



*Recognition Luncheon
for
American Electric Power Foundation
and
Mr. Joseph H. Vipperman, Jr.*

May 03, 2011

WELCOME !





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ICTAS overview

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Introduction

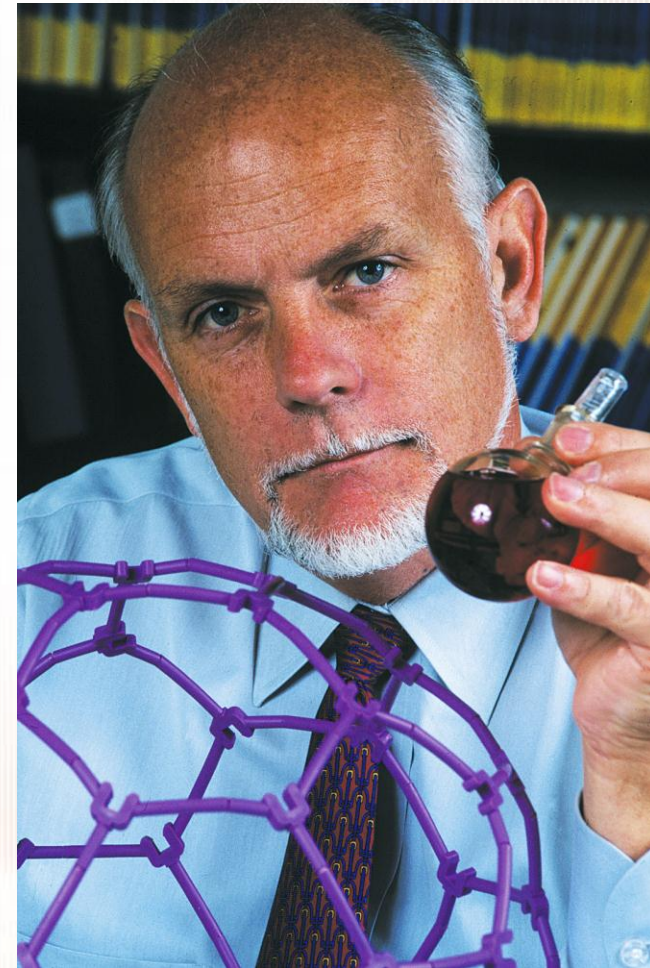
Top Ten problems of Humanity for next 50 years

1. **Energy**
2. **Water**
3. Food
4. **Environment**
5. Poverty
6. **Terrorism & War**
7. **Disease**
8. **Education**
9. Democracy
10. Population

Richard E. Smalley, noted scientist and Nobel prize winner

Source: Energy and Nanotechnology Conference, Rice University, May 3, 2003

- **Complex**
 - **Interdependent**
 - **Global**
 - **Multiple perspectives**
-
- **Need for IDR focus-
beyond silos**





ICTAS was created at VT to fulfill this need.

- To act as a **catalyst** for high impact, **Interdisciplinary Research (IDR)** at the intersection of Engineering and the Sciences



- To act as an **agent** of **Innovation**

**Buds of creativity
bloom at intersections.**

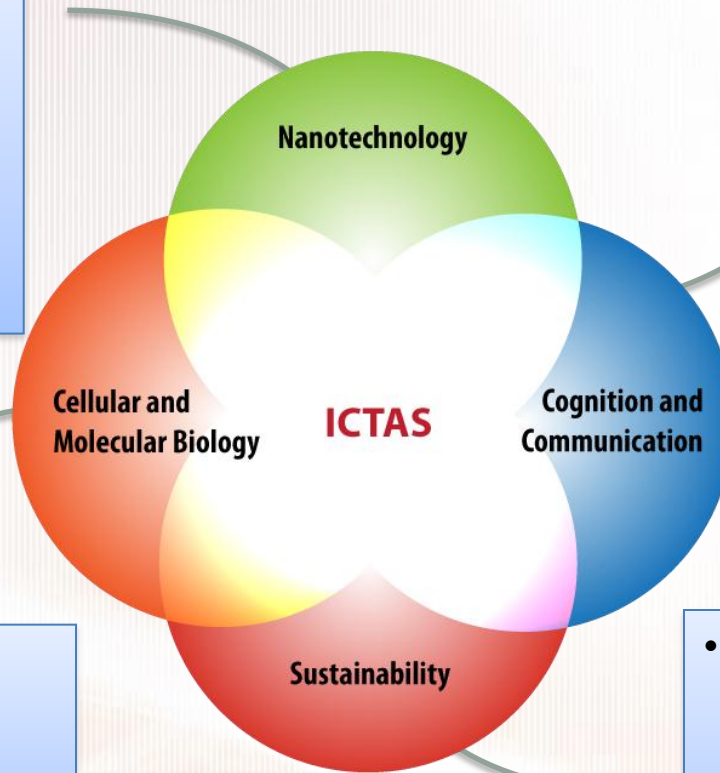
- To enhance educational experience of students in IDR
- To promote economic development and enhance quality of life in the COV, USA and the world



