

10 BIG IDEAS

Growing Convergence Research @ NSF

For NSB

May 9, 2017

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NSF's 10 Big Ideas

RESEARCH IDEAS



Work at the Human-Technology Frontier: Shaping the Future



Windows on the Universe: The Era of Multi-messenger Astrophysics

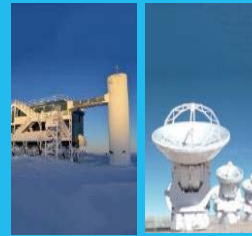


The Quantum Leap: Leading the Next Quantum Revolution

Harnessing Data for 21st Century Science and Engineering



Navigating the New Arctic



Understanding the Rules of Life: Predicting Phenotype



PROCESS IDEAS

Mid-scale Research Infrastructure



NSF 2026



Growing Convergence Research at NSF



NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

Identifying and Closing Gaps



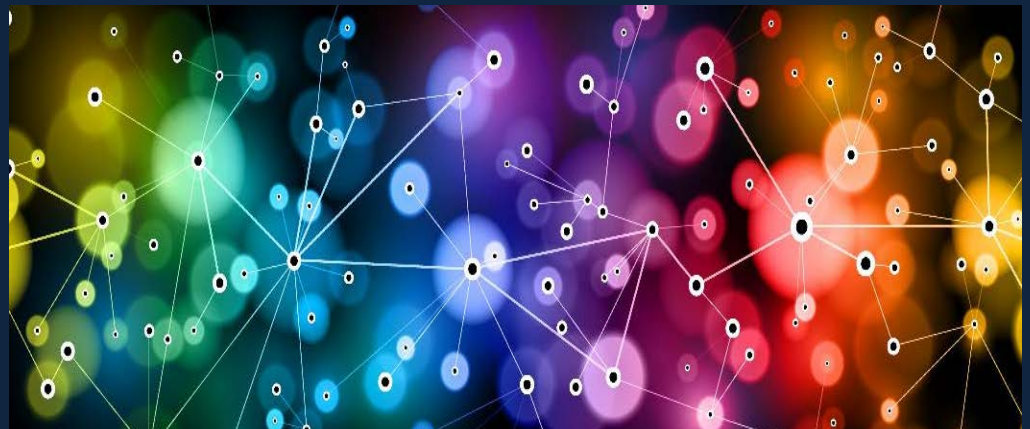
