Overview of Chemical, Bioengineering, Environmental, and Transport Systems

Dimitrios Papavassilou for JoAnn S. Lighty (Division Director)
Program Director, Fluid Dynamics
VISION OF CBET

• CBET supports fundamental engineering research that involves:
  – the transformation of matter by chemical, thermal, or biological means
  – the exchange of mass, energy, or momentum

• With the goals that:
  – The quality and length of life will be maximized
  – Humans will live sustainably on earth

http://www.cnh-lcms.org/uploads/hands_earth_many2_280x240.JPG
Over 75% of the community is:

Chemical Engineering, 24%

Mechanical Engineering, 24%

Bioengineering/Biomed Engineering, 15%

Civil/Environmental Engineering, 13%

West VA Univ.

JBEI/Jay Keasling
• Unsolicited Proposals
  – ALL programs in ONE window, with a deadline of Nov. 5th, 2014 and October 20 thereafter.
  – See program descriptions for information regarding the emphasis, etc.
  – Grant Opportunities for Academic Liaison with Industry (GOALI) deadline the same
  – PLEASE be aware that GPG guidelines are followed and proposals will be RWR if they are found noncompliant.
Early-Concept Grants for Exploratory Research (EAGER)
- Approval by program officer only

RAPID
- Grants for rapid response with regard to data, facilities, or equipment
  - Example: Dear Colleague Letter on Ebola Virus, NSF 15-006
  - Contact program officer for approval

Workshops and Supplement (to existing grants)
- Contact program officer

CAREER: Faculty Early Career Development
- ENG award size increased to $500K
- Usually due in July but see website
- CBET CAREER Webinar
  - Over 300 people in attendance each day
  - Agenda included mock review panel
  - Check the website for posting of the Webinar
Budget percentages within core programs:

- **CAREER ~13.5%**
- **EAGER/RAPID ~ 3%**
- **GOALI ~ 2.4%**
- **Workshops/Conferences ~ 0.8%**
- **Supplements ~ 0.8%**
Integrative Strategies for Understanding Neural and Cognitive Systems
- Letter of Intent, 12/10/2014
- Full Proposal, 01/26/2015

**Neuroengineering and Brain-Inspired Concepts and Designs:** includes technologies for imaging, sensing, recording, or affecting real-time brain activity and behavior; computing paradigms; brain-computer interfaces; **Individuality and Variation**
NSF Catalyzing A Research Topic:
What is a new way to think of cooling for power plants?
- Requires fundamental basic research and real-world knowledge

NSF/EPRI Funding
- 4 NSF / 3 EPRI / 3 joint
- 3 years, $3M NSF/$3M EPRI

Became an ARPA-E topic in the latest solicitation for $30 million
WORLD'S POPULATION BOOMS

>9 BILLION by 2050

Larger, more urban and richer population

Food production will need to increase ~60%

Energy production will need to increase ~50%

Water demand will increase ~30%

FOOD

2010 2050

ENERGY

2010 2050

WATER

Image credit: http://www.aquate.com
National Science Foundation

CBET ORGANIZATIONAL
CHART

Seventeen programs across four clusters

Division Director
JoAnn Lighty

Deputy Division Director
Susan Kemnitzer

Chemical and Biochemical Systems

- 1401 - Catalysis and Biocatalysis
  Bob McCabe

- 1417 – Chemical and Biological Separations
  Rose Wesson

- 1403 – Process and Reaction Engineering
  Maria Burka

Bioengineering and Engineering Healthcare

- 1491 - Biotechnology and Biochemical Engineering
  Friedrich Srienc

- 5345 - Biomedical Engineering
  Thanassis Sambanis

- 7236 - Biophotonics
  Leon Esterowitz

- 7909 - Nano-Biosensing
  Rajakkannu Mutharasan

- 5342 – General and Age Related Disabilities Engineering
  Alex Leonessa

Environmental Engineering and Sustainability

- 7644 - Energy for Sustainability
  Gregory Rorrer

- 1440 - Environmental Engineering
  William Cooper

- 1179 - Environmental Health & Safety of Nanotechnology
  Nora Savage (Acting)

- 7643 - Environmental Sustainability
  Bruce Hamilton

Transport, Thermal, and Fluid Phenomena

- 1407 – Combustion and Fire Systems
  Ruey-Hung Chen

- 1443 Fluid Dynamics
  Dimitrios Papavassiliou

- 1414 - Interfacial Processes and Thermodynamics
  Nora Savage (Acting)

- 1415 - Particulate and Multiphase Processes
  William Olbricht

- 1406 - Thermal Transport Processes
  Ruey Chen (Acting)
Reactors, Vessels, Control Systems, Scalability

Feedstocks

Process & Reaction Engineering

Products

A

Separation Needed: Purity, Co-products, Recovery

B

Chemical & Biological Separations

Catalysts: Inorganic, Organic, Biological Needs: Yield, Selectivity, Reaction rate

