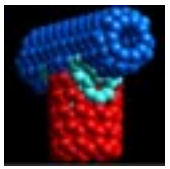
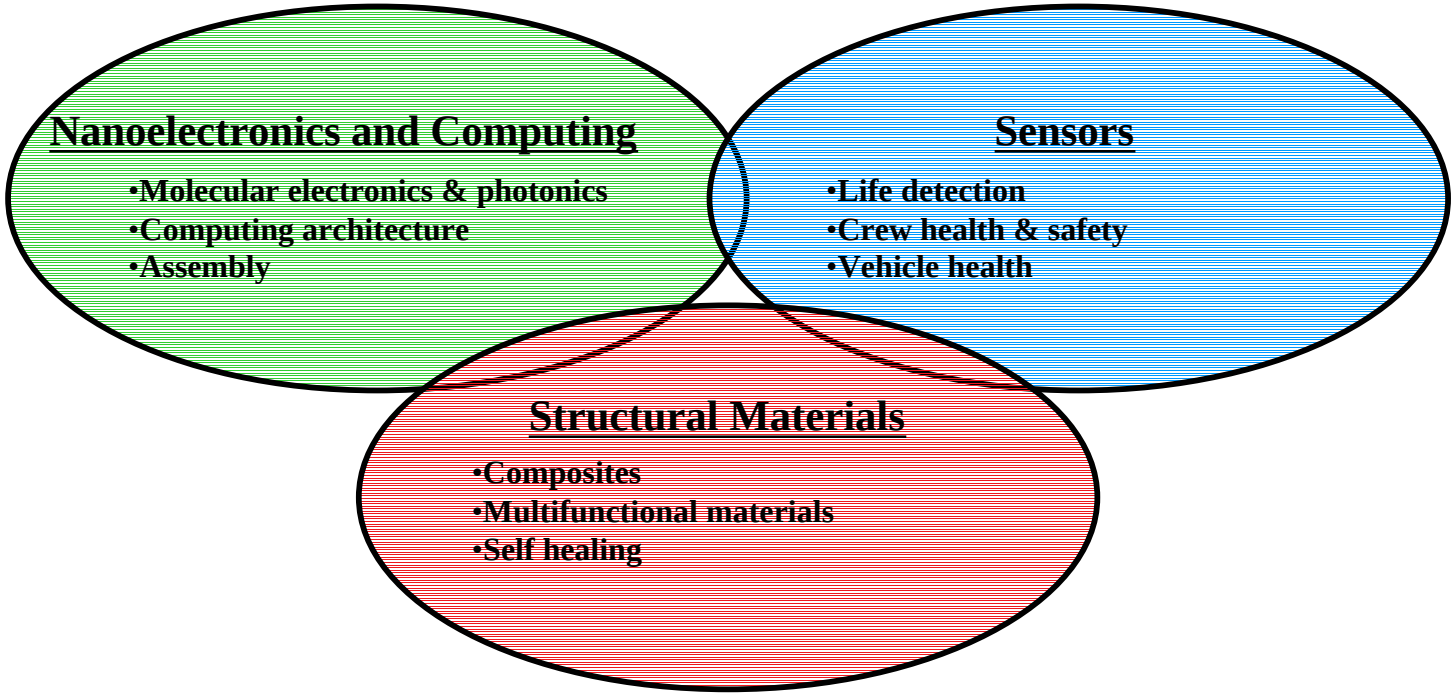
Ames Research Center

NASA Nanotechnology Program Content

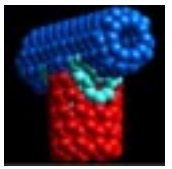


- **Nanotechnology Program Elements**
  - **Nanoelectronics and Computing**
  - **Sensors**
  - **Structural Materials**