NSF INCLUDES



NSF 2026

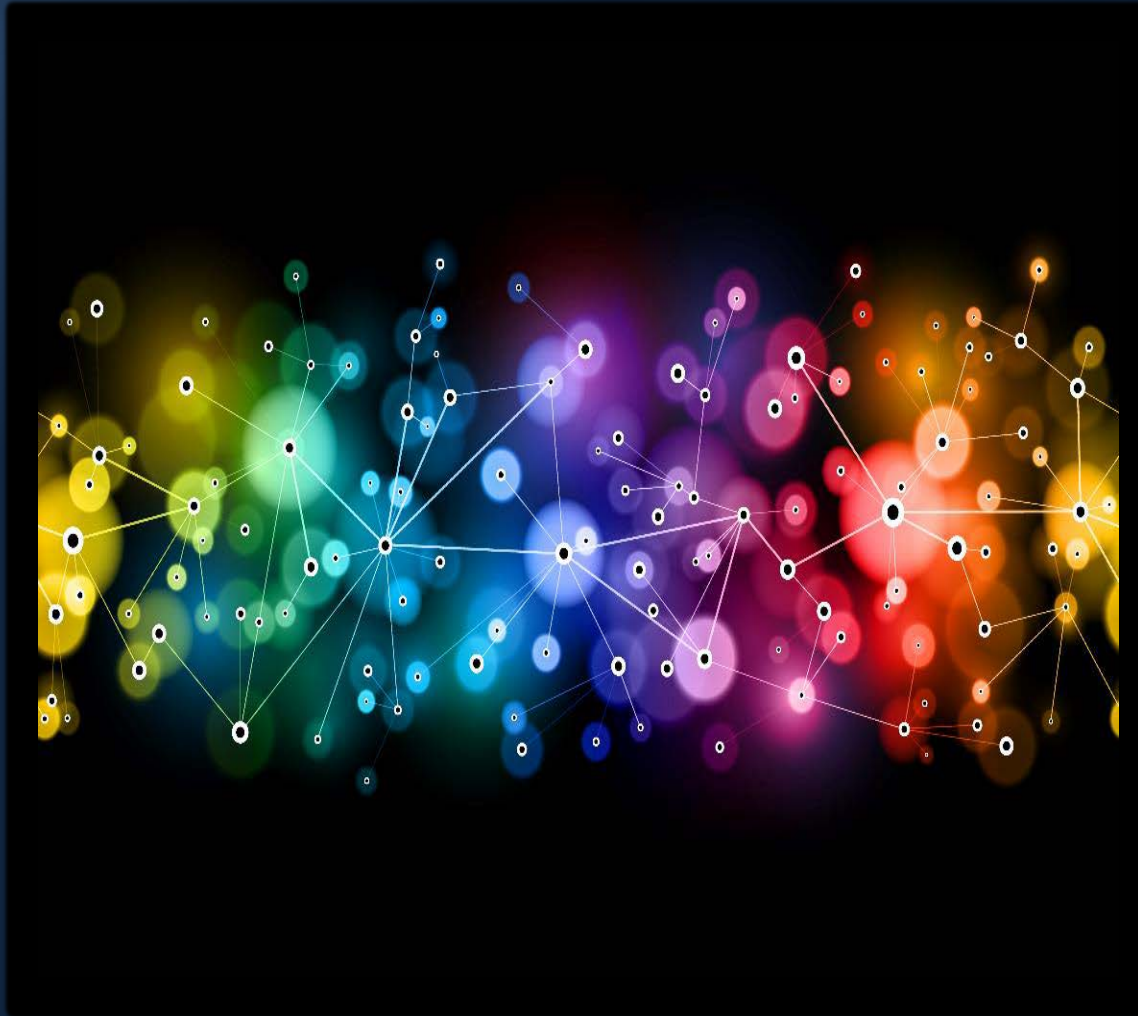


Mid-scale Research Infrastructure

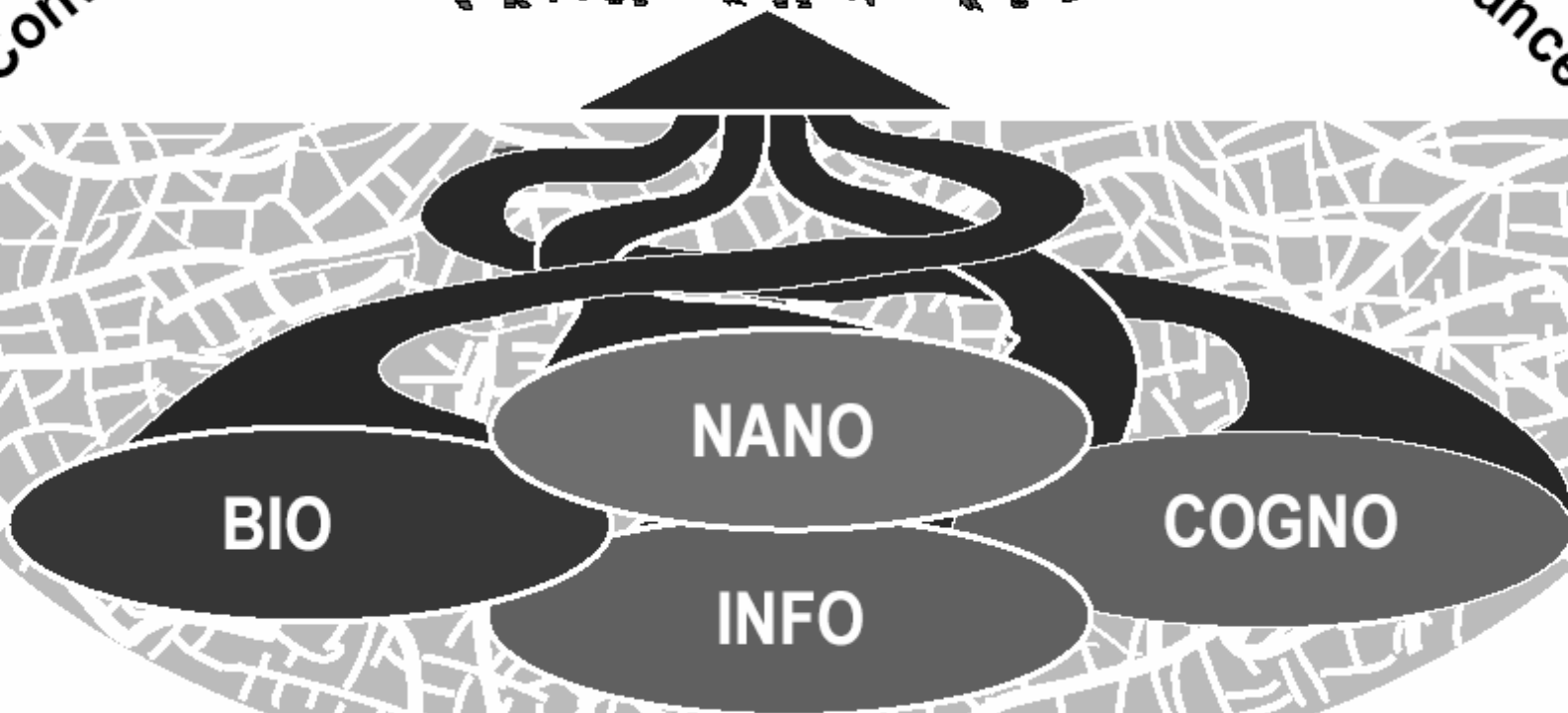


Growing Convergence Research at NSF

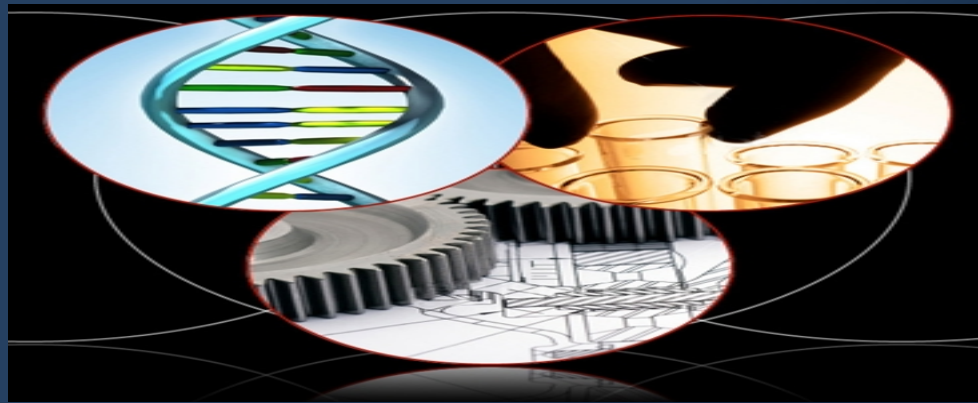
Growing convergence research at NSF



Converging Technologies for Improving Human Performance



R.E.Horn, 2002



National Academies, 2014

MIT, 2011 & 2016




Convergence



Facilitating Transdisciplinary Integration of
**Life Sciences, Physical Sciences,
Engineering, and Beyond**

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

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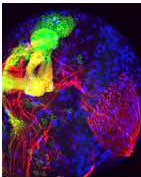
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Convergence Research at NSF

Announcement



Through the **Dear Colleague Letter: Growing Convergence Research at NSF (NSF 17-065)**, the Foundation seeks to highlight the value of convergence as a process for catalyzing new research directions and advancing scientific discovery and innovation. This Dear Colleague Letter describes an initial set of opportunities to explore Convergence approaches within four of the research-focused NSF Big Ideas:

- Harnessing the Data Revolution for 21st Century Science and Engineering
- Navigating the New Arctic
- The Quantum Leap: Leading the Next Quantum Revolution
- Work at the Human-Technology Frontier: Shaping the Future

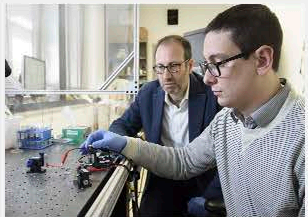
General inquiries about this opportunity may be directed to convergence@nsf.gov.

What is Convergence?

