THE INTERNATIONAL PROGRAM IN CREATIVE EDUCATION AND ITS COMPONENTS

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Contents

Program Receives National Awards

ACS convention in Philadelphia, 2004

ACS convention in Boston, 2007

American Chemical Society

2006 CERTIFICATE OF EXCELLENCE

The ACS President and the Committee on Public Relations & Communications proudly recognize the nomination of the

Northern New York Local Section

for the

Best New Public Relations Program of a Local Section

To recognize outstanding efforts by local sections to promote chemistry to the public.

Katie Hunt
ACS President

Russell Johnson
Chair, Committee on Public Relations & Communications

Program Goals

To turn students of all ages onto science and engineering.

To prepare these students to be critical thinkers and creative problem solvers.

Brief Definition of Creativity

- **Creativity is the ability to produce original work and ideas.**
- **It also includes the combining of existing work and objects to create new items such as a motor bike composed of a motor and a bike.**
- **The creative process starts with a creative person (ex. engineer) and results in a creative product (ex. new type of bridge). It includes the thinking and acts that take place to produce an original item.**

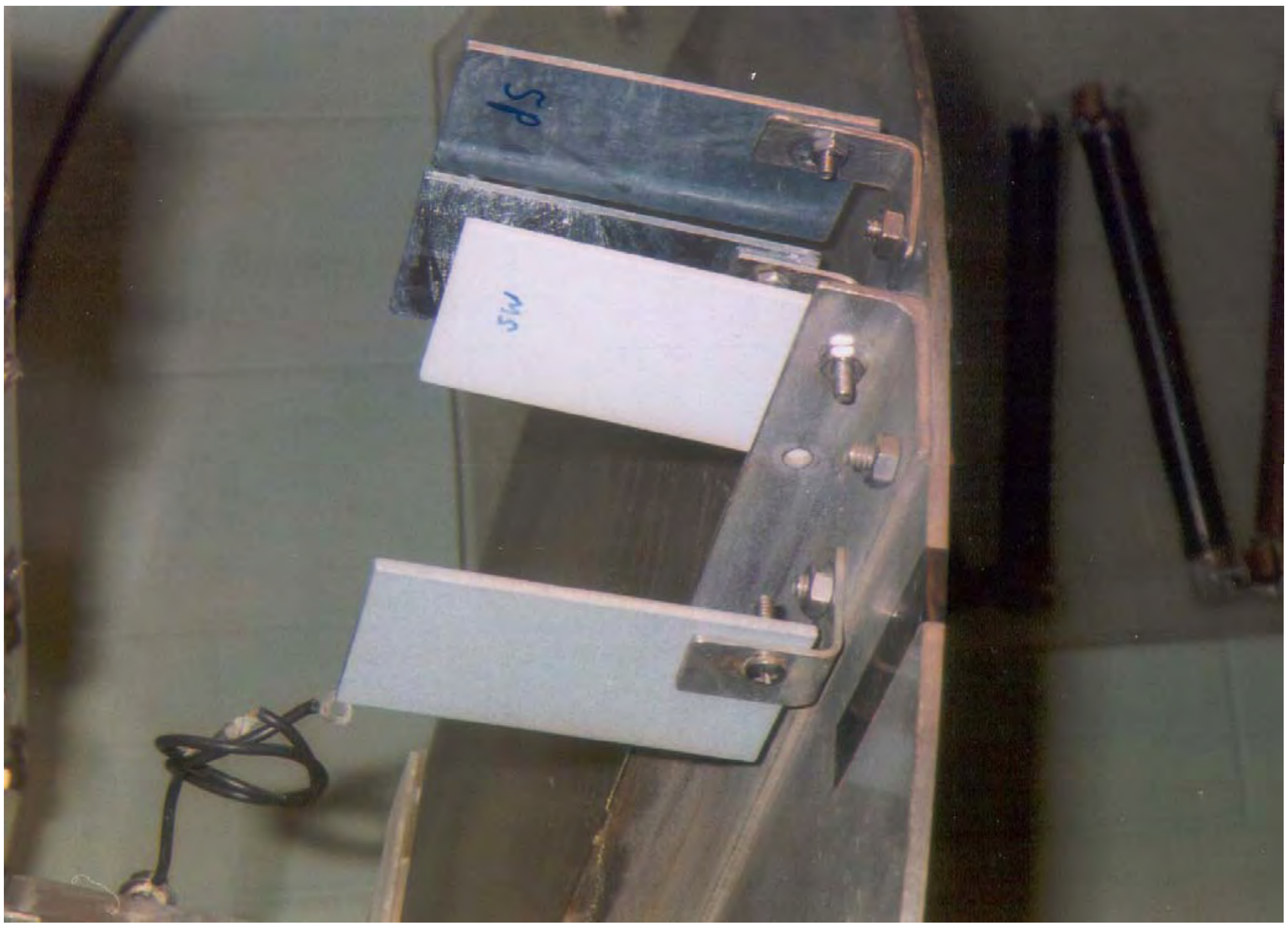
