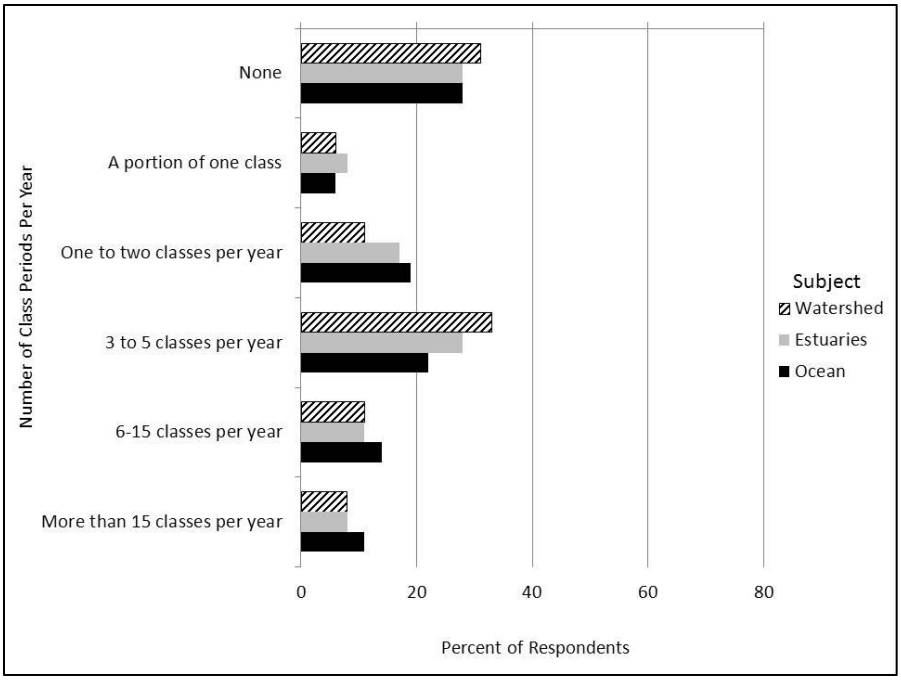

Figure 8. 6th-8th grade teacher response rates for number of class periods per year focused on watersheds, estuaries, and oceans.

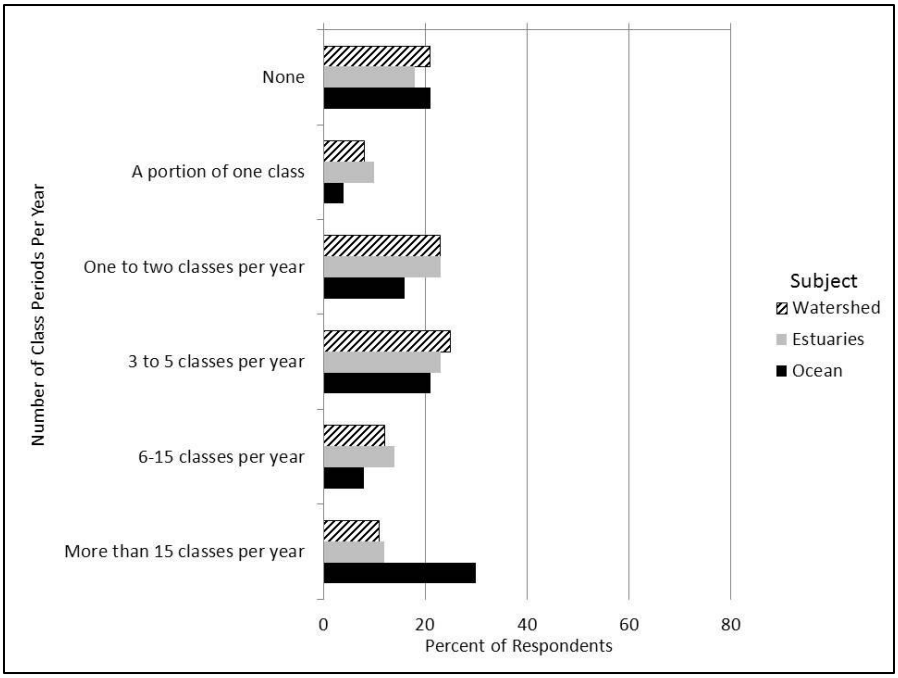

Figure 9. 9th-12th grade teacher response rates for number of class periods per year focused on watersheds, estuaries, and oceans.

Need for Information

Teachers were asked for their level of need for further information or educational materials from a list of science topics. For K-5th grade teachers, information and educational materials needs on life cycles and food webs, habitats and wildlife, weather, scientific method and erosion/sedimentation received response rates of ≥70 percent (Figure 10). Other topic areas ranked as needing additional support included biodiversity and adaptation, aquatic pollutants and technology and instrumentation. The top three topics that did not require any additional information needs or materials included recreation opportunities, water chemistry and case studies of research projects.

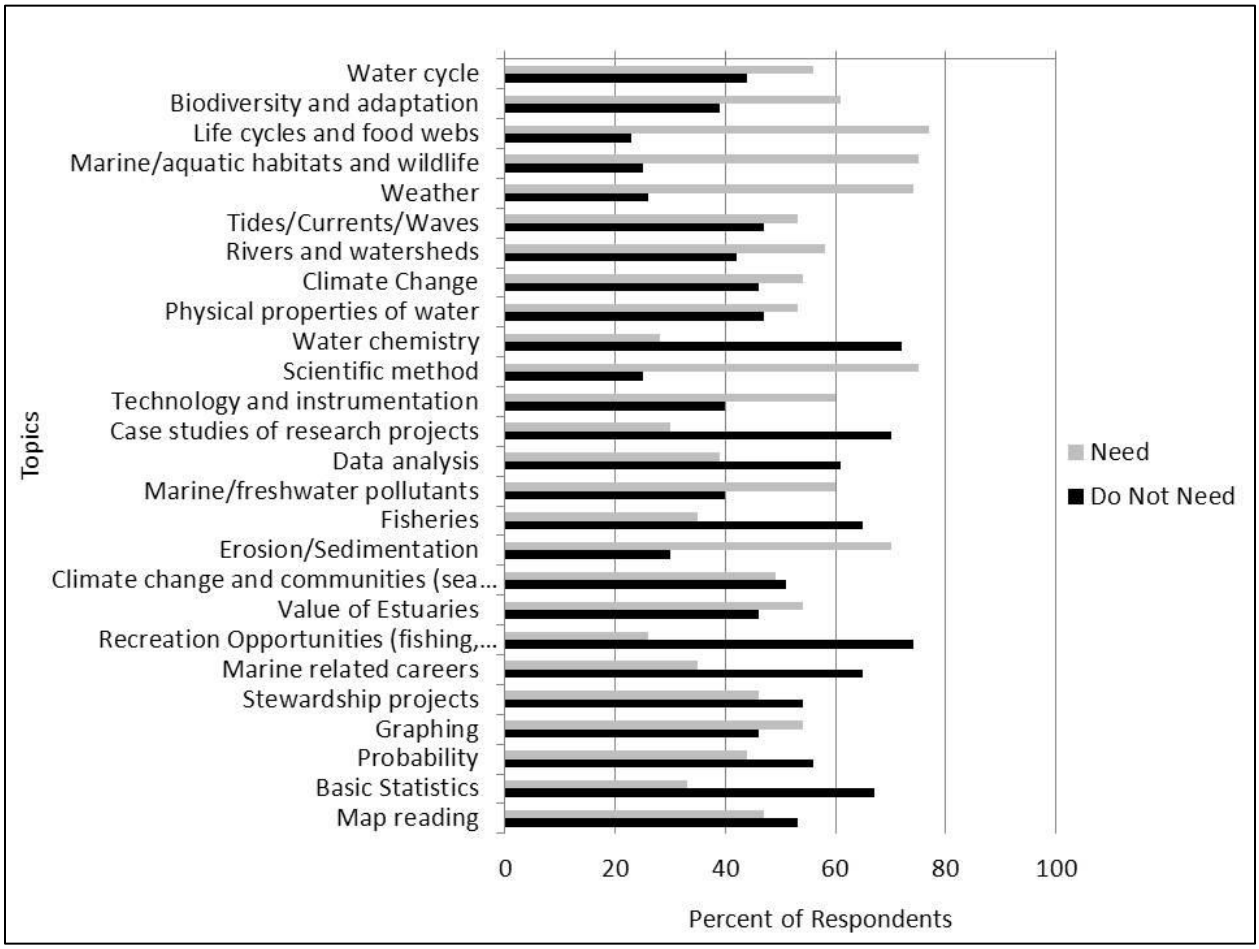

Figure 10. K-5th grade teacher response rates for information and educational material needs.

Topics ranked (≥70 percent response rates) as a high need by middle school teachers included habitats and wildlife, rivers and watersheds, climate change, scientific method, technology and instrumentation, climate change and communities, and value of estuaries (Figure 11). Other topics ranked as a relatively high need included biodiversity and adaptation, weather and aquatic pollutants. The three topics identified as not requiring additional information or educational materials include fisheries, marine related careers and recreation opportunities.