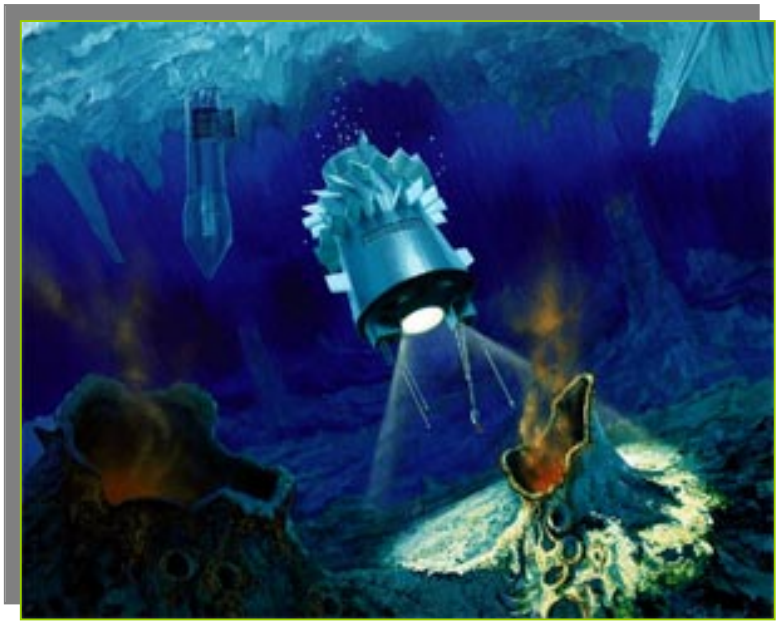
Ames Research Center

NASA Mission Needs



- Onboard computing systems for future autonomous intelligent vehicles
  - powerful, compact, low power consumption, radiation hard
- High performance computing (Tera- and Peta-flops)
  - processing satellite data
  - integrated space vehicle engineering
  - climate modeling

- Revolutionary computing technologies
- Smart, compact sensors, ultrasmall probes
- Advanced miniaturization of all systems
- Microspacecraft
- 'Thinking' spacecraft
- Micro-, nano-rovers for planetary exploration
- Novel materials for future spacecraft



NASA Nanotechnology Roadmap

C A P A B I L I T Y

Multi-Functional Materials

High Strength Materials (>10 GPa)

Reusable Launch Vehicle (20% less mass, 20% less noise)

Revolutionary Aircraft Concepts (30% less mass, 20% less emission, 25% increased range)

Autonomous Spacecraft (40% less mass)

Bio-Inspired Materials and Processes

Adaptive Self-Repairing Space Missions

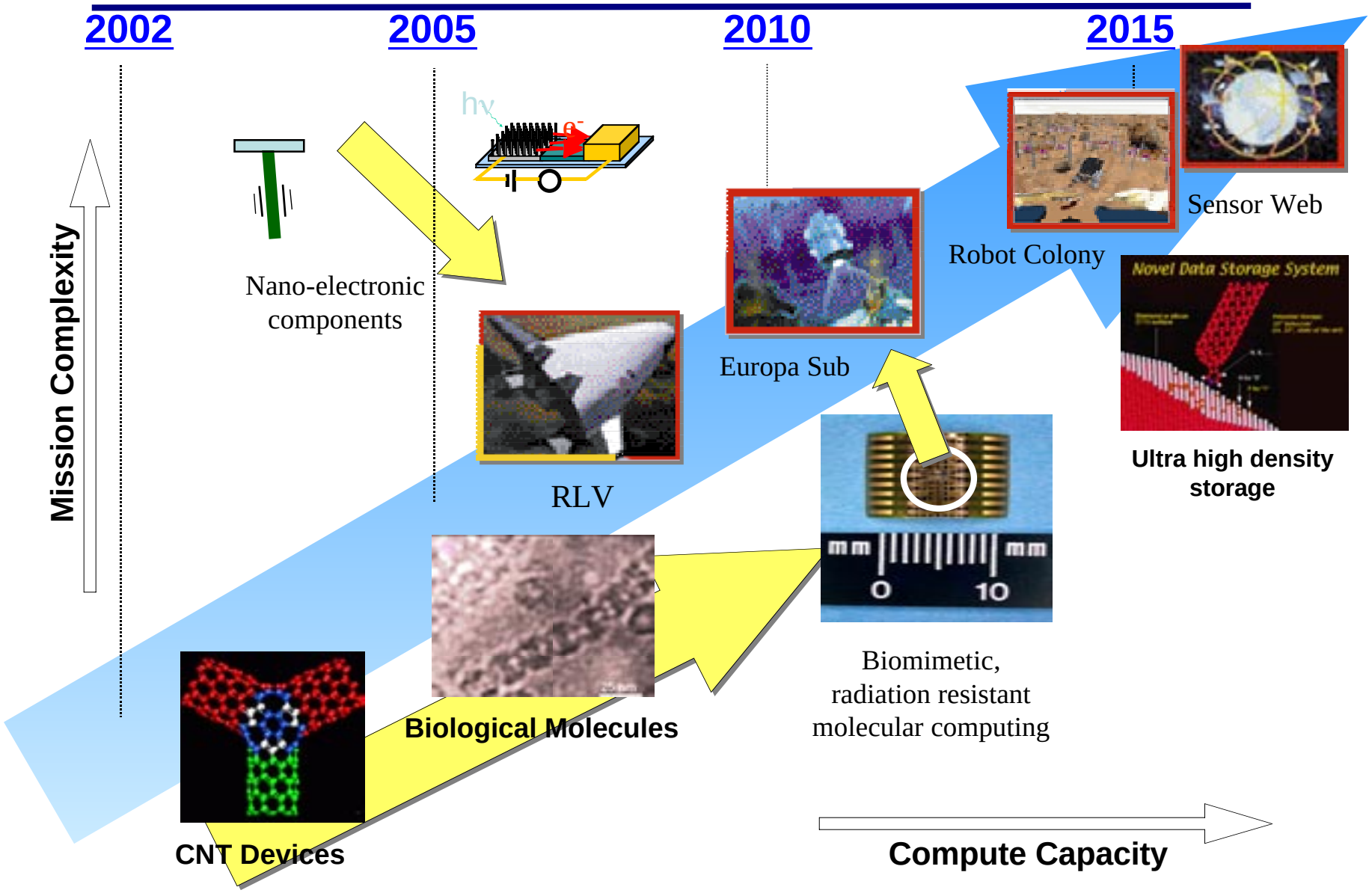
Increasing levels of system design and integration →