Creativity & Engineering Design

- **Engineering design is an advanced version of a problem solving method that many people use in their daily lives.**
- **ABET (the Accreditation Board for Engineering and Technology in the US) defines it as a method of devising a system, component, or process to meet desired needs.**
- **A creative engineering design process incorporates creativity.**

Creative Design Process

- This is really a creative problem solving model.
- It could start with a creative problem defined by a creative engineer.
- It might involve creative equipment that is designed to carry out experiments for solving the problem.

Rotating wheel creatively designed to hold metal samples for acidic corrosion tests.



Creative Design Process Continued

- **Most often creativity (creative thinking) is used for finding possible solutions to the problem that needs to be solved. This requires individuals to be curious, open-minded, and to brainstorm for ideas.**
- **Creative engineering design is essential for engineers to meet the demands of society and to solve the challenging problems of our ever changing world.**

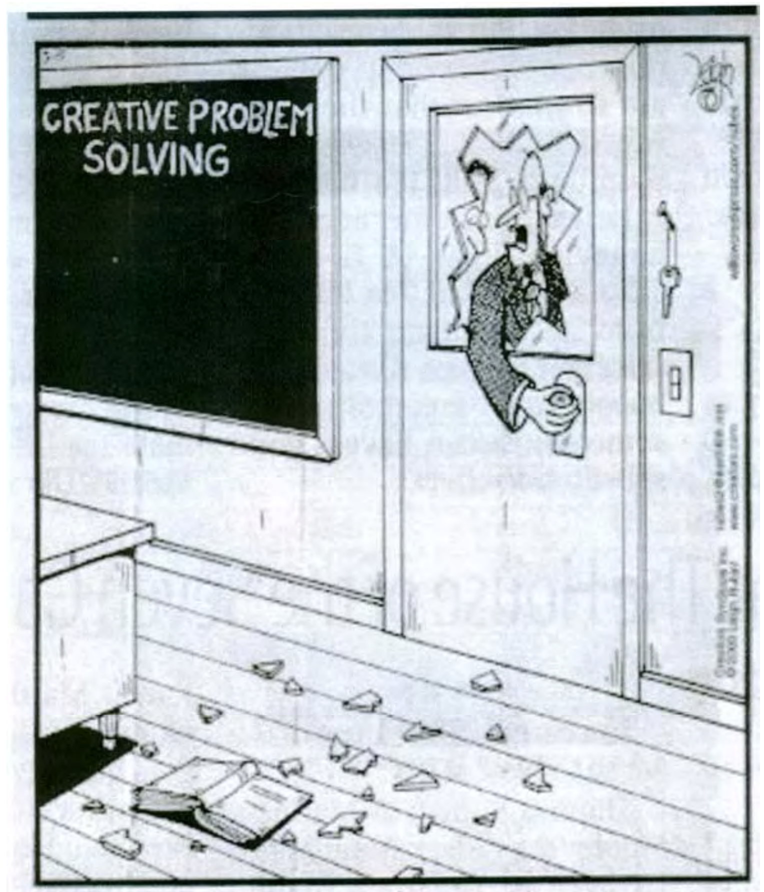
Role of the Teacher / Instructor in Creative Education

to promote creative thinking

to encourage students to express innovative ideas (ex. hold debates on various topics)