ICTAS Research

- Next industrial revolution
- \$3.3 Trillion global market
- New phenomena, materials
- Environmental issues

- Brain: the next frontier
- Reverse engineering the brain
- IT



- DNA, RNA
- Cell growth
- Cell differentiation
- Cellular behavior

- Meeting needs of the present without compromising the ability of future generations to meet their needs



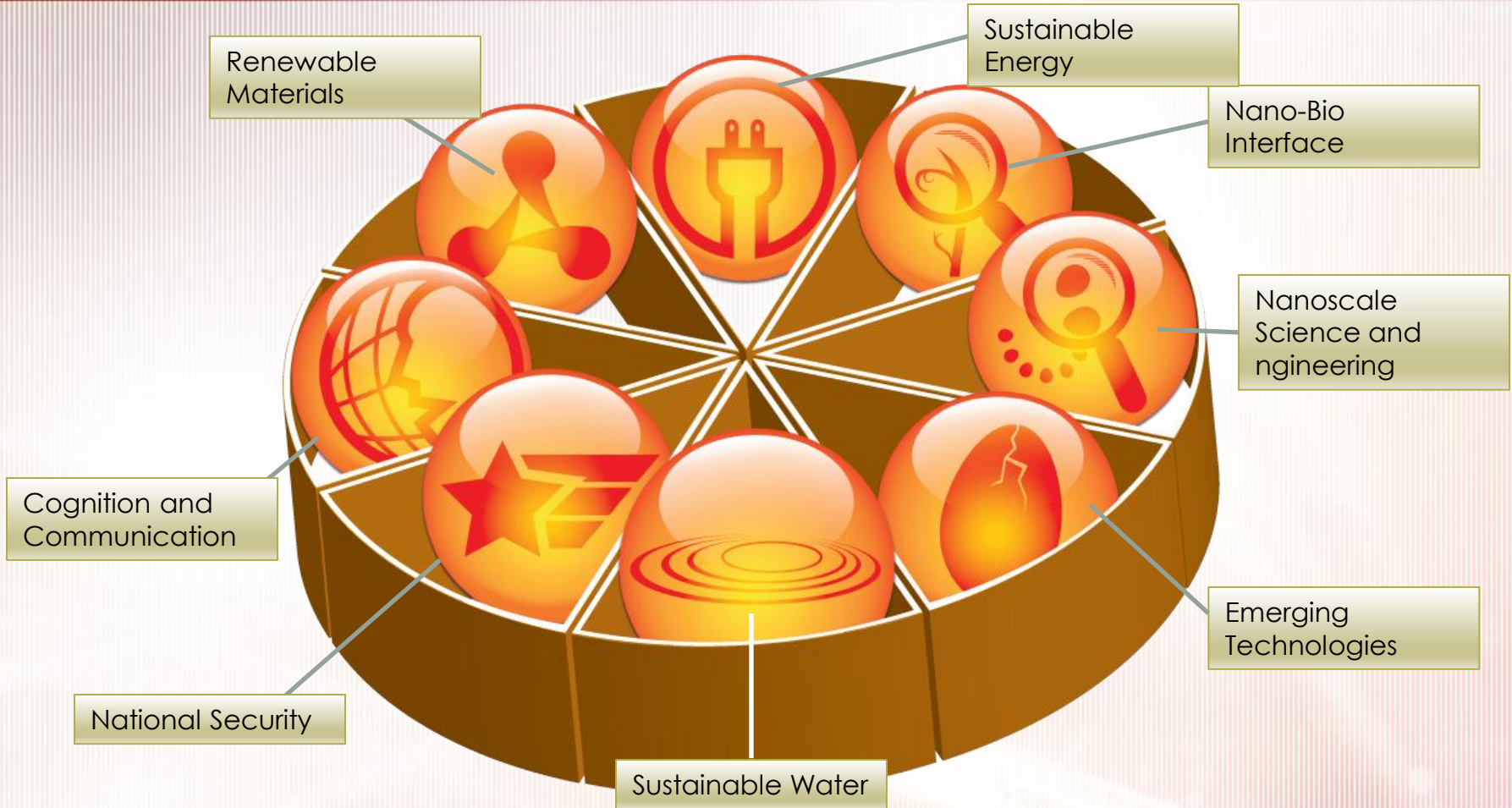