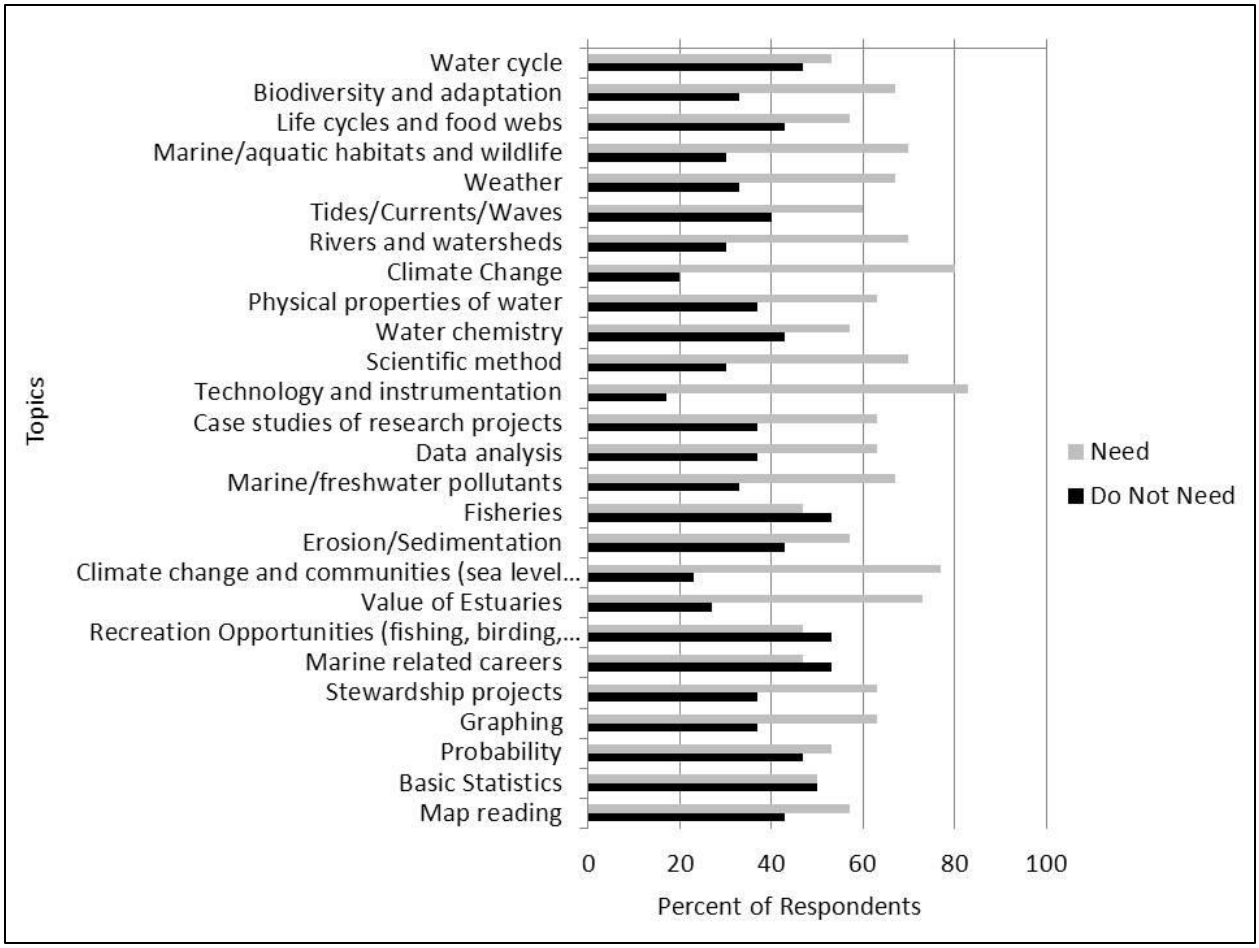

Figure 11. 6th-8th grade teacher response rates for information and educational material needs.

High school teachers reported a high need (≥70 percent response rates) for educational materials and information on biodiversity and adaptation, habitats and wildlife, technology and instrumentation, aquatic pollutants, climate change, climate change and communities, data analysis, stewardship projects and value of estuaries (Figure 12). Other topics of need included fisheries and rivers and watersheds. Topics such as the water cycle, scientific method, and recreation opportunities ranked as no need.

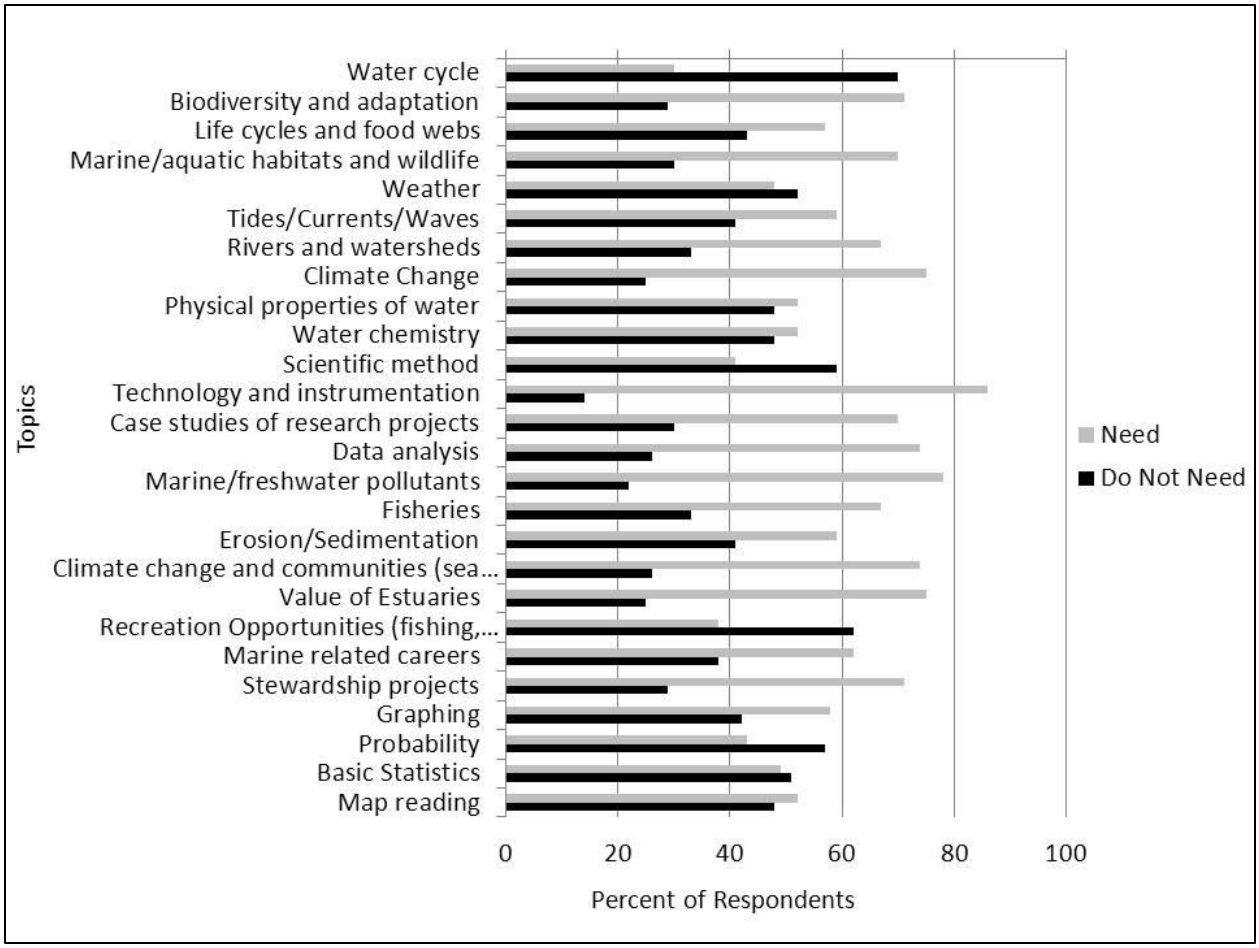

Figure 12. 9th-12th grade teacher response rates for information and educational material needs.

Utility of Web Resources

A number of survey questions were asked to assess the use of and identify commonly used web-based resources. With respect to computer access in the classroom, response rates for all binned grade levels were high (K-5th grade=86%, 6th-8th grade=62%, 9th-12th grade=68%). Though some respondents answered "no" to access to computers in the classroom, computers at the school may be accessible through a computer lab. The availability of computers in the science classroom will have a direct impact on the ability to access web resources for in-class instruction, such as real-time monitoring data. The use of web resources increased greatly beyond the K-5th grade levels. Thirty-three percent of the K-5th grade teachers indicated that they do not use web resources as compared to only 14-19 percent of the middle and high school grade level teachers (Figure 13).

Teachers were asked about web resources and which sites are used to obtain watershed, estuary, and ocean information. Given the choices offered, NOAA's Education website, http://www.education.noaa.gov, was the most commonly used in for K-5th grades (29%) and high school grade levels (56%), while for middle school teachers, the CBNERRVA website, www.vims.edu/cbnerr was the most commonly used web resource (56%)(Figure 13)(note: 6-8th grade is a target group for

CBNERRVA). Following the NOAA and NOAA partner based websites, EPA education and Virginia State Government web resources were used to a lesser degree. Virginia State Government websites include Virginia Naturally and Virginia Resource Use Education Council websites, which contain numerous resources for teachers. The non-profits that were listed included Chesapeake Bay Foundation, Cacapon Institute, Lynnhaven River NOW, Scuttlebutt, VIMS Bridge, Virginia Resource Use Education Council, Chesapeakebay.net, Environmental Literacy Council, Elizabeth River Project, Chesapeake Bay Program, Chessie, Folly Beach Turtles Nesting Site, NEED project, United Streaming, and Keep Norfolk Beautiful. The Bridge, a portal of teacher-approved marine education resources, and the Chesapeake Bay Foundation were mentioned several times in the high school "other" responses. United Streaming, an online Discovery Channel website, and the NEED project, a non-profit ministry dedicated to supporting families with special needs children and adults, both were mentioned in the elementary school responses.

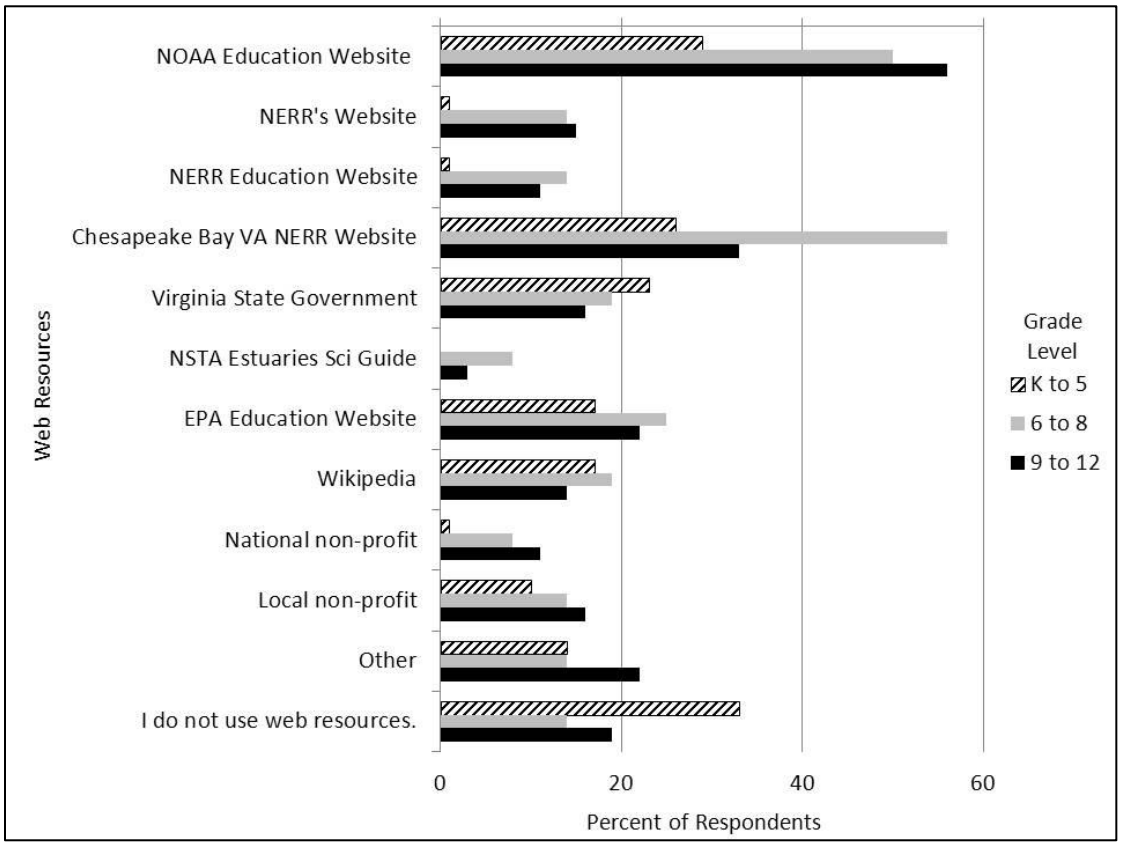

Figure 13. Response rates for web resources used throughout the school year.