Convergence can be characterized as the deep integration of knowledge, techniques, and expertise from multiple fields to form new and expanded frameworks for addressing scientific and societal challenges and opportunities. It is related to other concepts used to identify research that spans disciplines: *transdisciplinary*, *interdisciplinary*, and *multidisciplinary*. Convergent research is most closely linked to transdisciplinary research in its merging of distinct and diverse approaches into a unified whole to foster new paradigms or domains. Characterizations of convergence are presented in recent reports by the National Research Council [3] and MIT [1, 2], and a series of volumes on convergence edited by Mihail C. Roco and William S. Bainbridge [4, 5, 6, 7, 8].

Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering, and Beyond, National Research Council, 2014.

"Convergence is an approach to problems solving that cuts across disciplinary boundaries. It integrates knowledge, tools, and ways of thinking from life and



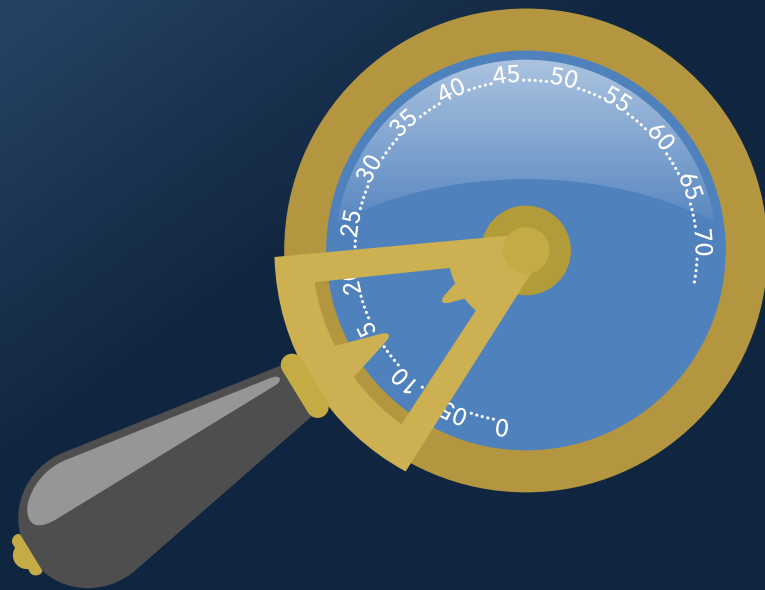
A new organic artificial synapse made by Stanford researchers could support computers that better recreate the way the human brain processes information. It could also lead to improvements in brain-machine technologies.

Alberto Salleo, associate professor of materials science and engineering, with graduate student Scott Keene characterizing the electrochemical properties of an artificial synapse for neural network computing. They are part of a team that has created the new device.

The new artificial synapse mimics the way synapses in the brain learn through the signals that cross them. This is a significant energy savings over traditional computing, which involves separately processing information and then storing it into memory. Here, the processing creates the memory.

This synapse may one day be part of a more brain-like computer, which could be especially beneficial for computing that works with visual and auditory signals. Examples of this are seen