Materials	• Single-walled nanotube fibers	• Nanotube composites	• Integral thermal/shape control	• Smart "skin" materials	• Biomimetic material systems
Electronics/ computing	• Low-Power CNT electronic components	• Molecular computing/data storage	• Fault/radiation tolerant electronics	• Nano electronic "brain" for space Exploration	• Biological computing
Sensors, s/c components	• In-space nanoprobes	• Nano flight system components	• Quantum navigation sensors	• Integrated nanosensor systems	• NEMS flight systems @ 1 µW

2002 2004 2006 2011 2016 >

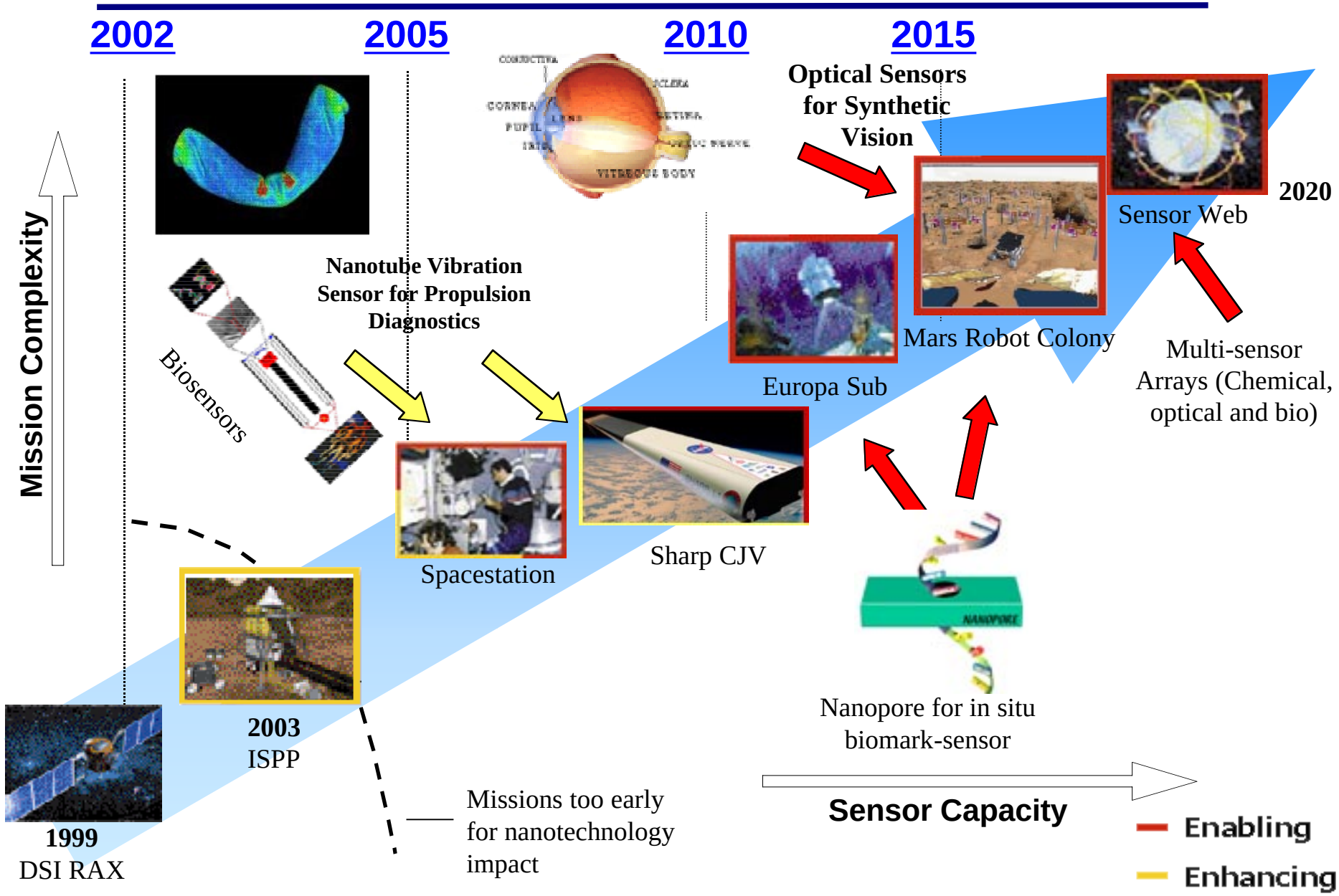
Nanoelectronics and Computing Roadmap

Impact on Space Transportation, Space Science and Earth Science



Nanosensor Roadmap

Impact on Space Transportation, HEDS, Space Science and Astrobiology



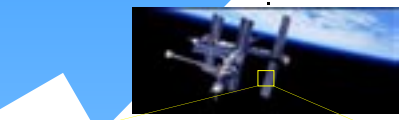
Nano-Materials Roadmap

Impact on Space Transportation, Space Science and HEDS

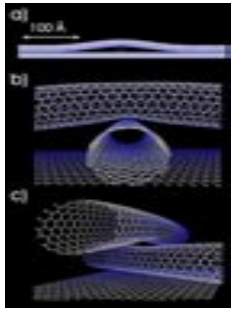
2002 2005 2010 2015

Mission Complexity

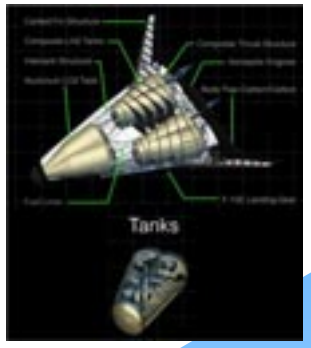
Generation 3 RLV HEDS Habitats



