Dear Senator Gardner and Senator Peters:

On behalf of the ocean science and technology community, both academia and industry, I’d like to thank you for the opportunity to provide input as the Committee develops legislation for the reauthorization of the America COMPETES Act. Serendipitous timing of our Fall Member and Board meeting and the inaugural Industry Forum this week allowed for ample in-person discussion and consideration of your questions, and I am pleased to share highlights of their input.

Maximizing the Impact of Basic Research

America is the greatest maritime nation in history, located in the middle of the world ocean systems, yet less than 10% of that ocean on which we depend for prosperity and security has been measured. Its critical processes are insufficiently understood and its resources (living, mineral) haven’t been thoroughly characterized in a manner that leads to useful business or sustainability decisions. Predictable basic research investment (continual and growing at least with the cost of living) attracts the strong career scientists and new graduate students. Without that draw, several industries on which America depends for energy, protein, coastal development, security and recreation will be without a competent workforce.

Science, Technology, Engineering, and Math (STEM) Education and Workforce Issues

On the most basic level, we need to increase investments. The United States has led the world in STEM growth and discovery for the past several decades for a reason, and that is that the federal government has provided funds for science education and research, funds that have been largely unfettered from direction. Scientists and engineers have been free to follow their passion and curiosity without being pushed into predetermined directions. And that has led to incredible discoveries, innovation, and our science primacy.

If the nation is to drive STEM education toward workforce needs, it is best to keep federal STEM education investment decentralized and managed by the agencies that are most aware of the business and societal needs within their respective areas of responsibility.

Students make life choices about STEM in middle school. To make the STEM choice they must see the excitement, relevancy and future of STEM careers. Mission agencies (like NOAA) can provide that visual and participatory excitement that will lead to studies in the core STEM disciplines. After initial excitement and commitment to STEM, the higher education sector can focus the students on specific STEM careers (and that may end up creating a STEM worker in any field).

A few agencies can provide the initial middle school excitement: focus on them.
1. How does the availability of STEM graduates affect corporate decision-making about where to conduct research and manufacture goods?
   - Industries will locate to regions where critical talent exists.
   - A location is attractive if the concentration of academic professionals is large- consider Research Triangle Park in North Carolina.
   - A qualified workforce brings in business investment. STEM graduates have the background and overall training to understand how to conduct research and make scientifically sound decisions about manufacturing goods.
   - STEM undergraduates get jobs, but STEM graduates (masters, PhD) make jobs.
   - Availability of STEM graduates is a primary consideration in where research is conducted and also where centers of operational expertise are located.
   - Business need educated and trained internal brokers to advise, but they also need them to be part of corporation to trust.

2. To make best use of limited resources, how can the federal government, in coordination with the private sector and academia, best prioritize STEM education investments and help respond to shifting academic and private sector workforce needs?
   - Federal investment in basic and applied research in American universities, federal laboratories and industry sets up a fierce competition for funding that naturally elevates the best science, best scientists/graduate students and most important science.
   - STEM education investments are not just important to workforce needs. Every American citizen should be educated in STEM because the results of engineering and science affect the decision-making in so many different ways. An appreciation for the role that science plays and the evidence based approach of science is something that carries forward in everyday life decision-making. Workforce needs come and go, but a solid STEM education is for life.
   - Incentivize academia to be flexible to reorder curricula to reflect the needs of the emerging Workforce.
   - Through existing agencies, the federal government could encourage the private sector and academic institutions to meet (all the way to the local level) to discuss and determine best current academic and industry needs for STEM education.
   - Continued graduate student support is needed, possibly through reduced student loan debt interest rates (look into UK model where debt repaid automatically from wages with amount linked to salary level).
   - Incorporate internships into STEM federal investments.

3. What factors should federal agencies consider to measure the impact and success of the federal STEM education portfolio, and to decide whether to expand, modify, or replace individual programs given limited resources?
   - Follow the students to see where they land, assess their ability to end up in STEM professions. Accept that it may take several years for a student to find that position, so this cannot be a one or two year assessment.
   - Beware driving the national STEM program using only business metrics. While it is necessary to collect STEM education metadata, STEM education direction should be naturally directed by the needs perceived by the federal research funding agencies: the needs they see rising and the science opportunities that reveal themselves. Fierce competition for federal research/education will self-select the best program directions.
   - It is typical when thinking about higher education-level STEM education to focus on R-1 institutions and the graduate research experience. It will be important to national STEM success, if the federal research funding agencies also consider undergraduate STEM funding and especially federal support for undergraduate STEM education infrastructure (labs, instruments, opportunities for field/at-sea work) at liberal arts and comprehensive universities. At least 50% of all students who pursue STEM graduate education come for liberal arts/comprehensive universities and more that 50% of students who choose STEM careers have had experience with hands-on research while an undergraduate. Therefore, the federal STEM education portfolio
should include funding for undergraduate students and facilities, and a specific effort should be made to include undergraduate STEM programs at non-R-1 universities.

- Keep in mind, that the timeline for achieving success in transforming STEM education is long, as it is with diversity issues as well.
- Generate quantitative statistics on numbers in program, retention, graduation, post-graduation
- Undergraduate and graduate degrees tracking where graduates wind up (what industries) would be very useful.

4. **How can federal agencies best identify and encourage implementation of promising, research-driven STEM education teaching models and best practices?**
   - Recognize and reward truly promising research development without politicization.
   - Make funding available to the education institutions so that they can try new approaches and then let them try it. The IGERT program at NSF was a successful model.
   - Use the same proposal submission ranking and evaluation procedures that NSF and other federal agencies already have in place, but include a panel with private sector members with STEM backgrounds.
   - Encourage – reward excellence in teaching on par with research.