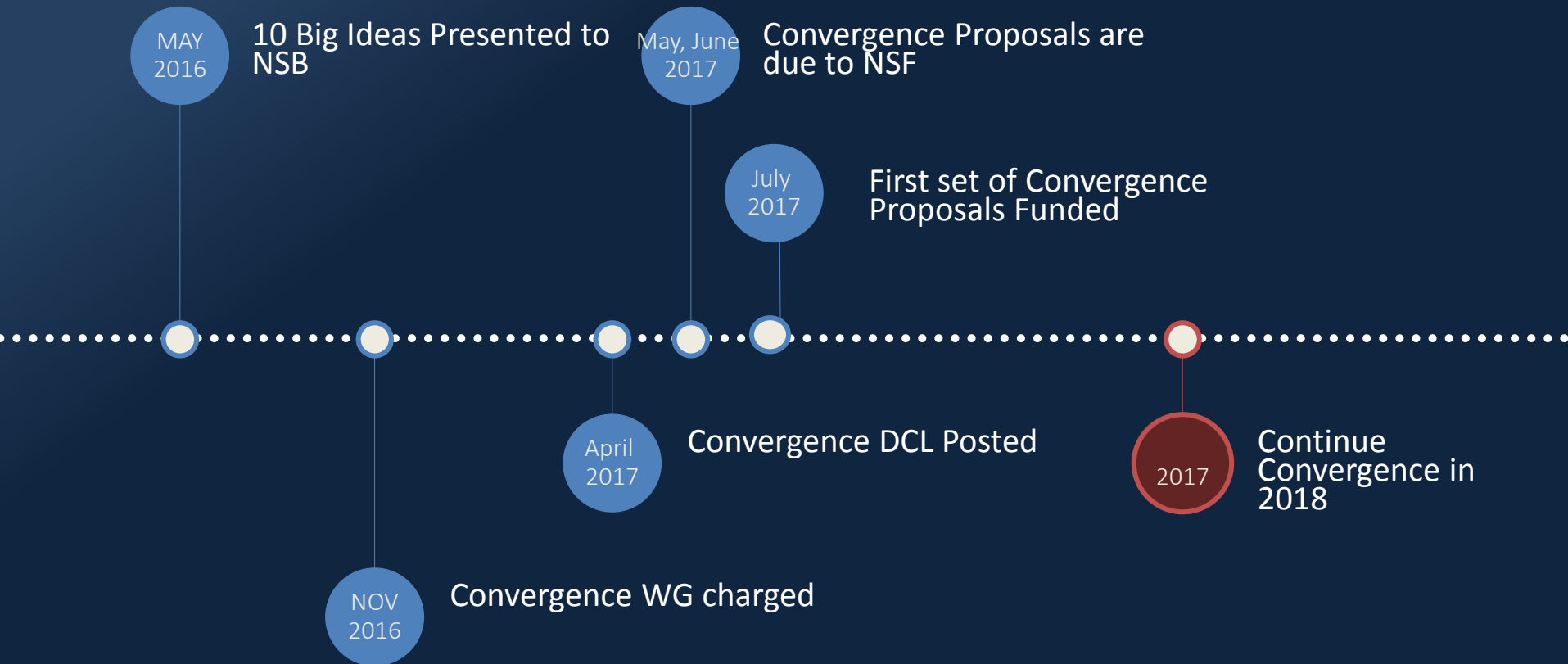
Growing Convergence Research at NSF: DCL (NSF 17-065)
<https://www.nsf.gov/od/oa/convergence/index.jsp>



Accelerating

The creation of self-sustaining ecosystems of convergence; closing the gap on effective implementation of convergence