Utility of Real-Time and Archived Data Sets

In addition to general web-based resources, teachers were also asked specifically about real time data sets and their level of interest of data sets being compiled into age-appropriate educational materials and visualizations (Table 5). K-5th grade teachers represented the highest percentage of respondents that were not interested in real time data sets, which is to be expected, and many of the topical data

sets had less than 10 percent of teachers interested. For K-5th grades, there was a high interest in relatively simple, straight-forward data sets such as air and water temperature. The highest interest for real time data sets (≥50% response rate) for middle school grades included air temperature, salinity and pH. There was also a moderate interest level (response rate ≥30 and <50%) in additional physical (i.e., currents, waves and water temperature), biological (i.e., animal tracking, fish species and abundance and zooplankton), water quality (i.e., algal bloom, dissolved oxygen, nutrients and turbidity) and climate change related (i.e., atmospheric CO_2 and sea level rise) variables. In high school grades levels, again there was a noted increase in both an interest for real time data sets and broader diversity of measurement categories. Most data categories, with the exception of water depth, waves, ocean color, air and water temperature, water turbidity, and fish species, received a >50% response rate. The topics receiving the highest response rates by high school teachers suggest an increased interest in climate change or human impact topics as well; these included atmospheric CO_2, pH, algal blooms and sea level rise. Some of the "other" suggestions for real-time and archived data sets included math manipulatives, weather, plants, solar systems, food chains, volcanic aerosols, water pollution, food web, oyster growth, tides, sea ice, coastal development and population increases, and mineral resources. A few respondents listed a variety of weather data sets.

Table 5. Response rates, binned by grade level, indicating subject area interest in real-time data sets. Subject areas with ≥ 50 percent response rates are highlighted by shading.

		Grade Level		
Discipline	**Real-Time Data**	**K to 5**	**6 to 8**	**9 to 12**
Physical	temperature: air	65	51	47
	temperature: water	46	49	49
	bathymetry/topography	3	24	52
	water depth	13	19	35
	currents	22	35	52
	waves	24	41	43
	sea level rise	16	30	56
Chemical	atmospheric carbon dioxide	4	43	60
	dissolved oxygen (DO)	7	38	53
	nutrients	16	46	53
	ocean color	11	16	30
	pH	9	54	57
	salinity	29	51	55
	water contaminants	22	46	51
	water turbidity (clarity/cloudiness)	8	38	43
Biological	algal blooms	8	49	56
	animal tag/tracking	25	41	52
	fish species and abundance	17	43	49
	zooplankton species	21	32	51
Other/None	other	9	5	7
	none of the above	17	3	9

Utility of Outdoor Experiences

Over the past two years, 53 percent of respondents have incorporated opportunities for outdoor exploration activities with their students. Seventy percent (70%) of K-5th and 6th-8th grade teachers have included outdoor exploration with their students in the past two years, while 60 percent of high school teachers have done so. Examples of outdoor activities ranged from schoolyard programs, to boat trips and out of town field experiences; a full list of these activities is included in Appendix III.

In order to assess the value of outdoor activities with respect to stewardship ethics, respondents were asked if they noticed an increase in environmental awareness in students after they participated in an outdoor activity as compared to traditional classroom teaching. Ninety three percent of teachers surveyed that included outdoor exploration indicated an increase in student awareness (positive response rates across binned grade levels ranged between 54-79%), citing some of the following as evidence: pointing out things they learned in science lesson, more interest in helping protect the Bay, proof of their own outdoor research, understanding of concepts, increase in observation skills and questions, and awareness of human activities and their effects.

Ninety two percent of respondents were interested in incorporating more outdoor education activities with their students (K-5th grade: 94%; 6th-8th grade: 96%; 9th-12th grade: 86%). The barriers respondents noted for taking a class on a field trip are numerous; however the most common answer was funding followed by transportation issues across all binned grade levels (Figure 14)**.** Moderate response rates were provided for lack of knowledge in outdoor activities, lack of knowledge of flora and fauna and the "other" category. Examples of "other" responses included scheduling, monitoring behavior of students, time, class size, relating the trip to the Standards of Learning, lack of nearby areas, lack of equipment, and students' special needs. Time was the most commonly listed "other" reason, including scheduling around the SOL tests. Lack of administration support and confidence in leading outdoor activities received the lowest response rates.

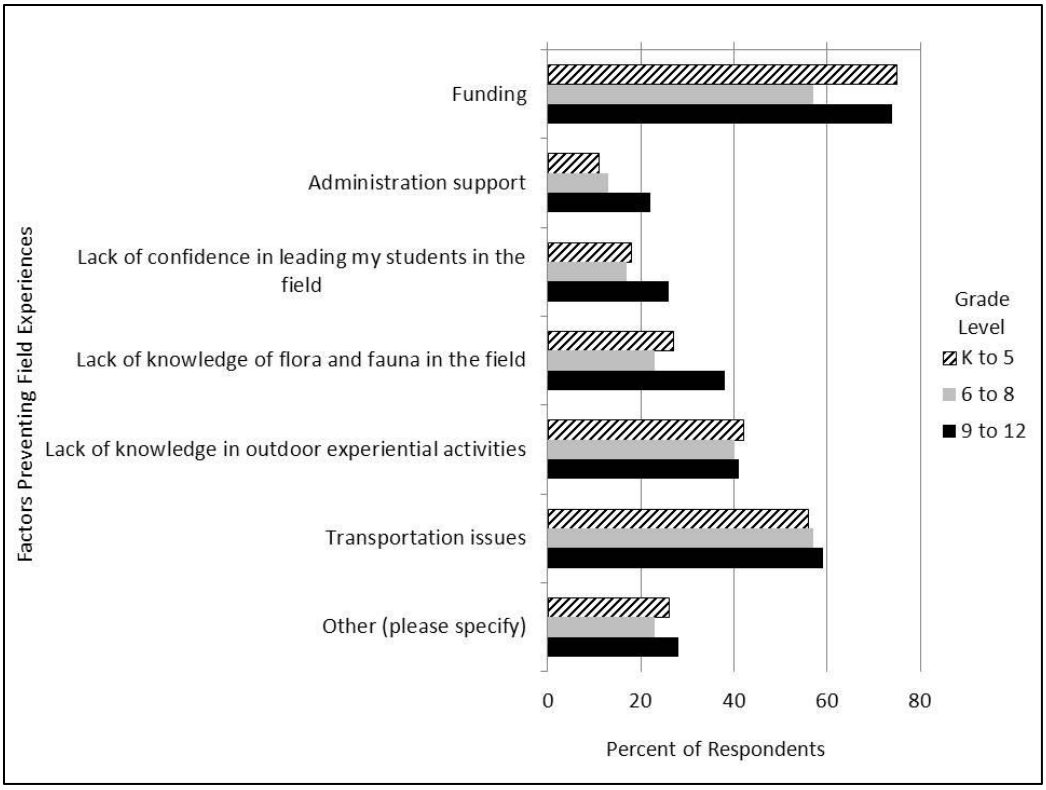

Figure 14. Percent response rate of barriers limiting field experiences for students.

A large percentage, generally exceeding 50 percent for all binned grade levels, of the respondents noted that help in conducting hands on activities, facilitating inquiry-based activities and field supplies would increase their likelihood of incorporating more outdoor education into their classroom (Figure 15). It should be noted that facilitation of field data collection also ranked high for high school respondents. Some other suggestions for help included funding, ways to use schoolyard parks, lesson ideas, guest speakers, class sets of equipment, and assistance on field experience. Conducting hands-on activities, facilitating inquiry-based activities, and facilitating with field work/data collection are focus areas for the CBNERRVA Education Program.

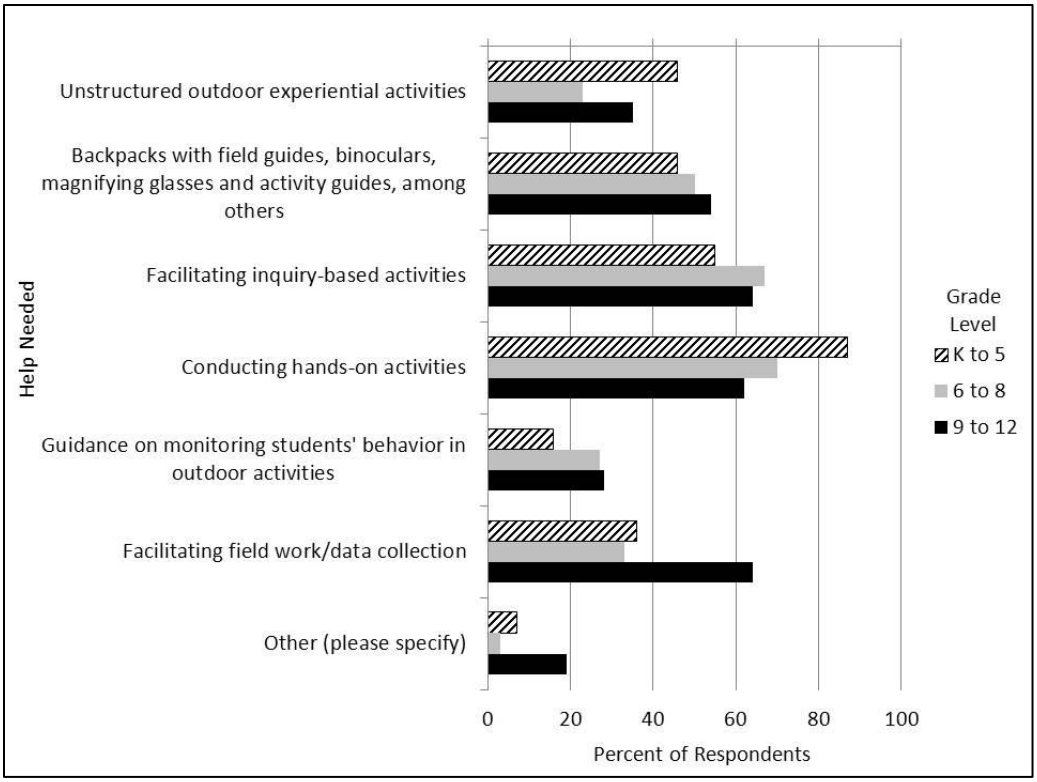

Figure 15. Percent response rate of help needed to incorporate more outdoor education in the classroom.