ICTAS

INSTITUTE *for* CRITICAL TECHNOLOGY
and APPLIED SCIENCE *Virginia Tech*

VISION

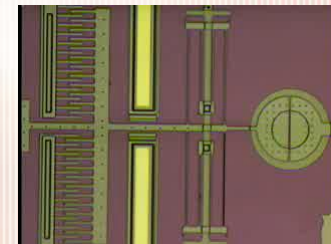
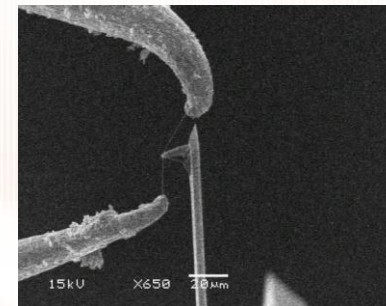
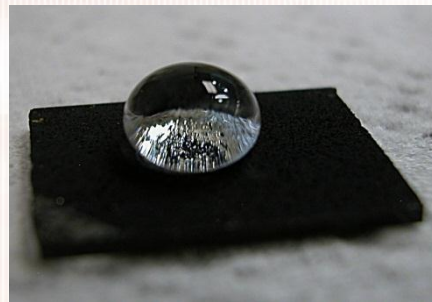
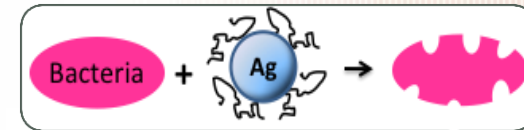
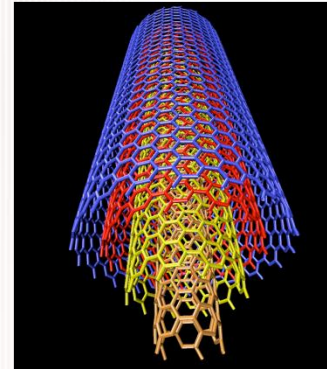
***To be among the top-ranked global institutes in
transformative technologies for a sustainable future***