Catalysis & Biocatalysis
National Science Foundation

CBS INVESTMENT CATEGORIES
FY14

Unsolicited: 66%
CAREER: 13%
GOALI: 12%
EaGER/RAPID: 5%
Workshops/Conferences: 2%
Supplements: 1%
External Funding Collaborations: 1%

**CBET Overall ~3%
Seventeen programs across four clusters

1401 - Catalysis and Biocatalysis
Bob McCabe

1417 – Chemical and Biological Separations
Rose Wesson

1403 – Process and Reaction Engineering
Maria Burka

1491 - Biotechnology and Biochemical Engineering
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7643 - Environmental Sustainability
Bruce Hamilton

1407 – Combustion and Fire Systems
Ruey-Hung Chen

1443 - Fluid Dynamics
Dimitrios Papavassiliou

1414 - Interfacial Processes and Thermodynamics
Nora Savage (Acting)

1415 - Particulate and Multiphase Processes
William Olbricht

1406 - Thermal Transport Processes
Ruey Chen (Acting)
Technology Advancement

Biotechnology & Biochemical Engineering
Biomedical Engineering
General and Age-Related Disabilities Engineering

Microbial chemical factories
Corn starch
Artemisinin chemicals

Vasculogenesis in tissue constructs

Nano-Biosensing, Biophotonics

Diagnostics & Sensing
BEH INVESTMENT CATEGORIES
FY14

$39.9M

23%**

68%

1% 2%

Unsolicited
CAREER
GOALI
EaGER/RAPID
Workshops/Conferences
Supplements
External Funding Collaborations

**CBET Overall ~13.5%
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**Chemical and Biochemical Systems**
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**Transport, Thermal, and Fluid Phenomena**
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- 1414 - Interfacial Processes and Thermodynamics
  - Nora Savage (Acting)

- 1415 - Particulate and Multiphase Processes
  - William Olbright

- 1406 - Thermal Transport Processes
  - Ruey Chen (Acting)
Environmental Impacts

Environmental Engineering

Environmental Health & Safety of Nanotechnology

Energy for Sustainability

Environmental Sustainability

Sustainable Technologies
**EES had a large RAPID component for WV chemical spill**
**National Science Foundation**

**CBET ORGANIZATIONAL CHART**

**Seventeen programs across four clusters**

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**Fluid Flow & Heat Transfer**

- **Fluid Dynamics**
  - Thermal Transport Processes

- **Particulate & Multiphase Processes**
  - Interfacial Processes & Thermodynamics

- **Highly Concentrated Particle Environment**

- **Combustion & Fire Systems**

**Images and Credits:**
- Natural-convection-heat-sink-fluid-WBG.jpg
- Dept ME, Iowa State Univ.
- Thomas Peacock, MIT

**Links:**

**Title:**
- National Science Foundation
- TRANSPORT, THERMAL, AND FLUID PHENOMENA (TTF)

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National Science Foundation

TTF INVESTMENT CATEGORIES FY14

72% Unsolicited
16% CAREER
1% GOALI
2% EaGER/RAPID
1% Workshops/Conferences
1% Supplements
7% External Funding Collaborations

**CBET Overall ~3%
Program Objectives:
• Support combustion science and technology for sustainable growth, as well as basic combustion and fire sciences

Areas of Emphasis Include:
• Fundamental flame/fire phenomena and chemistry
• Pollutant emission from combustion and fire
• Manipulation of flame/fire for human benefits
Program Objectives:

- Support research that can lead to applications with significant societal/technological impact
- Support experimental and theoretical research projects, from the molecular to the macroscopic scale

Areas of Emphasis Include:

- Turbulence and flow control, instabilities, fluid mechanics at interfaces and surfaces
- Bio-inspired fluid mechanics
- Flow of complex fluids, new fluid materials
- Micro- and nano-fluidics
Program Objectives:

• Support fundamental research in interfacial phenomena, mass transfer and molecular thermodynamics

Areas of Emphasis Include:

• Directed- and self-assembly of novel surfactant-based films, structures, and composites, including polymers
• Bio-molecular interfaces and nanodelivery systems
• Polymer micro- and nano-structures
• Molecular thermodynamics and mass transfer
Program Objectives:
• Support theoretical, computational and experimental research
• Support discovery of innovative processes for particulate-based advanced materials

Areas of Emphasis Include:
• Multiphase flow phenomena and microstructured fluids
  • Including biological systems
• Granular materials
• Colloidal and nanoscale particulates
• Prediction of macroscopic properties of fluids based on microstructural dynamics
Program Objectives:

• Promote the fundamental understanding and application of thermal transport at different scales

Areas of Emphasis Include:

• Control of thermal/flow transport processes in devices/systems and in materials processing & manufacturing
• Novel simulation and diagnostics of flow and heat transport, bridging across scales
• New materials/fluids/processes resulting in improved properties and performance