Teacher Professional Development

Introduction and Incentives

Teacher professional development provides a way to inform K-12th grade teachers of effective classroom methods and best practices relating to their content area. A fundamental desire to increase knowledge base in teaching and subject matter as well as interest in the subject matter provided the primary motivation for teachers to participate in professional development programs. The value of teacher recertification points and continuing education units (CEUs) were identified as providing an intermediate level of motivation. Recommendation by administration or lead teacher and grant requirement received the lowest motivation ranks. The response pattern was similar across all grade levels.

Level of Watershed, Estuary and Ocean Specific Training

In order to assess recent training program participation in key subject areas (watersheds, estuaries and oceans), teachers were asked how many hours of professional development they had received in the last three years. Responses for K-5th grade, middle and high school grade levels are provided in Figures 16-18, respectively. The majority of teachers in all binned grade levels have not had any training on watersheds, estuaries, and oceans in the last three years. There was an increased level of exposure to

training by middle and high school level teachers over elementary school teachers. With respect to the three topic areas (watersheds, estuaries and oceans), no single topic dominated the responses.

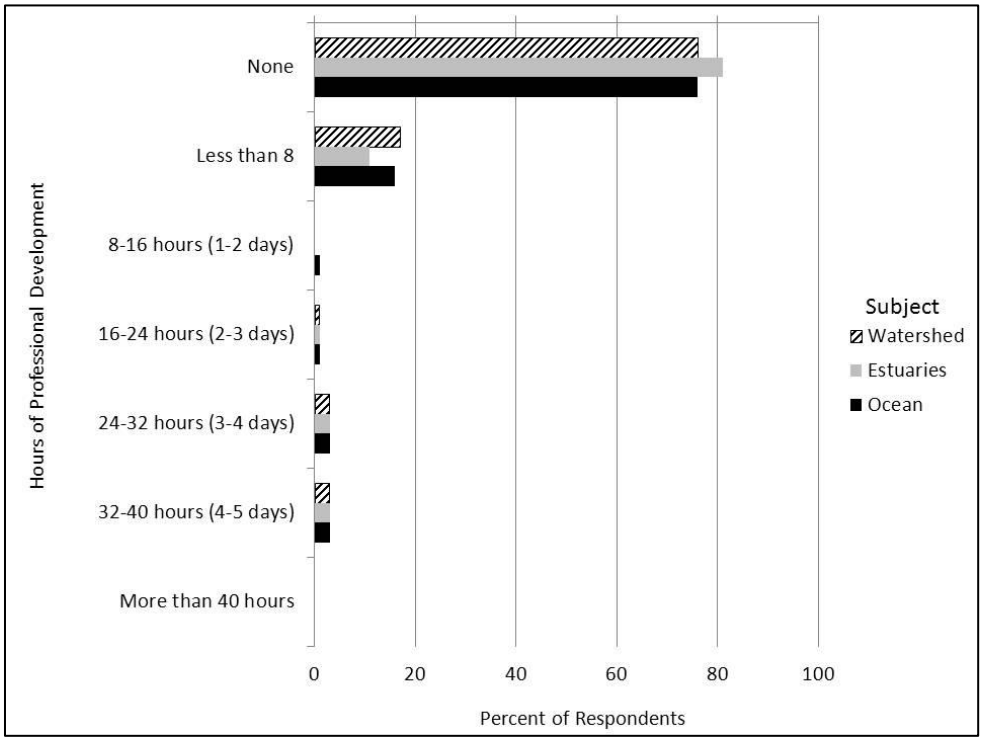

Figure 16. K-5th grade teacher response rates with respect to hours of professional development in the subject areas of watersheds, estuaries, and oceans over the past three years.

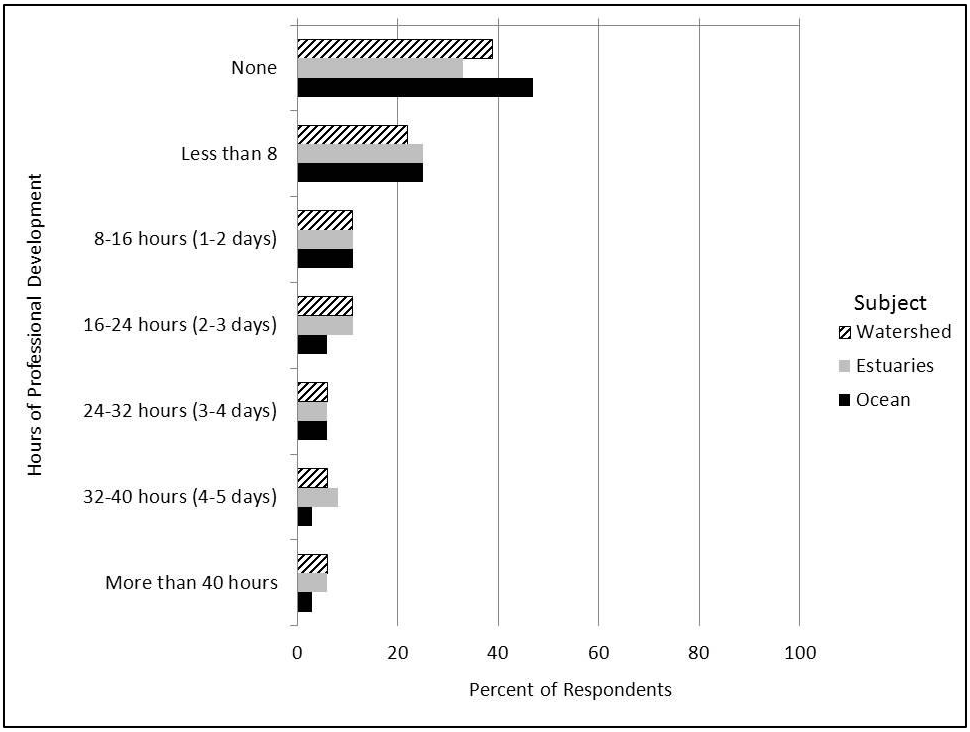

Figure 17. Middle school teacher response rates with respect to hours of professional development in the subject areas of watersheds, estuaries, and oceans over the past three years.

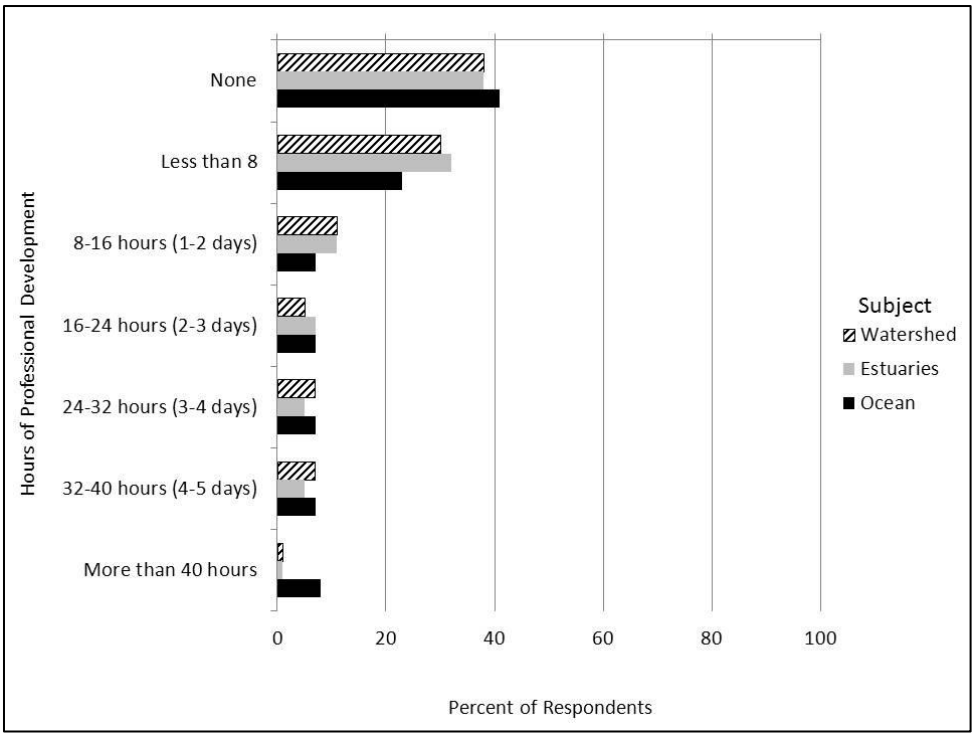

Figure 18. High school teacher response rates with respect to hours of professional development in the subject areas of watersheds, estuaries, and oceans over the past three years.

Over half of the K-5th grade and middle school teachers, and 30 percent of the responding high school teachers have not taken any of the professional development trainings specifically identified in Figure 19. This question did not ask for trainings within a time frame, so trainings attended may have occurred a number of years ago. Project WET and Project Wild Aquatic, targeted towards all K-12 grades, were the most attended across grade levels. Green Eggs and Sand, targeted towards middle and high school teachers, and the Jason Project are not typically hosted in this local area. The NOAA/NERRS Teachers on the Estuary Training (TOTE) has only been offered with the region once in 2008. Responses to the "other" training category included NOAA on-line and in-person workshops, Chesapeake Experience and Chesapeake Bay Foundation field trips and trainings, NOAA Ocean Explorer workshop, Chesapeake Bay Coastal Academy, Oyster Reef Keepers Advanced Oyster course, online classes in science education, Trout in the Classroom, Lynnhaven NOW, Elizabeth River Project, Wonders of Wetlands, CBIBS, National Marine Education Association conferences, VIMS teacher workshop on the Eastern Shore, and various other VIMS courses.