Research Thrusts



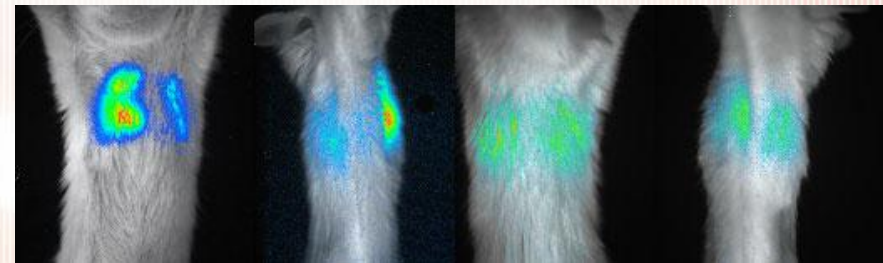
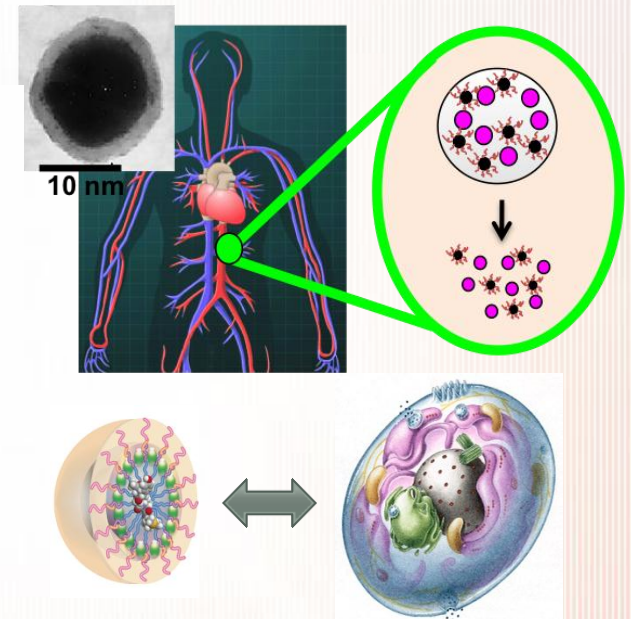
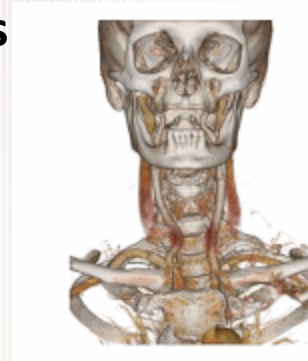


- Environmental Nano-science and Technology
- Nano-materials including carbonaceous materials
- **Nano-sensors**
- Nano-devices
- Nano-composites
- Nano-fibers
- **Nano-Computation**





- Targeted Delivery of Nano-medicine
- Non-invasive Sensing and Diagnosis
- Inflammation
- **Bio-Imaging**
- **Biomedical Computing & Cellular Engineering Microsystems (CEMS)**
- System Biology of Engineered Tissues
- Veterinary Regenerative Medicine



SBES M-BEDS ISBET CFI
GU CVRM WFU



COGNITION AND COMMUNICATION

Wireless@VT

➤ **Cognitive Radio Networks**

- ❑ Physical radio test bed deployed throughout the ICTAS building
- ❑ Total nodes 48; nodes; 12 nodes per floor
- ❑ No restrictions on other wireless systems inside building
- ❑ Unique test-bed with incredible potential for wireless research

➤ **Antennas and Propagation**

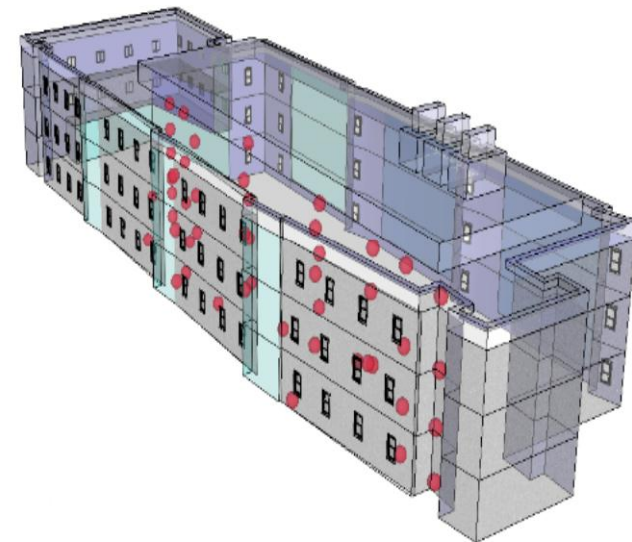
➤ **Secure Communications**

➤ **Wireless and Social Networks**

➤ **Signal Processing**

➤ **RF/VLSI Circuit Design**

Human Computer Interface





- **IDIQ with Dahlgren**
- **Ground Unmanned Support Surrogate (*GUSS*)**
 - A “flagship” project with NSWC Dahlgren for Marine Corps War-fighting Lab.
 - Four Vehicles participated in Rim of Pacific (RIMPAC) Exercise 2010
 - Operated by Marines
 - Significant Press Interest



“GUSS surprised everybody with its growth and technological capability.”