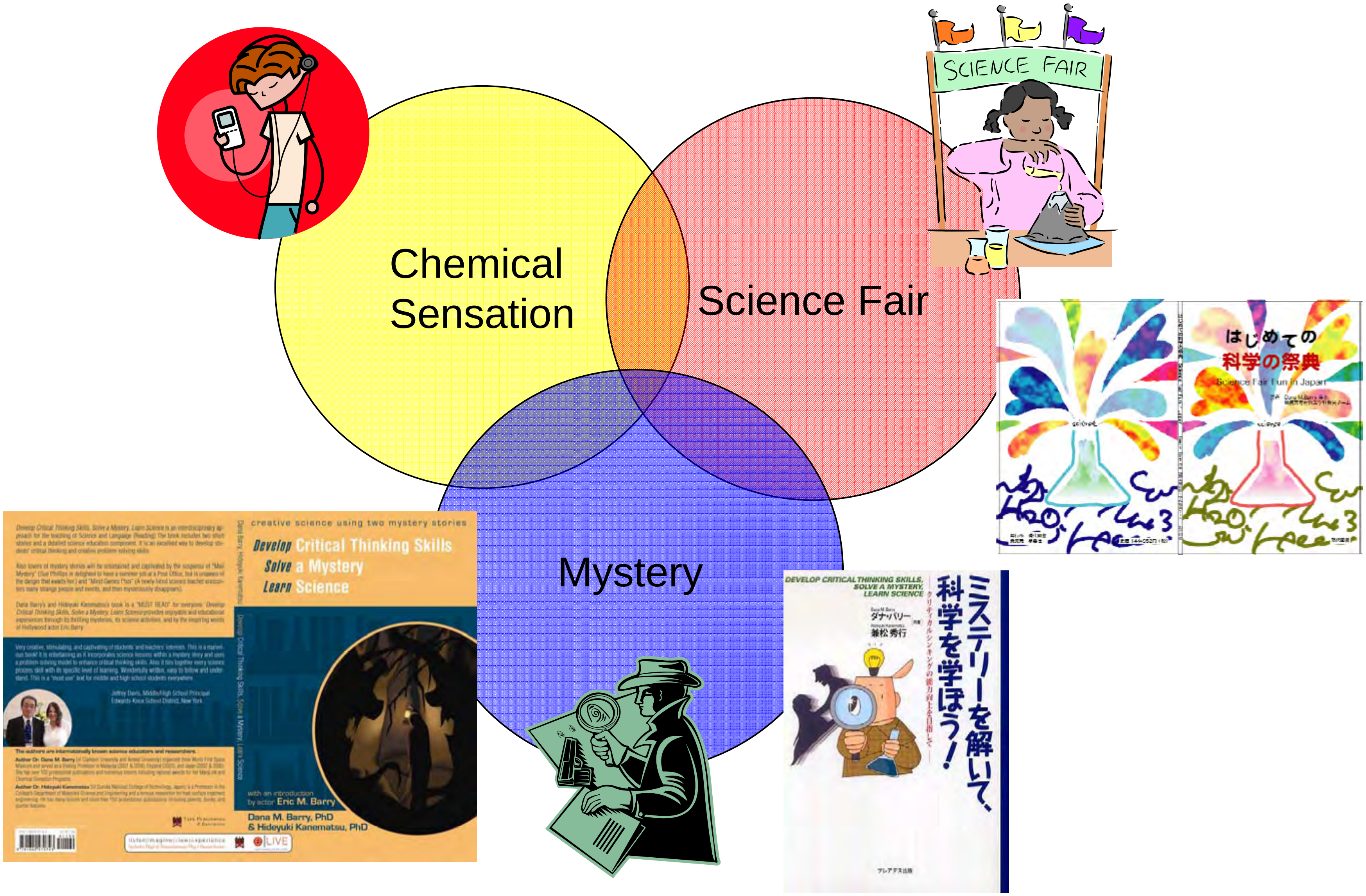
to be open-minded, value originality, and seek imaginative solutions to problems

Cartoon



"As you can see, son, simplicity is the key."

Program Components



Other Program Components

- **Space Science**

- **E- Learning**

Multisensory (Chemical Sensation) Teaching Approach

- **This approach takes advantage of students' senses (ex. seeing, hearing)**
- **It is designed to meet individual student needs & requires teachers' lessons to incorporate visual, writing, listening, & lab activities.**
- **This approach includes science songs, visual aids, lab activities, & forms of evaluation.**
- **Sample Song: PERIODIC TABLE**

Chemical Sensation Project's Student Multisensory Lesson about Acids and Bases Carried out in the U.S.