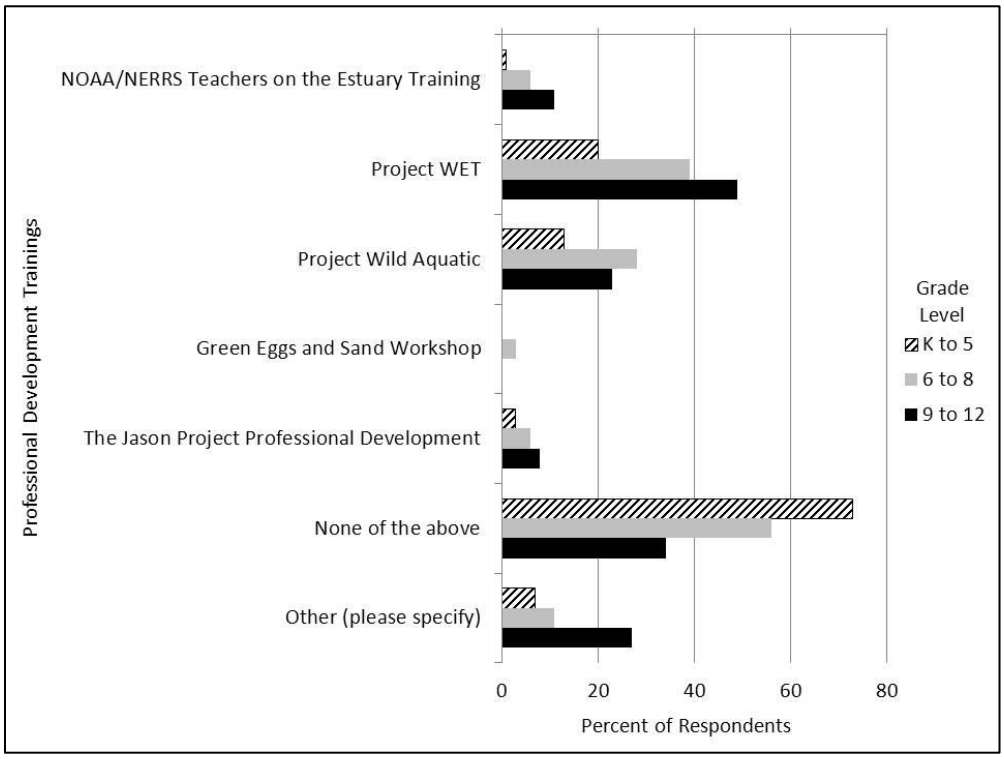

Figure 19. Percent response rate of attending professional development on watersheds, estuaries, and oceans.

Hindrances to Training

With a greater than 60% response rate for each binned grade category, high registration fees was identified as the primary barrier preventing K-12th grade teachers from attending professional development training (Figure 20). This was followed by lack of available time for K-5th grade teachers, lack of available time and travel/transportation constraints for middle school teachers, and travel/transportation constraints for high school teachers. Response rates of training information not being relevant to teacher needs varied between 16-44 percent, with trainings being more relevant for

secondary school levels than elementary levels. Lack of available educational credits and administration support for professional development exhibited an overall low (<20%) response rate~~s~~ by each binned grade level category.

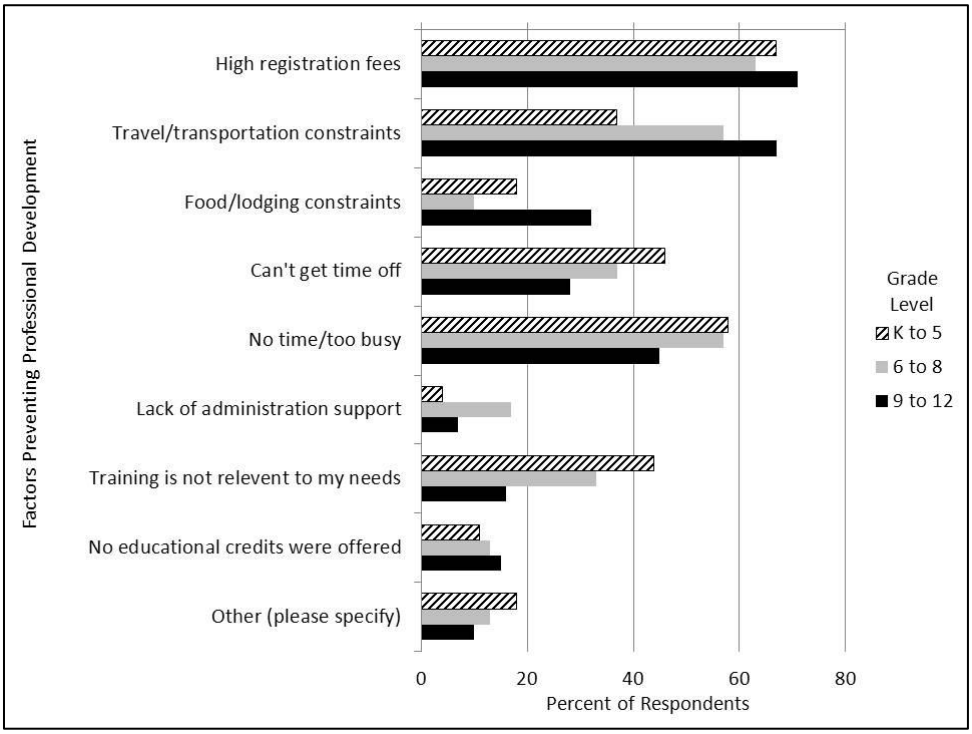

Figure 20. Percent response rate of factors preventing attendance at professional development opportunities.

Subjects Needing Additional Training

Teacher professional development needs by binned grade levels is presented in Table 6. Teacher development needs in the topic area 'conducting hands-on activities' received a high response rate (≥50%) across all grade levels. Additional development topics receiving a high response rate included science content and facilitating inquiry based activities for K-5th grade level teachers and incorporating new lab activities for middle school teachers. Additional high response rate topics for high school teachers were numerous and included facilitating inquiry-based activities, incorporating new lab activities, facilitating field work/data collection and using real-time or archived data. Development need topics receiving moderate response rates (≥30% and <50%) for the K-5th grade level included incorporating new lab activities. Numerous topics received a moderate response rates from middle school teachers, the top three being science content, facilitating inquiry-based activities and using real-time time or archived monitoring data. Moderate response topic needs for high school teachers included science content, using computer generated visuals and new websites, and analyzing data.

Table 6. Response rates, by binned grade levels, for topic-related professional development needs. High response rates (≥50%) are highlighted by shading.

	Grade Level		
Professional Development Topics	**K to 5**	**6 to 8**	**9 to 12**
Science content	51	47	49
Facilitating inquiry-based activities	51	47	58
Conducting hands-on activities	83	70	68
Incorporating new lab activities	47	67	65
Facilitating field work/data collection	28	27	54
Analyzing data	5	23	30
Using computer-generated visualizations of data	18	40	41
Using new websites	28	30	30
Using real-time or archived data from monitoring sites	14	43	52
Other (please specify)	2	7	4

Professional Development Structure

With respect to structure of professional development program offerings, focused one-day workshops was the top ranked development program format for all three grade level categories, followed in general by focused 2-3 day workshops (Table 7). Other program formats receiving moderate response rates by K-5th grade teachers included after school workshops and on-line training. Middle and high school teachers provided moderate responses for extended one-week summer training and on-line training. Online peer discussion and semester long courses were less desirable training structures across all binned grade level teachers.

Table 7. Response rates, by binned grade levels, for desired format for professional development offerings.

	Grade Level		
Professional Development Formats	**K to 5**	**6 to 8**	**9 to 12**
Single after school workshop	40	17	19
Series of after school workshops	23	20	13
Focused 1-day workshop	56	50	67
Focused 2 or 3-day workshop	25	37	44
Extended training of 1 week or more (during the summer)	14	47	29
Online training or course	23	30	42
Online peer discussion course	0	3	6
Semester long course	0	7	6
Other (please specify)	4	3	3

Professional Development Advertisement

Direct e-mail contact was identified as the best way to reach teachers about professional development opportunities (K-5th grade response rates: 70%; 6th-8th grades: 73%; and 9th-12th grades: 67%) followed by contacting key personnel at the individual schools. Identified key contact school personnel included the school's principal for K-5th grades, teacher's curriculum coordinator for middle school and department heads at the high school level. List serves, local newspaper, and television received low response rates.

NERRS Awareness

Across all binned grade levels, the majority of respondents (54%) were not aware of the NERRS. Individual response rates for awareness of NERRS by binned grade levels were 33 percent for K-5th grade respondents, 58 percent for middle school and 48 percent high school level respondents. Of those aware of NERRS, use of reserve related educational services and products was 8 percent for K-5th grade, 44 percent for 6th-8th grade and 38 percent for 9th-12th grade teachers. Greater awareness of NERRS by middle school teachers, a CBNERRVA targeted group, was evident. Examples of CBNERR educational services or products teachers have used include field trips, estuaries modules, classroom visits, teacher collection events, and teacher workshops. It should be noted that the CBNERRVA Education Program primarily serves the Gloucester, Mathews and, more currently, the York County school jurisdictions. This leaves much of the Hampton Roads region outside the Reserve's core geographic education program focus area, and therefore, may explain the overall lower awareness of NERRS by regional teachers.

Discussion

This K-12th grade environmental education needs assessment was undertaken to identify gaps in existing educational programs in the Virginia Hampton Roads study region, determine informational needs of regional K-12 teachers and provide insight on how to improve delivery of programs to the region. Information related to this needs assessment was collected from 190 respondents using an on-line survey. Respondents were binned according to appropriate grade levels and included elementary (K-5th grade; 19% of the respondents), middle (6th-8th grade; 40% of the respondents) and high (9th-12th grade; 41% of the respondents) school teachers. Responding teachers exhibited varied years of instructional experience resulting in a range of information and insight from those in the more beginning stages of their career to the more established, senior-level teachers.