-Vince Goulding, Director

Experiments Division Marine Corps War fighting Lab

- **Autonomous Vehicles**
- **Sensor and sensor fusion**
- **Cyber Security**

- Modes of operation
 - GPS/Waypoint Sight
 - “Follow Me”
 - Drive by Wire
 - Manual



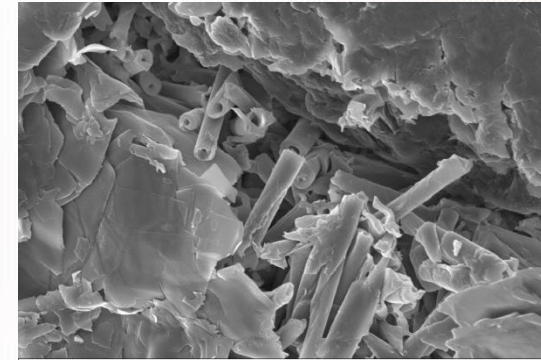
Research Thrust: Bio-based Materials



<<
Simulating
impact of
protein
structure
on tissue
mechanics

>>
Self-
assembled

peptide-like

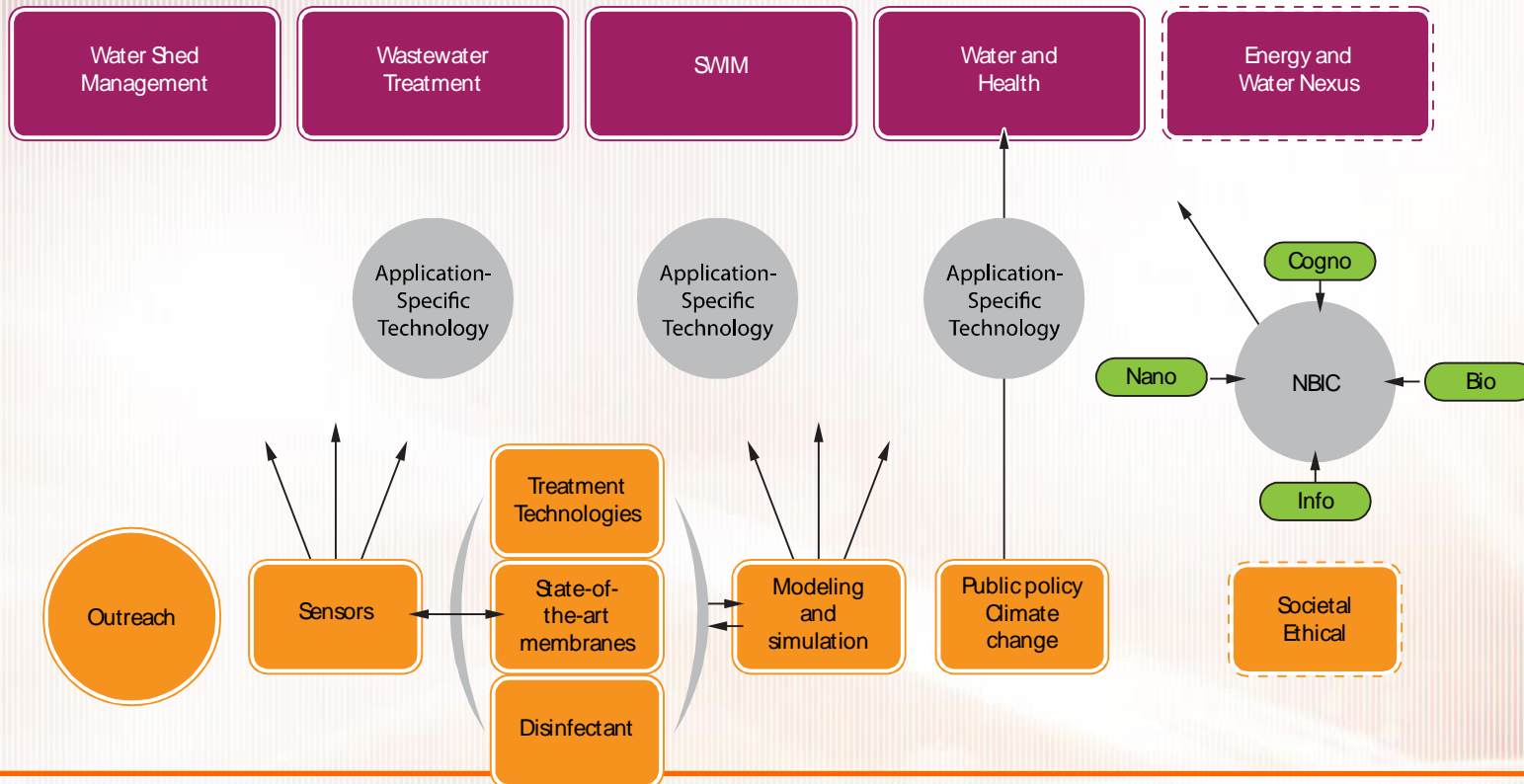


- ❑ Conversion of renewable polymers from nature into advanced materials
- ❑ Many potential applications
 - Tissue engineering**
 - Drug delivery**
 - Next-generation biofuels and catalysts.**
- ❑ Sample research projects
 - Spinning of polysaccharide nanofibers for drug delivery and tissue engineering
 - Development of advanced proteins to replace bone lost in traumatic head injury
 - Use of natural polymers to create a functioning artificial liver
 - Enhanced drug delivery to attack deadly diseases like TB and HIV