5. **What actions can the federal government, private sector, and academia pursue to broaden STEM participation and provide education and research opportunities to students from all backgrounds?**
   - Provide programs that are well supported and that fund students directly, particularly disadvantaged students.
   - Excite students! Agencies that pursue the unknown like NOAA, NASA, USGS, NIH, who own the infrastructure and are filled with career STEM professionals should be specifically provided federal funds and the mandate to excite students.
   - The best way to increase diversity is to either provide the students with appropriate role models, or provide enough funding to allow a cohort to be large enough to allow for the students to be surrounded by other, similar students.
   - Access to STEM facilities, teachers trained in STEM disciplines, and making STEM relevant are the first steps.
   - Link education programs to career opportunities
   - Low rates of federal funding support clearly impact the quantity and quality of research and education. A great portion of the STEM graduate education is funded through research grants by paying tuition and research assistantships for students. Without federal funding for research in the first place, the money doesn’t make it to the students to be trained.
   - Increase private sponsorship (and thus recognition) of innovative STEM programs.
   - Geoforce Texas is a groundbreaking STEM outreach for underserved populations and may be a good model.
   - Connect pre-collegiate experiences to scholarships to research and training pathway opportunities to career options.

**Research Commercialization and Technology Transfer**

1. **What roles is federal, state, and private sector actors best suited to play in bridging the “valley of death” and reducing barriers to domestic, full-scale production of innovative products?**
   - Federal and state governments need to facilitate private sector personnel to go out to academic institutions for training seminars and workshops to educate both the academics and STEM students. Support or tax incentives for Innovation Centers would be used to reduce barriers.
   - The technology transfer pipeline has a major gap that is well recognized. But research organizations, private sector, and the government all seem to not jump in to fill the gap. It must be recognized that the private sector and venture capitalists are not interested in funding the feasibility and proof of taking a particular research
product or technology through the point where venture capitalists are willing to take on the risk. Having good solid reviews of feasibility at an early stage is important as well as the funding

- Fund workshops for industry-academic collaboration.
- Provide funding to help with overcome these barriers, such as the Marine Sensor Innovation Ocean Technology Transfer program of the Integrated Ocean Observing System.
- Provide tax incentives to groups working on transitioning new technologies and promoting private-public partnerships, such as NSF’s Partnerships for Innovation: Building Innovative Capacity program.

2. **How can federal agencies under the Senate Commerce Committee’s jurisdiction incentivize institutions of higher education to improve research commercialization and accelerate innovation?**
- Fund more NSF Small Business Innovation Research grants that propose strong and viable partnerships.
- Provide opportunities for industry to witness tests and evaluations of new university-developed instruments and platforms in real mission-centric environments.
- Create avenues for funding related to innovation, such as Academic Innovation Centers, and provide tax incentives to private sector actors contributing support for these centers or academic departments.
- Maintain and build federal programs addressing this, such as NOAA’s competitive Ocean Technology Transfer Grant Program.
- More funding for critical ocean sensors with a mandate for commercialization.
- Connect the fundamental research and development enterprise to identified national priorities, then use the partnership as a mechanism to establish priorities.

3. **How can federal agencies under the Senate Commerce Committee’s jurisdiction better promote the sharing and commercialization of federally-funded research and data?**
- Good data infrastructure and strong data policies. Data should be made public and as quickly as quality control allows.
- Government investment can start a robust, highly technical, but inefficient program. Use the Global Positioning System as a model - federal research and initial investment in the science and technology of GPS before being turned over to private industry that turned GPS into a utility akin to electricity and water.
- Sharing and commercialization of research and data requires the needed easily accessed data-bases and structures. There is a lot of geoscience data sitting in individual computers because there is no funding to transition that to an informatics system. There is little recognition that this step requires approaches that bring together research domain scientists with information scientists in order to create useable data-base systems.
- Provide opportunity for supplemental awards to grants to help support commercialization of technology developed as a result of science awards.

4. **What barriers or disincentives exist to effective R&D collaboration among federal, State, and private sector actors, and what are successful public-private partnership models that should be piloted or replicated?**
- The current federal funding process can delay research and development activities, agile funding is necessary to support effective and successful collaborations.
- It must be recognized that barriers exist because each of these entities has different goals and motivations. Partnerships are successful when agreement can be reached on goals and objectives, process, motivation, resources, intellectual property, etc. This does not happen with a single conversation but requires lots of time to develop the partnership.
- Competing models to develop applied products hinder collaboration and can result in promoting defense of turf.

5. **How should federal agencies coordinate, evaluate, and update manufacturing-related programs, such as those related to advanced manufacturing or aimed at small-and medium-sized manufacturers?**
- Create centers of excellence and innovation that are based on public/private partnership tied to national priority.

Ocean Leadership’s member institutions appreciate the difficult decisions Congress must make in the face of a constrained budget environment. We also know that if the nation is to maintain and grow our economic stability, it will be on the back of an adequate and sustained federal investment in the scientific enterprise. The research and education components of NSF (and the mission agencies under the Committee’s jurisdiction that can complement the implementation of a robust COMPETES bill) deserve your full support in the reauthorization of the America COMPETES Act. I welcome the opportunity to continue working with the Committee in building the strong science framework necessary to facilitate discovery and innovation while nurturing and training the next generation of scientists. Both efforts are crucial to keeping America competitive.

Regards,

Sherri W. Goodman
President and CEO
Consortium for Ocean Leadership

cc: The Honorable John Thune, The Honorable Bill Nelson