

# Grand Challenges for Sustainability

John Kunz and Martin Fischer

## Sustainable Built Environment Program at *Stanford* -- Grand Challenges

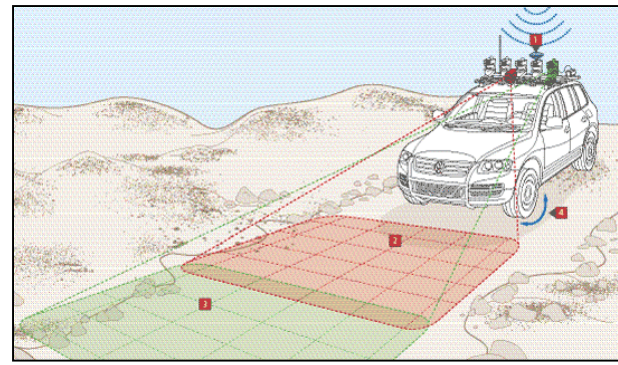
- Clearly stated
- Solution methods contribute to scientific, engineering knowledge
- Socially worthy
- Difficult but not impossible to achieve at *Stanford*

## Examples

- Determine DNA sequence for human genome
- Make Quantum Computing a Reality
- Solve New Problems with Quantum Computers
- Prove the Security of Quantum Key Exchange
-

## Examples

- Clay Mathematics Institute: seven \$1 million prizes; solutions to seven classic problems in mathematics.
- NASA, Centennial Challenges Program: multiple \$250,000 challenges; speed space exploration.
  - include extract oxygen from moon rocks, advanced explorer robots.
- Methuselah Mouse Prize: \$3 million, extend lifespan of a certain species of mouse from three to five years.
- DARPA Grand Challenge: Autonomous robot on 132-mile course in desert -- 3 narrow tunnels; > 100 sharp turns; avoid sheer drop-offs on both sides
  - 2004: no vehicles completing; 2005, 4 vehicles finished; (7 hrs winning time)
  - 195 entries





# Public Health Goals & Grand Challenges

## **To improve childhood vaccines:**

- GC 1: Create effective single-dose vaccines that can be used soon after birth;
- GC 2: Prepare vaccines that do not require refrigeration;
- GC 3: Develop needle-free delivery systems for vaccines.

## **To create new vaccines:**

- GC 4: Devise reliable tests in model systems to evaluate live attenuated vaccines;
- GC 5: Solve how to design antigens for effective, protective immunity;
- GC 6: Learn which immunological responses provide protective immunity.

## **To control insects that transmit agents of disease:**

- GC 7: Develop a genetic strategy to deplete or incapacitate a disease-transmitting insect population;
- GC 8: Develop a chemical strategy to deplete or incapacitate a disease-transmitting insect population.

## **To improve nutrition to promote health:**

- GC 9: Create a full range of optimal bioavailable nutrients in a single staple plant species.

## **To improve drug treatment of infectious diseases:**

- GC 10: Discover drugs and delivery systems that minimize the likelihood of drug-resistant microorganisms.

## **To cure latent and chronic infections:**

- GC 11: Create therapies that can cure latent infections;
- GC 12: Create immunological methods that can cure chronic infections.

## **To measure disease and health status accurately and economically in poor countries:**

- GC 13: Develop technologies that permit quantitative assessment of population health status;
- GC 14: Develop technologies that allow assessment of individuals for multiple conditions or pathogens at point-of-care.

## Methods today

- Teams of 2 – 3
  - Brainstorm
  - Choose a few goals, associated grand challenges
  - Present to class
- Class
  - Discuss proposals
  - Vote (3 votes each)
  - Discuss