 - Creating the understanding of enzyme catalysts that will lead to practical biofuels, helping forge energy independence
 - Creating renewable plastics from waste proteins



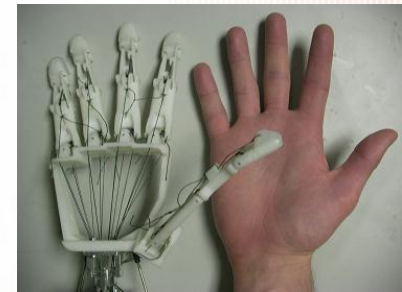
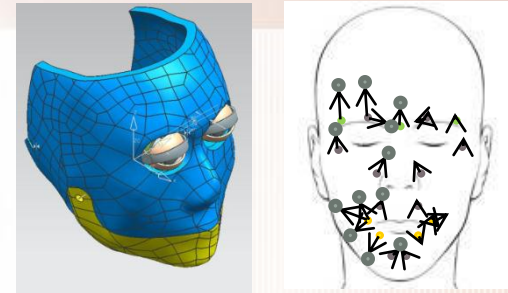
Sustainable Water

Comprehensive Research: *Shed to Shower*





- **Humanoid Hospital**
- **Discovery Analytics**
- **Space@VT**
 - Cubesat technology for geospace exploration.
- **Innovation- based Manufacturing**
- **Bio-Inspired Science and Technology**

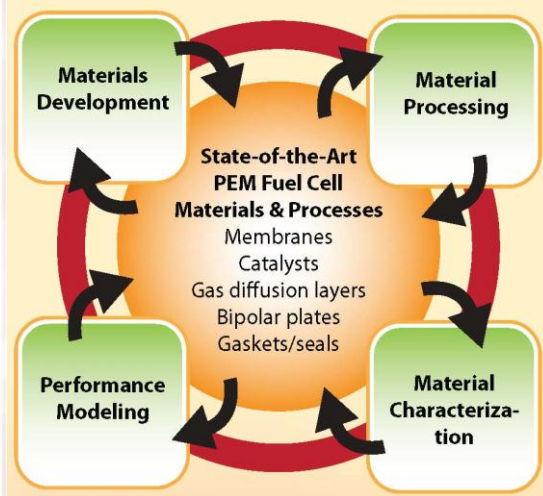
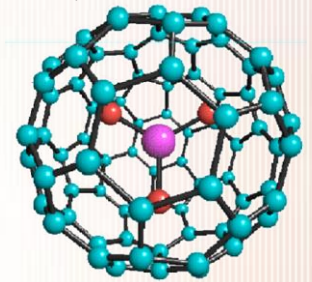




**Technology to meet
society's
energy needs –
renewably and
responsibly**

Principle areas of research

- *Cleaner more efficient energy conversion systems*
 - *Fuel cells*
- *Renewable energy resources*
 - *Solar*
 - *Organic Photovoltaic cells*
 - *Multi-junction solar cells*
 - *Wind energy*
 - *Bio-fuels*
 - *Energy harvesting*
- *Clean Coal Energy*



➤ **ECE – A key partner**

- Power Engineering, Smart Grid, Sustainable building design....