Study Area Demographics

The Hampton Roads region presents both challenges and opportunities given its high diversity of population demographics such as population density and economic status. Population density, defined as number of people per land unit area (km^2), in high density urban regions can be many times greater (up to 44 times) than the most rural county jurisdiction. The under the age of 18 group contribution to total population generally was ≥ 24 percent within all jurisdictions except for James City County/City of Williamsburg (21%) and Mathews County (20%). The College of William and Mary has a significant influence on James City County/City of Williamsburg, whereas Mathews County is becoming more recognized as a retirement area. With respect to median household incomes, five of twelve jurisdictions were below the national median level ($51,914) and one-half were below the state median ($61,406)

(US Census 2006-2010 data). Median household incomes above the state average occurred in regions of moderate population density (>80 and <700 people/km^2) as compared to the low density rural and high density city jurisdictions.

Geographically, the CBNERRVA focus areas of Gloucester, Mathews and York Counties share or are in close proximity to similar water bodies which include the York River, Mobjack Bay and Chesapeake Bay proper. Because water contribution to the total area of these counties is high, ranging from 25 to 66 percent, these counties will continue to share dependence to tidal waters for both commercial and private activities. These counties exhibit relatively low (40-242 people/km^2) population densities, and with the exception of York County, have a strong rural character. York County differs from Mathews and Gloucester in that the expansive federal government holdings in the central portion of York County contribute to its overall low population density. Elevated population densities in York County are associated with the southern (adjacent to the City of Newport News) and northern (adjacent to the City of Williamsburg) portions of the county. Additionally, a significant range in annual median household occurs within the CBNERRVA focus area, from a high of approximately $81,000 in York County to $47,500 for Mathews County. In contrast to York (61%) and Gloucester (65%) Counties where program coverage was at or slightly above the median for this survey, program coverage in Mathews County (48%) was relatively low. Factors influencing the lower program coverage rate would include the overall low population density, the relative low percent of population of K-12th grade age, and the somewhat geographic isolation from large population centers. Funding, school system priorities, and initiative and interest of school districts must also be taken into account as their participation is needed for education providers to reach them.

Teaching about Watersheds, Estuaries, and the Ocean

Teaching experience, as related to watersheds, estuaries and oceans, varied across the three binned grade levels and depicted a general increasing trend with grade level. The response "no" years teaching experience received the highest response rate among the K-5th grade teachers for each of the three topics as compared to 3-5 years teaching experience for middle school and greater than seven years for high school level teachers. In addition to limited teaching experience, particularly in the lower grade levels, the majority of teachers in all binned grade levels have not had any training on watersheds, estuaries, and oceans in the last three years. The need for greater professional development opportunities in the three focus areas is evident for the Hampton Roads region and represents an opportunity for CBNERR and partner organizations to meet teacher needs. K-5 teachers represented the largest need for this training, with approximately 75% of respondents reporting no training on watersheds, estuaries, and oceans, which could be due to the fact that the standards of learning for K-5 are basic in those grade levels and are not focused on specific habitats. Approximately 40% of middle and high school teachers had no training on watersheds, estuaries, and oceans. Focusing on teacher professional development, especially increasing offerings of Teachers on the Estuary (TOTE) trainings, last offered at CBNERR in 2008, is another opportunity for CBNERR.

Elementary School

Elementary school teachers (K-5) reported one barrier to attending professional development is trainings that are offered are not relevant to them. While some elementary school teachers will attend trainings at the middle and high school level, and adapt the lesson for their grade, most will not attend unless it is specifically focused on elementary grade levels. Educational materials and information at the K-5 level is needed to demonstrate how to incorporate watersheds, estuaries, and oceans into their

course planning. Within the K-5 standards of learning, there is ample room to discuss watersheds, estuaries, and oceans in the classroom, including life processes, earth patterns, cycles and change, and earth's resources. K-5 teachers reported a need for information and educational materials on life cycles, food webs, habitats, weather, the scientific method, and erosion/sedimentation. These topics are all easily connected to watersheds, estuaries, and oceans, and are covered through most CBNERR education programs, with weather arising as a topic to focus on in the future with these students. Water chemistry was reported as no need. This could either be due to numerous other water quality monitoring activities and programs, or a misunderstanding of "water chemistry" by the elementary school teachers. Clarification on this would be needed when designing programs for these grade levels.

Middle School

Approximately 40% of middle school teachers have no specific training on watersheds, estuaries, and oceans, with an additional 20% of middle school teachers having less than 8 hours of training on these subjects. Middle school teachers identified habitats, rivers/watersheds, climate change, the scientific method, technology, and the value of estuaries as a need. This shows the introduction of climate change information during grades 6-8, as well as an interest and need for more training and information on watersheds, estuaries, and oceans. Middle school should be the easiest grade level to encourage to attend training with the 6th grade standards of learning including estuaries directly. A focus for CBNERR will be to include 6th grade teachers in its professional development training, which has not been the case in the past due to the focus on 7th grade teachers through grant-funded projects. CBNERR will continue to offer resource boxes, activities, and web resources that include the topics listed above, and this data confirms the relevance of the current middle school programs offered.

High School

High school teacher respondents showed slightly more attendance at trainings on watersheds, estuaries, and oceans than their middle school counterparts, but the majority of respondents still identified no or less than 8 hours of training on these topics. High school teachers identified biodiversity, habitats, technology, aquatic pollutants, climate change, data, stewardship, and the value of estuaries as a need for educational materials and information. High school teachers rank the highest in interest of real-time data. The data requested by respondents in 9-12 grades included many parameters focused on human-related factors and climate change factors, indicating a needed expansion of the introduction of climate change in middle school to more locally relevant data interpretation at the high school level. This grade level's needs match up the best with the NERRS mission, programs, and research focus. An increased participation with high school teachers through materials, relevant data, and professional development is a focus for the future for CBNERR.

Topics of Need

Teachers across all grade levels were asked to report on areas of high need including educational materials and programs, both through web resources and in person.

Of the choices that were given on web access, teachers that are using the web to access watershed, estuary, and ocean information are mainly using the NOAA Education website (K-5th grade = 29%, 6-8th grade = 50%, 9-12th grade = 56%) and the CBNERR website (K-5th grade = 26%, 6-8th grade = 56%, 9-12th grade = 33%). Results provide strong support for continuous upgrading of the information included on the CBNERR website as it is one of the higher ranked sites used by teachers. NERRS and NOAA resources

were represented well through the NOAA Education website and the local NERRS website, although the national NERRS website and the NERRS educational site, estuaries.gov were not ranked high. Estuaries 101 middle and high school curricula exist on the estuaries.gov site, which most people do not use. This is an area of focus for CBNERR and advertisement of those materials and resources should be increased during public programs, K-12 field trips, teacher trainings, and direct emails to teachers.

Of the top five interests in real time and archived data sets, four of the parameters are those collected with the CBNERR water quality and weather data. This presents another outreach opportunity through the CBNERR website and through professional development trainings. CBNERR can teach teachers how to access and utilize the SWMP data as well as the NERRS SWMP interface which will make the data more visually appealing and age appropriate.

The scientific method was a common need for both K-5 and 6-8 teachers. Middle school teachers were also interested in real time data including air temperature, salinity, and pH, all of which we collect during our field experiences except for air temperature. While teachers reported that topics such as fisheries and recreation opportunities are not needed in educational material, there has been discussion through the Advisory Committee that wording of some topics could have been misleading to some people, therefore giving them a lower rank (Figures 10-12). For example, if fisheries had been listed as seafood or sustainable seafood choices, it may have ranked differently. Respondents' interpretation of the topics influenced their selection. Most topics that ranked as a low priority for elementary school teachers was as high priority for high school teachers (and vice versa), indicating that a low ranking may be a topic too advanced (or too simple) for that particular grade level. Understanding the needs and interests of each grade level will prove helpful for future CBNERR education program planning.

Climate Change

Climate change is an ever-increasing topic of conversation between environmental resource personnel and educators. Although not specifically listed on the standards of learning, 63% of respondents suggested that they would like to include more discussion on the effects of climate change with their students. Higher response rates were provided for 6-8th (78%) and 9-12 grade (69%) teachers as compared to the lower (K-5) grade level where the response rate was less than 50 percent. The discrepancy between broad grade levels would be expected given the complexity of the subject matter. No question was asked regarding teachers' current instruction of climate change in the classroom, only of their interest to include more discussion. Please see Appendix IV for needs of teachers in order to do so. Based on the input from the teachers, long term data sets, locally relevant information, and updated scientific research is needed in order to do this. CBNERR can incorporate this into information on the website, through professional development trainings, and into curriculum for school visits.

Outdoor Experiences

Recognizing the importance of field studies in connecting students to the local environment and to the broader topic of science, the majority of respondents have included some outdoor experiences as part of their curriculum in the past two years. These results are somewhat contradictory to the low response rate for the field studies category when teachers were asked to identify commonly used modes of instruction. This could be due to the fact that teachers do not view field experiences as a typical mode of instruction, or that they are relying on outside educators to lead the outdoor experiences that their students are participating in. Regardless of question and/or response interpretation, a vast majority (>90%) of the teachers are interested in learning how to include more outdoor education into their

curriculum, specifically in hands-on activities and inquiry-based lessons. This is strong proof for a continuation of the MWEE Capacity Building workshops held at CBNERRVA in conjunction with Virginia Sea Grant the past two years.

Recent school budget reductions have become a major issue affecting K-12th grade environmental education activities within the Reserve target region. Given these budget reductions, it is imperative that programs maximize their effectiveness and support school systems to the greatest degree possible. Some of the local impacts include shortening the school year, which cuts down on the amount of available days for environmental instruction from outside educators, and the elimination of field trips off campus in some counties unless the experience takes place after school or on the weekends. Some solutions that CBNERRVA has offered to local schools are after-school programs, Saturday programs, and focusing more on meaningful watershed educational experiences that take place on the school grounds. Any programming that CBNERRVA can provide that includes transportation costs and substitute teacher costs will reduce limitations schools have to attend off campus field experiences.

Class size and class length can also impact the feasibility of field programs for teachers. For K-5th grade teachers, who have one class whose size is typically less than 25, it is easier to ensure that all students participate in a meaningful field experiences, while for a high school teacher that has up to 150 students, multiple days or an educational facility that can hold that many students at a time are needed in order to ensure all students have a field experience. These field experiences are more difficult to schedule, are more intimidating, and are more costly. Field experiences typically take place for longer than one class period, therefore causing disruption to other classes and teachers when one teacher is off campus with a class. Schools may be more tentative to send teachers off campus because they will have to pay a substitute to cover the teacher's other classes. If focusing more on MWEE's on campus, class length can impact the amount of time available for environmental education activities because typically these events are kept to the normal class schedule. High school classes may have greater lab and field opportunities given that their class lengths are 80 minutes or more, while shorter class length may restrict field studies, especially those taking place off campus.

