Defense Advance Research Projects Agency (DARPA) Urban Challenge In-Class Projects

Understanding Autonomous Ground Vehicles (AGVs):
Concepts in robots that can think and function for themselves

Focus
Scientific principles behind the movement, design and use of autonomous ground vehicles and /or robots.

Grade Level

Middle/High School using a robotic aid: To help emphasize certain geometric concepts, students learn how to plot points on a navigational map, which will lead lessons in beginning programming and engineering. Using a programmable robot helps illustrate the unpredictability of math in the real world. Students will better understand real-world variables such as the impact of a surface on movement, and other circumstances beyond their control and how programs are developed counteract possible negative situations.

Elementary concepts with a robot: Teach fundamental concepts as angles, degrees and basic geometry. Instead of simply drawing shapes on a board or manipulating them on a computer screen, teachers can work with students to program robot movements into and then watch as the machines carry out each action as assigned.

Focus Questions
What is the difference between remote controlled and autonomous vehicles?
What are the challenges in designing and building an autonomous ground vehicle?
What are some of the obstacles that autonomous ground vehicles and their developers have to deal with/plan for?

Learning Objectives
One of DARPA's goals, through its Urban Challenge, is to inspire today's youth to become interested in careers in the science and technology fields. DARPA selected a Challenge that anyone could participate in, as it is easy to access materials needed to build an autonomous vehicle together (a car, computers, radars, GPS and other off-the-shelf products). The people on the teams bring the ingenuity of how to bring all these systems together that allow the autonomous vehicle to run safely and obey common traffic laws.

Specifically, the learning objectives for the DARPA Urban Challenge for students are:

- Enhancing technical vocabulary and to begin to learn about robotics, systems, tracking, programming, etc.
- Understanding how current robots are being used currently and how they could be enhanced to provide greater use.
- Understanding the challenges that affect the performance of autonomous ground vehicles and that can cause barriers for greater use.
- Thinking about how autonomous ground vehicle technology could be used in a variety of other applications.
- Learning about GPS (global positioning satellites) and how important mapping and geography are to a variety of industries and to the general public.

- Using basic problem solving and the fundamentals of math and science to help solve some critical national security issues.

Key Words
Autonomous
Robotics

Background Information
Learning Procedure
1. Briefly review Background Information on DARPA and why an autonomous ground vehicle might benefits the men and women in uniform at www.darpa.mil/grandchallenge

2. What are the challenges these vehicles will face in an urban environment?

3. What are some of the driving skills that we or our parents take for granted that a robot would have to learn?

(Optional, for more advanced students)
4. Adopt and team and track their progress and the hurdles they face. (team information can be found at www.darpa.mil/grandchallenge/teams)

5. Have the students give a short presentation on how they see this technology possibly being used in other ways (farming, mining, at home, on the roads, homeland security, underwater, space or in manufacturing)

6.What are some of the downsides of having more advanced technology like this?

Writing Assignment
Have students write an essay describing how they might use a moving robot to help complete a task that they or a family member may routinely perform, and what some of the challenges would be to the performance of the robot.

Connections to Other Subjects
English/Language Arts, Mathematics, Science, Computer Science

Resources
www.darpa.mil/grandchallenge – Web site the DARPA Grand Challenge and 2007 Urban Challenge.
www.auvsi.org-- Website for Association of Unmanned Vehicle Systems International devoted to advancing the unmanned systems community.
http://science.howstuffworks.com/robot4.htm – General site about how autonomous vehicles work.

National Science Education Standards
Content Standard A: Science as Inquiry
• Ability to do scientific inquiry
• Understanding scientific inquiry
Content Standard B: Physical Science
• Motions and forces
• Plotting points and mapping on a topographical map
Content Standard E: Science and Technology

• Abilities of technological design
• Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

• Science and technology in local, national and global challenges