Convergence Timeline



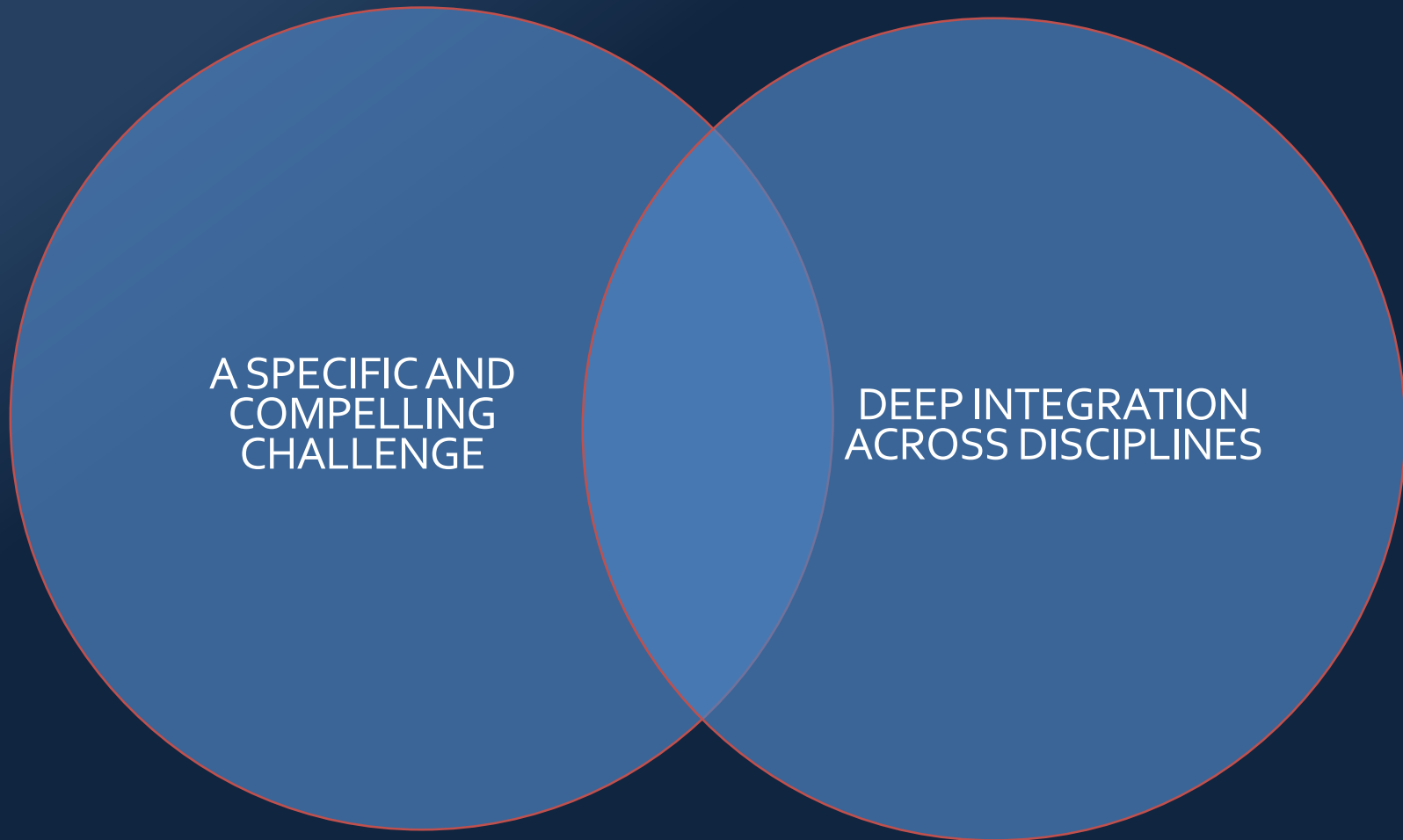
Background

Convergence Working Group

Convergence Working Group	
Name	Directorate/Office
Tom Baerwald	SBE
Dean Evasius, Chair	EHR/OIA
Daniele Finotello	MPS
Chuck Liarakos	BIO
Leah Nichols	OIA
Wendy Nilsen	CISE
Ram Ramasubramanian	ENG
Laura Regassa	EHR
Jessica Robin	OISE
Sarah Ruth	GEO