Professional Development

Respondents are motivated to take professional development by their own desire to increase knowledge, on both teaching methods and subject matter, while teacher recertification points and continuing education units (CEUs) only provided an intermediate level of motivation. Despite the desire to participate in professional development trainings focused on watersheds, estuaries, and oceans, the majority of teachers in all binned grade levels have not received training in these topic areas over the past three years. Primary barriers to participating in professional development opportunities included high registration fees followed by transportation constraints. The impact of these two factors can be exacerbated during periods of a down-turned economy such as we are currently experiencing. Limiting or eliminating registration fees, and where possible, travel costs, would be particularly beneficial to the region's teachers. Possible solutions could include cost offsets by grants, selection of strategic locations, and providing trainings in a more cost-effective format.

Professional development topic areas receiving the highest response rates by teachers within the study region included: developing and implementing hands-on activities, incorporating new lab activities into classroom instruction, and facilitating inquiry-based activities. High school teachers also expressed a desire to receive additional training in the areas of data collection and use of real-time or archived data. The preferred structure for receiving development training, across all binned grade level teachers, was

one-day workshops followed by workshops of variable duration based on grade level. One-day workshops have the benefit of reducing cost associated with overnight or multi-day travel. Online trainings and other format alternatives that could potentially reduce costs were less desirable across all binned grade level teachers.

Based on the information gathered for this report, professional development trainings offered by CBNERRVA are meeting, to some degree, the mode of contact, format structure and topic content desired by regional teachers. The Reserve currently uses its teacher listserv to alert teachers, as well as department heads and curriculum coordinators, as to upcoming training opportunities. Additionally, CBNERRVA does not charge for its one-day workshops that are designed to support the collection of estuarine specimens used in classroom instruction and enhance the capacity of teachers to conduct meaningful field experiences. Cost saving options could include encouraging and coordination of car-pooling among participants and selection of alternative locations. It should be noted that CBNERRVA laboratory and other resources are required for specific offerings and mandate offerings to be held at the VIMS. With respect to topic areas, CBNERRVA is well positioned to enhance professional development offerings through greater integration of the Reserve's water quality monitoring programs and climate change sentinel site initiative.

Summary

Given high response rate of teachers having no experience in teaching required watershed, estuary, and ocean related topics (see Figures 3-5) and those that have not taken any professional development training to supplement their estuary/watershed/ocean education (Figure 16-18), there appears to be an opportunity to provide professional development in these topical areas, especially with K-5 teachers.

Mathews County is an area of need in our survey locations, and programs taking place within the County will be increased.

CBNERR appears to be meeting most of the needs of area teachers for hands-on, inquiry-based field trip opportunities. There is a clear need to address climate change in the Reserve's offerings, starting in middle school and continuing into high school. Delivery of locally relevant data related to climate change and watersheds, estuaries, and the ocean in general, are needed especially at the high school level.

CBNERR will continue to offer meaningful field experiences and capacity building training on these experiences for local teachers, keeping in mind the hindrances that affect teacher participation.

More awareness of the Reserve is needed to alert more teachers to the opportunities at the Reserve and through the national NERR system. The CBNERR website is an important resource for teachers, so keeping it up to date is necessary, as well as increasing the amount of data and resources for all grade levels.

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Appendix I: Education Advisory Committee Members

Vicki Clark, Virginia Sea Grant, Marine Advisory Program, Virginia Institute of Marine Science

Shannon Ricles, NOAA National Monitor Marine Sanctuary

Andrew Larkin, NOAA Chesapeake Bay Office, Nauticus

Susan Walton, Natural History Museum of Virginia, retired teacher Peasley Middle School

Appendix II: Survey Instrument

Needs Assessment 2011

1. Background Information

The Chesapeake Bay National Estuarine Research Reserve in Virginia is conducting a K-12 needs assessment to determine what types of K-12 environmental education and teacher professional development programs are most needed by the teachers and students in Hampton Roads. Your input is valuable to us and will allow us to tailor our programs to better meet your needs.

Thank you for taking the time to complete the survey. It should take about 15-20 minutes to complete.

***1. In what educational setting do you teach?**

- ◯ Public School
- ◯ Private School
- ◯ Other (please specify)

***2. What is the name of your school?**

***3. What grade level do you teach? Check all that apply.**

- ☐ K
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10
- ☐ 11
- ☐ 12
- ☐ Other (please specify)

***4. Which of the following science subject matter courses do you teach? Check all that apply.**

- ☐ Biology
- ☐ Chemistry
- ☐ Physics
- ☐ Physical Science
- ☐ Earth Science
- ☐ Environmental Science
- ☐ Life Science
- ☐ Marine Science
- ☐ Technology/Computer Science
- ☐ Math/Statistics
- ☐ Other (please specify)

Page 1

Needs Assessment 2011

***5. How many years have you been teaching?**

- ◯ 0-2
- ◯ 3-5
- ◯ 6-10
- ◯ 11-15
- ◯ 16-20
- ◯ >20

***6. Approximately how many students do you teach science to per year?**

- ◯ 1-25
- ◯ 26-50
- ◯ 51-75
- ◯ 76-10
- ◯ 101-125
- ◯ 126-150
- ◯ 151-175
- ◯ 176-200
- ◯ >200

***7. How long is a typical science class that you teach?**

- ◯ <20 minutes
- ◯ 20-40 minutes
- ◯ 40-60 minutes
- ◯ 60-80 minutes
- ◯ >80 minutes

***8. What is your standard mode of teaching? Please select how often you use each method.**

	Always	Often	Sometimes	Rarely	Never
Lecture/Direct Instruction	◯	◯	◯	◯	◯
Discussion	◯	◯	◯	◯	◯
Indirect Instruction	◯	◯	◯	◯	◯
Worksheets and Handouts	◯	◯	◯	◯	◯
Video/Media	◯	◯	◯	◯	◯
Demonstration	◯	◯	◯	◯	◯
Web-quests/Other online activities	◯	◯	◯	◯	◯
Current Issues/Topics	◯	◯	◯	◯	◯
Hands-on/Inquiry-based activities	◯	◯	◯	◯	◯
Field Studies	◯	◯	◯	◯	◯

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***9. Think about your plans for your class for the entire year. How much emphasis did you or will you give each of the following?**

	Little or no emphasis	Moderate emphasis	Heavy emphasis	N/A
Outdoor experiential activities	○	○	○	○
Lab or Field Work/data collection	○	○	○	○
Stewardship projects or activities	○	○	○	○
Data analysis, statistics, and probability	○	○	○	○
Scientific inquiry skills	○	○	○	○

***10. Do your students have access to computers in the classroom?**

○ Yes

○ No

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***11. Which of the following real-time/archived data sets would you need synthesized into age-appropriate learning materials and visualizations for your teaching? Check all that apply.**

***Note: We're defining real-time data streams as data that you can access as the data are being collected by scientific instruments, or shortly thereafter, to study current conditions or events. Archived data are defined as older data that are still important and necessary for future reference, but are stored and indexed so that they can be easily located and retrieved.**

- [ ] algal blooms
- [ ] animal tag/tracking
- [ ] atmospheric carbon dioxide
- [ ] bathymetry/topography
- [ ] currents
- [ ] dissolved oxygen (DO)
- [ ] fish species and abundance
- [ ] nutrients
- [ ] ocean color
- [ ] pH
- [ ] salinity
- [ ] sea level rise
- [ ] temperature: air
- [ ] temperature: water
- [ ] water depth
- [ ] water contaminants
- [ ] water turbidity (clarity/cloudiness)
- [ ] waves
- [ ] zooplankton species
- [ ] none of the above

Other (please specify)

Page 4

Needs Assessment 2011

2. Estuary-Related Materials

For the following questions, please use the definitions below for estuary, watershed, and ocean.

Estuary - An estuary is a semi-enclosed coastal body of water where fresh and salt water meet and mix.

Watershed - An area of land where all the water drains to a common place.

Ocean - Related to a system of open-ocean habitats, characterized by exposure to wave action, tidal fluctuations and ocean currents.

***12. There is a National Estuarine Research Reserve located in Gloucester Point, Virginia called the Chesapeake Bay National Estuarine Research Reserve in Virginia, that is one of 28 Reserves around the country protected for the purposes of education, research, water-quality monitoring and coastal stewarship. Were you aware that your state has a National Estuarine Research Reserve?**

- ◯ Yes
- ◯ No

13. If "yes", have you ever used any of their educational services or products?

- ◯ Yes
- ◯ No

If yes, which services or products? If no, why not?

***14. Are estuary and estuary-related topics a required part of your school's/district's/ state's science teaching requirements?**

- ◯ Yes
- ◯ No

***15. How many years have you been teaching estuary, watershed and ocean related topics?**

	None	Less than 2 years	2-3 years	3-5 years	5-7 years	7-10 years	10-15 years	More than 15 years
Estuaries	◯	◯	◯	◯	◯	◯	◯	◯
Watershed	◯	◯	◯	◯	◯	◯	◯	◯
Ocean	◯	◯	◯	◯	◯	◯	◯	◯

Page 5

Needs Assessment 2011

***16. Which trainings have you taken to supplement your estuary/watershed/ocean education? Check all that apply.**

- ☐ NOAA/NERRS Teachers on the Estuary Training
- ☐ Project WET
- ☐ Project Wild Aquatic
- ☐ Green Eggs and Sand Workshop
- ☐ The Jason Project Professional Development
- ☐ None of the above
- ☐ Other (please specify)

***17. In the last three years, how many hours of professional development training in science have you obtained related to estuaries, watersheds and the ocean?**

	None	Less than 8	8-16 hours (1-2 days)	16-24 hours (2-3 days)	24-32 hours (3-4 days)	32-40 hours (4-5 days)	More than 40 hours
Estuaries	○	○	○	○	○	○	○
Watershed	○	○	○	○	○	○	○
Ocean	○	○	○	○	○	○	○

***18. How many class or activity periods of estuary, watershed, and/or ocean instruction do your students receive in a typical school year?**

	None	A portion of one class	One to two classes per year	3 to 5 classes per year	6-15 classes per year	More than 15 classes per year
Estuaries	○	○	○	○	○	○
Watershed	○	○	○	○	○	○
Ocean	○	○	○	○	○	○

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***19. From which web resources do you currently obtain estuary, watersheds, and ocean information for use in your classroom? Check all that apply.**

- ☐ NOAA's Education Website - http:/www.education.noaa.gov/
- ☐ National Estuarine Research Reserve System's Website - http://nerrs.noaa.gov/
- ☐ National Estuarine Research Reserve System's, Education Website - http://www.estuaries.gov
- ☐ Chesapeake Bay VA Reserve's Website - http://www.vims.edu/cbnerr
- ☐ Virginia State Government - http://www.virginia.gov
- ☐ NSTA Estuaries Sci Guide - http://sciguides.nsta.org/
- ☐ EPA Education Website - http://www.epa.gov/enviroed/
- ☐ Wikipedia - http://wikipedia.org
- ☐ National non-profit
- ☐ Local non-profit
- ☐ Other
- ☐ I do not use web resources.