ICTAS Research

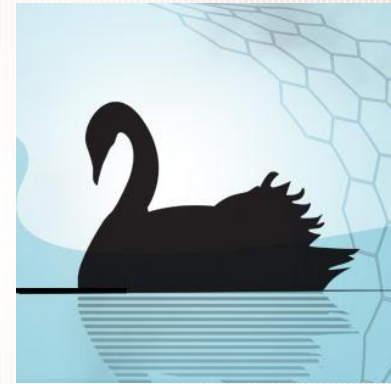
ICTAS Research is also about the next Black Swan



Game-Changer Technologies & Black Swans

- **A Black Swan** is an event that has three characteristics;
 - it is an outlier
 - it carries an extreme impact
 - it has retrospective predictability.

"The Black Swan", by Nassim Nicholas Taleb



Internet **Computer** Laser

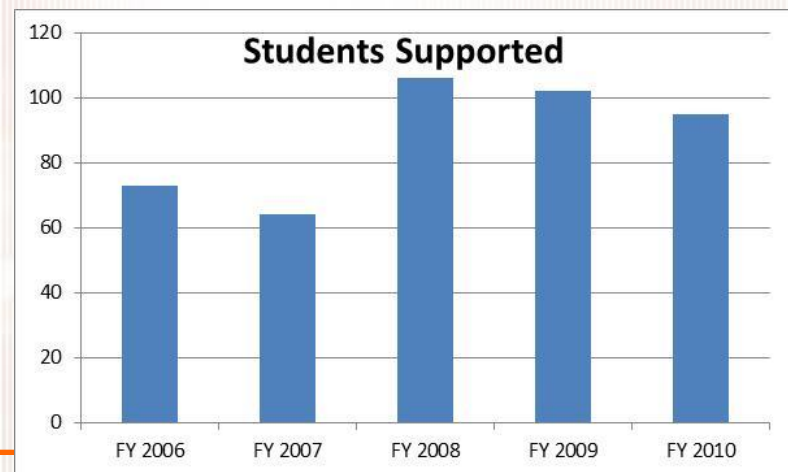
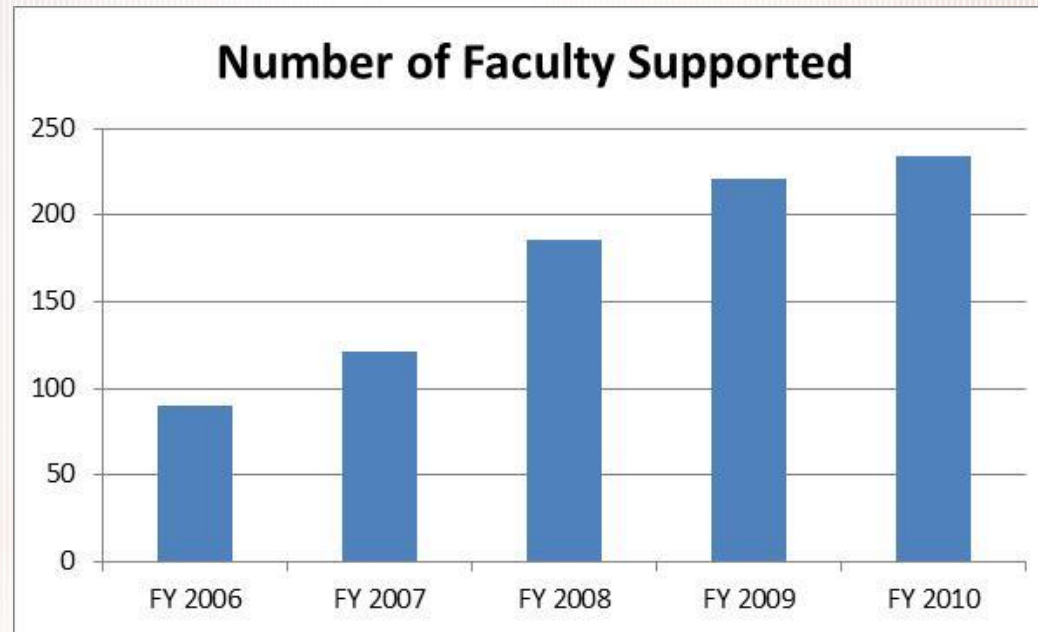
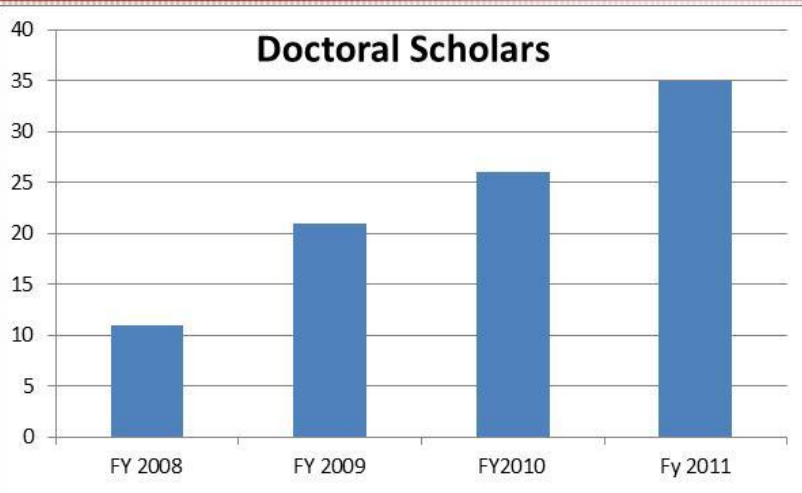
- **The Black Swan Seminars– Café X**
An informal discussion of the future