SELF-HEALING MATERIALS

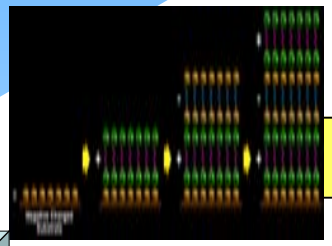


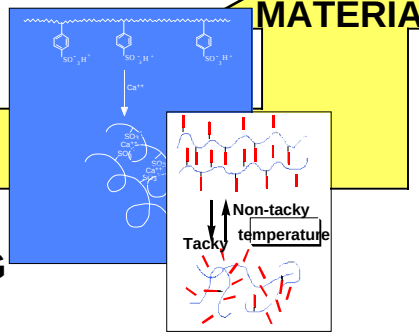
Production of single CNT



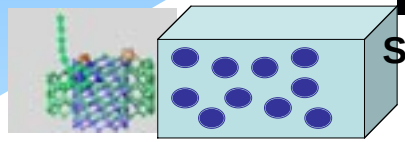
RLV Cryo Tanks

CNT Tethers



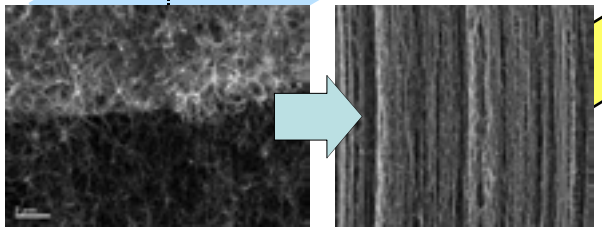


SELF-ASSEMBLING MATERIALS



NANOTUBE COMPOSITES

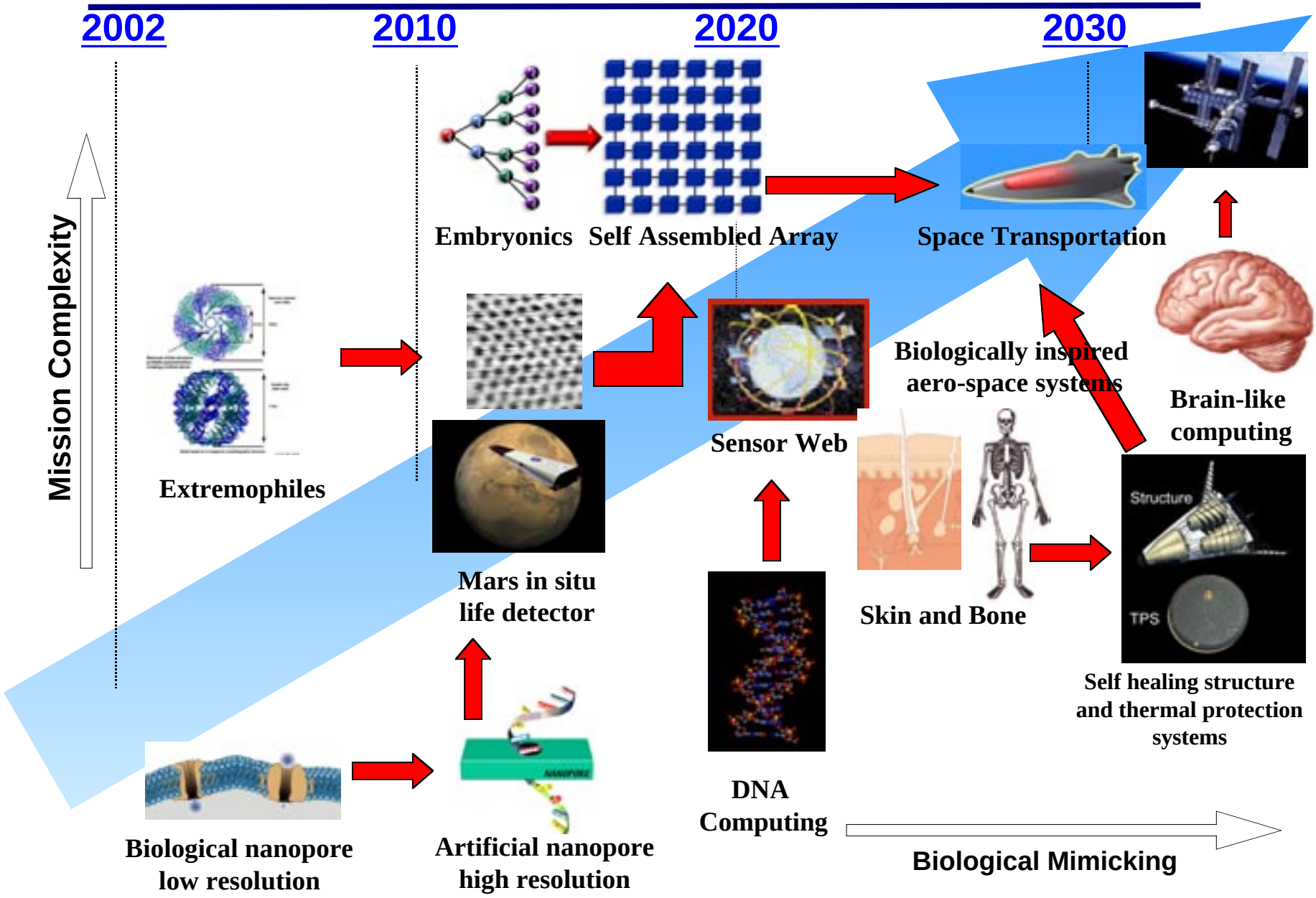
MULTIFUNCTIONAL MATERIALS



Nanotextiles

Strong Smart Structures

CNT = Carbon Nanotubes

Biomimetics and Bio-inspired Systems

Impact on Space Transportation, Space Science and Earth Science