If non-profit, which one? If other, what?

***20. Do you foresee a need for new estuary/watershed/ocean related educational materials in different languages?**

- ○ Yes
- ○ No

If yes, which?

***21. Do you want to incorporate more discussion about the effects of climate change on costal areas with your students?**

- ○ Yes
- ○ No

If yes, what resources do you need?

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3. Professional Development

***22. What is your primary motivation for attending teacher professional development training? Rank the following from 1 to 7, with 1 being your primary motivation and 7 being little to no motivation.**

	1	2	3	4	5	6	7
CEUs(Continuing education units)	○	○	○	○	○	○	○
Teacher recertification points	○	○	○	○	○	○	○
Interest in the subject matter	○	○	○	○	○	○	○
Principal or lead teacher suggests it	○	○	○	○	○	○	○
Requirement as part of a grant	○	○	○	○	○	○	○
Desire to increase my knowledge base in teaching and subject matter	○	○	○	○	○	○	○

***23. What factors prevent you from attending professional teacher development? Please check the three that most commonly occur.**

- ☐ High registration fees
- ☐ Travel/transportation constraints
- ☐ Food/lodging constraints
- ☐ Can't get time off
- ☐ No time/too busy
- ☐ Lack of administration support
- ☐ Training is not relevent to my needs
- ☐ No educational credits were offered
- ☐ Other (please specify)

***24. What type of professional development training do you need? Check all that apply.**

- ☐ Science content
- ☐ Facilitating inquiry-based activities
- ☐ Conducting hands-on activities
- ☐ Incorporating new lab activities
- ☐ Facilitating field work/data collection
- ☐ Analyzing data
- ☐ Using computer-generated visualizations of data
- ☐ Using new websites
- ☐ Using real-time or archived data from monitoring sites
- ☐ Other (please specify)

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***25. What type of teacher professional development format do you prefer?**

- [ ] Single after school workshop
- [ ] Series of after school workshops
- [ ] Focused 1-day workshop
- [ ] Focused 2 or 3-day workshop
- [ ] Extended training of 1 week or more (during the summer)
- [ ] Online training or course
- [ ] Online peer discussion course
- [ ] Semester long course
- [ ] Other (please specify)

***26. How do you find out about teacher professional development opportunities. Please select your top THREE choices.**

- [ ] School principal
- [ ] Department head
- [ ] Curriculum coordinator
- [ ] Direct email
- [ ] Word of mouth
- [ ] Local newspaper
- [ ] Listserves
- [ ] Local television
- [ ] Other, please specify

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***27. Please rate your level of need for further information or educational materials on the following topics related to estuaries.**

	Highly Need	Need	Do Not Need
Water cycle	○	○	○
Biodiversity and adaptation	○	○	○
Life cycles and food webs	○	○	○
Marine/aquatic habitats and wildlife	○	○	○
Weather	○	○	○
Tides/Currents/Waves	○	○	○
Rivers and watersheds	○	○	○
Climate Change	○	○	○
Physical properties of water	○	○	○
Water chemistry	○	○	○
Scientific method	○	○	○
Technology and instrumentation	○	○	○
Case studies of research projects	○	○	○
Data analysis	○	○	○
Marine/freshwater pollutants	○	○	○
Fisheries	○	○	○
Erosion/Sedimentation	○	○	○
Climate change and communities (sea level rise, etc)	○	○	○
Value of Estuaries	○	○	○
Recreation Opportunities (fishing, birding, boating, etc.)	○	○	○
Marine related careers	○	○	○
Stewardship projects	○	○	○
Graphing	○	○	○
Probability	○	○	○
Basic Statistics	○	○	○
Map reading	○	○	○

Other (please specify)

Page 10

Needs Assessment 2011

4. Field Experiences

***28. Have you incorporated opportunities for outdoor exploration activities into your curriculum in the past two years?**

- ◯ Yes
- ◯ No

If you would like, please provide some examples.

***29. Are you interested in incorporating more outdoor education activities with your students?**

- ◯ Yes
- ◯ No

30. As compared to traditional classroom teaching, have you observed an increase in environmental awareness of your students after participating in an outdoor activity?

- ◯ Yes
- ◯ No
- ◯ N/A

If you would like, please provide us with anecdotal evidence.

***31. What help do you need to incorporate more outdoor education in your classroom? Check all that apply.**

- ☐ Unstructured outdoor experiential activities
- ☐ Backpacks with field guides, binoculars, magnifying glasses and activity guides, among others
- ☐ Facilitating inquiry-based activities
- ☐ Conducting hands-on activities
- ☐ Guidance on monitoring students' behavior in outdoor activities
- ☐ Facilitating field work/data collection
- ☐ Other (please specify)

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***32. What factors prevent you from taking your students on meaningful field experiences? Check all that apply.**

- [ ] Funding
- [ ] Administration support
- [ ] Lack of confidence in leading my students in the field
- [ ] Lack of knowledge of flora and fauna in the field
- [ ] Lack of knowledge in outdoor experiential activities
- [ ] Transportation issues
- [ ] Other (please specify)

Appendix III: Outdoor Activities Examples

- Use of outdoor retention ponds/wooded area
- We go outside and look at where water flows around the school.
- Minor - weather data collection and erosion/weathering examples. Encourage star observation and star parties.
- Cloud observation and study of plant anatomy
- Showed students how the roots of plants hold soil so that is does not erode quickly, pick up litter to help the environment, look at cracks in the sidewalks from the roots of trees.
- CBF Canoe Program and Boating Program, American Rover schooner field trip
- BWET and GK12 programs w/ CNU
- Water testing throughout Richmond County from different tributaries to the Chesapeake Bay.
- Animals in their habitats - season changes - animal adaptations - comparing trees- weather
- We do walkabout during plant units in Biology
- CBF boat program, specimen collection at Lynnhaven inlet, beach profile at First Landing State Park
- Layers of soil and decomposers in the park adjacent to the school
- Survey of life in early autumn woods
- With my biology class, we created a biome in a jar using a frog, twigs, leaves, and moths collected from areas around the schoolyard.
- Classes will be taking a kayaking trip on Chickahominy for water testing
- MWEE - outdoor related wetland activities & sampling of on-site water quality
- We come to VIMS every two years. Coming this year again and staying in a beach house with students
- Rivers studies with VIMS staff; York River State Park fossil dig, canoeing, rock hunts, geocaching; New Quarter Park, Birdwatching, nature walk; Virginia Air and Space Museum , Good Bug/Bad Bug, Rocketry, Robotics; Virginia Living Museum, Paleontology, Fossils, Astronomy
- Oyster gardening and water quality monitoring
- Mapped beach formations at First Landing State Park
- VIMS
- Stream monitoring, box turtle monitoring
- Push/pull activites/seasons activities/ scientific investigation
- Field trips for water quality investigations
- We take our students at the beginning of the year to First Landing State park to see the different habitats of an estuary. Last year I took my class kayaking with a tour group.
- Boxerwood walking field trip(water quality testing)
- Visited VIMS
- Summer camps and outdoor garden classroom from April to October
- Outdoor classroom, Box turtle monitoring program with DGIF

- The waterfront at the school; overnights to Tangier Island; canoeing the Dragon Run; Visits to Nuclear Power Plant, Aquariums etc.
- Ditch sampling--water sampling
- Only in marine biology, not general biology
- Worms, animals in habitat, weather observation/tools
- All of my students have been given the opportunity to attend a field studies trip with focus on various topics. Adaptations of marine organisms, bay ecology, species diversity, and water quality were all addressed for each of the field study sites along a salinity gradient.
- I take the IB juniors for field studies to Eastern Shore Lab of VIMS
- Observation of plants and animals on school property
- Water collection
- World Water Monitoring Day
- National Coastal Clean-up, Litter Collection and Analysis, Weather-related activities
- Tree activities, planting
- On campus field trips exploring sediments, soil, weathering, erosion, deposition, mapping

Appendix IV: Needs for More Climate Change Discussion

- Long term data
- How this information can be obtained and measured by students
- Internet information, possibly web quest
- How sea level rise might affect our local communities
- More graphic information showing the tides and how they work on video
- Lessons
- Hands on activities that do not require a ton of materials
- Data not here say form politicians
- Projected maps of areas likely to be submerged in the next 100 years in Gloucester County, VA
- Updates as the years pass
- Anything
- Teacher courses, relevant data sets, documentaries, sampling instruments, video cameras, still cameras, real time data
- Aerial photos of tidewater area from 1950 to today showing development of wetlands
- Just what thrives in warmer environment and which things tend to not do well
- Experts in a field who can create hands-on labs about their specific topic (i.e. global warming effect on sea grasses of the Chesapeake Bay)
- Real data to use to find trends, maps
- Up to date information
- Guest speakers who are knowledgeable in the field
- Data could be helpful along with a pre-made worksheet
- Websites, PowerPoint, handouts for notebooks
- Lesson plans
- Data about sea level rising in Virginia Beach, migratory patterns of marine life/birds due to climate change, etc.
- Grade appropriate reading material, pamphlets, posters, etc.
- Age appropriate for Kindergarten
- DVDs, handouts, anything
- Teacher and student resources about local waterways
- Specific data related to Virginia and Mid-Atlantic climatic temperature, rainfall data
- Reading materials since our text doesn't cover this
- Focused professional development training or free reading materials geared to educators
- Specific up to date information on the Chesapeake Bay
- Updated resources
- A way/demonstration to show how the large impact of a small sea level rise
- One day out of the box ready to go class activity including a hands-on activity and without having to pay for consumable materials when used
- Websites and colorful brochures

- From A-Z at the primary level
- Literature to support this, lesson plan ideas
- Maps
- Real world and/or hands on activities and projects
- A lot of the information is too high-level.
- What direct impact has sea level changes had on Guinea?
- What effects have been seen locally?
- Streaming videos
- Data regarding climate change or water levels
- Archived data for our area: temperature (air and water), thermal expansion data, tropical storm frequency
- Maps, field trips, experiential education time
- Update info about effects on near and distant future