WHAT WILL MAKE YOU IRRELEVANT IN 7 years?



Motivation

ICTAS by the numbers

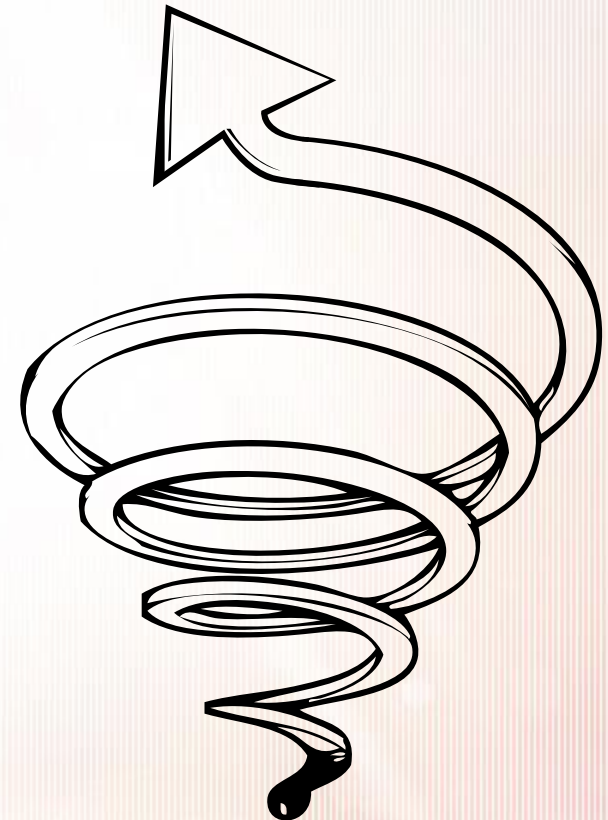




- **ICTAS is dedicated to high impact, IDR.**
 - **Cutting-edge**
 - **Transformative**
 - **Built on VT strengths**
 - **Non-linear growth**
 - **Among the top three**
 - **Innovative with a blue-skies component**
 - **Collaborative and faculty-centric**

- **ICTAS is committed to enhance the quality and experience of our graduate students**

- **Equally invested in promoting the economic development through innovation and industrial collaboration**





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Thank you!!