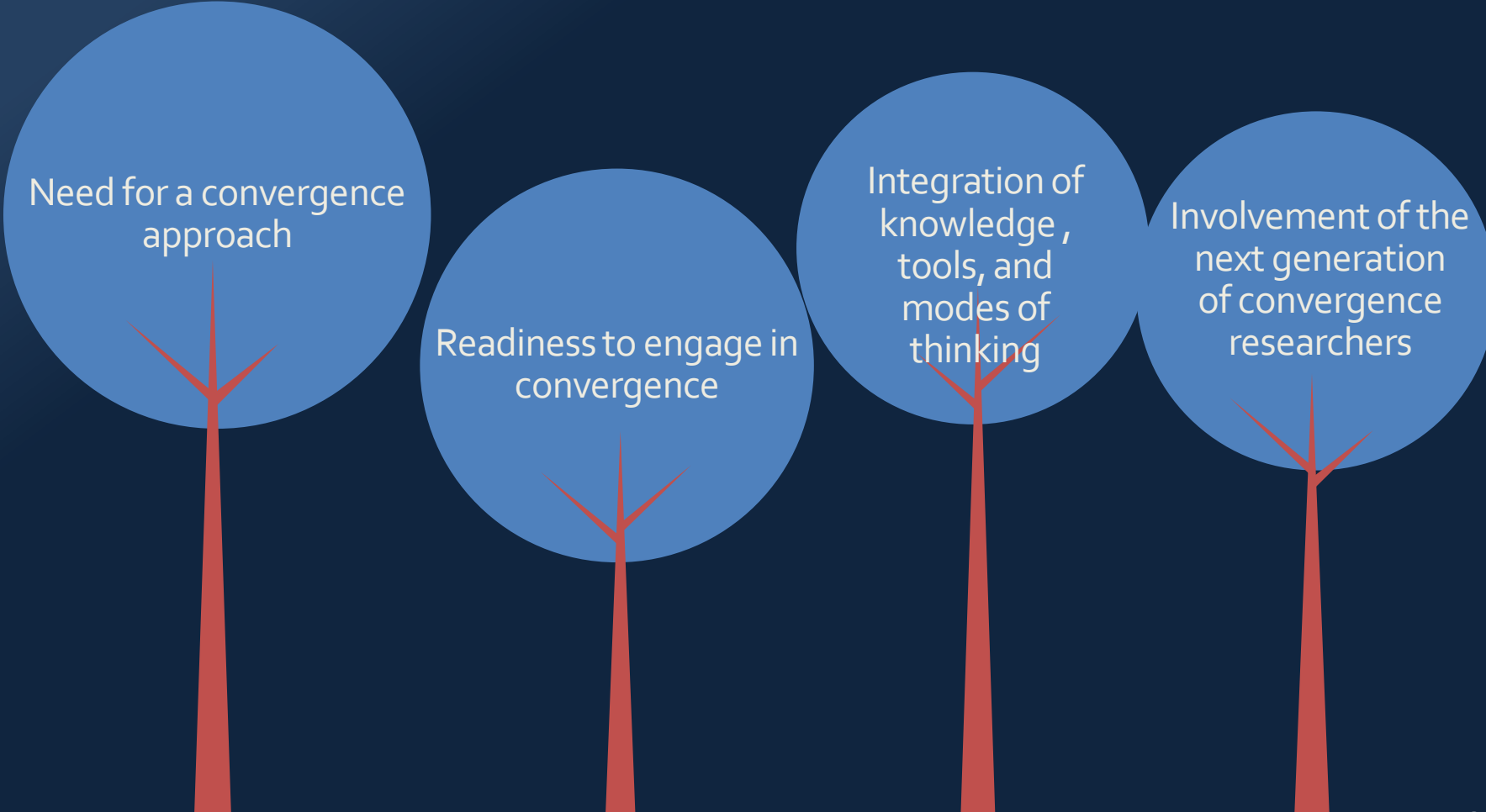
- Select a chair and members
- Charge the WG
 - Develop an NSF characterization of convergence
 - Establish appropriate review criteria
 - Draft a DCL to promote convergence in the Big Ideas
- Post the DCL; review the proposals

Characterizing Convergence



Convergence Merit Review

Key Characteristics



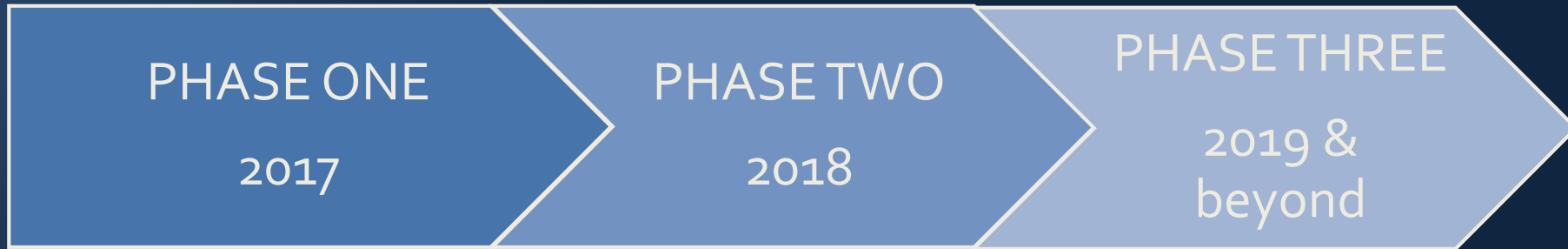
Need for a convergence approach

Readiness to engage in convergence

Integration of knowledge, tools, and modes of thinking

Involvement of the next generation of convergence researchers

Three Phases of Implementation



- Characterize convergence
 - Establish review criteria and pilot review process
 - Develop DCL for planning activities in the Big Ideas
 - Learn by doing--how NSF will handle convergence proposals
- Further develop the convergence merit review processes
 - Expand the convergence research communities
 - Consider different models for the Convergence program
 - *Internal, external, hybrid*
- Establish a sustainable Convergence Research Program
 - Focus on the next generation of convergent researchers
 - Conduct portfolio analysis and assess gaps and opportunities

Challenges & Next steps



Questions?