Overall Results of the Chemical Sensation Project Carried out in the U.S.

organization	Hands-on activities category. Percentage of Neutral-Very Positive Reaction Responses (%)	Songs category Percentage of Neutral-Very Positive Reaction Responses(%)
Clarkson University (US)	100	93
Edwards-Knox High School (US)	100	90
Canton High School (US)	86	81
Total for 3 US Organizations	96	88

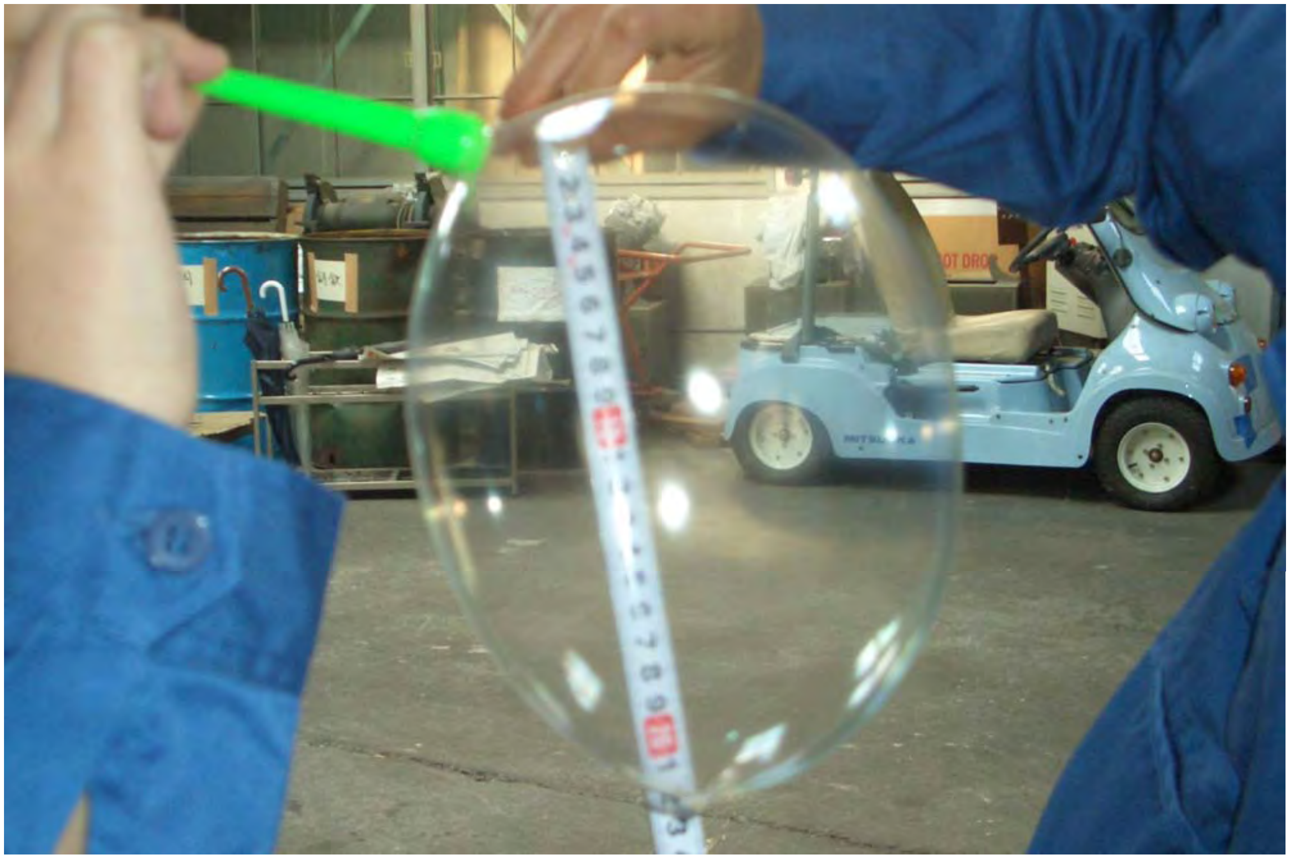
Overall Results of the Chemical Sensation Project Carried out in Japan

organization	Hands-on activities category. Percentage of Neutral-Very Positive Reaction Responses (%)	Songs category positive (%) Percentage of Neutral-Very Positive Reaction Responses(%)
Suzuka National College of Technology, Japan	98	65
Takada High School, Japan	91	98
Kanbe High School, Japan	92	77
Total for 3 JP Organizations	93	82
Total for Both US and Japanese Organizations	94	84

Science Fair Project Teaching Approach

- Students have a chance to select a project (problem to solve) that is of interest to them.
- They creatively design a procedure to carry out their investigations.
- Individuals then make creative displays and posters to share their projects and results with others.

College students investigate the growth of bubbles.



Students prepare creative posters to display their results.

Science Fairs

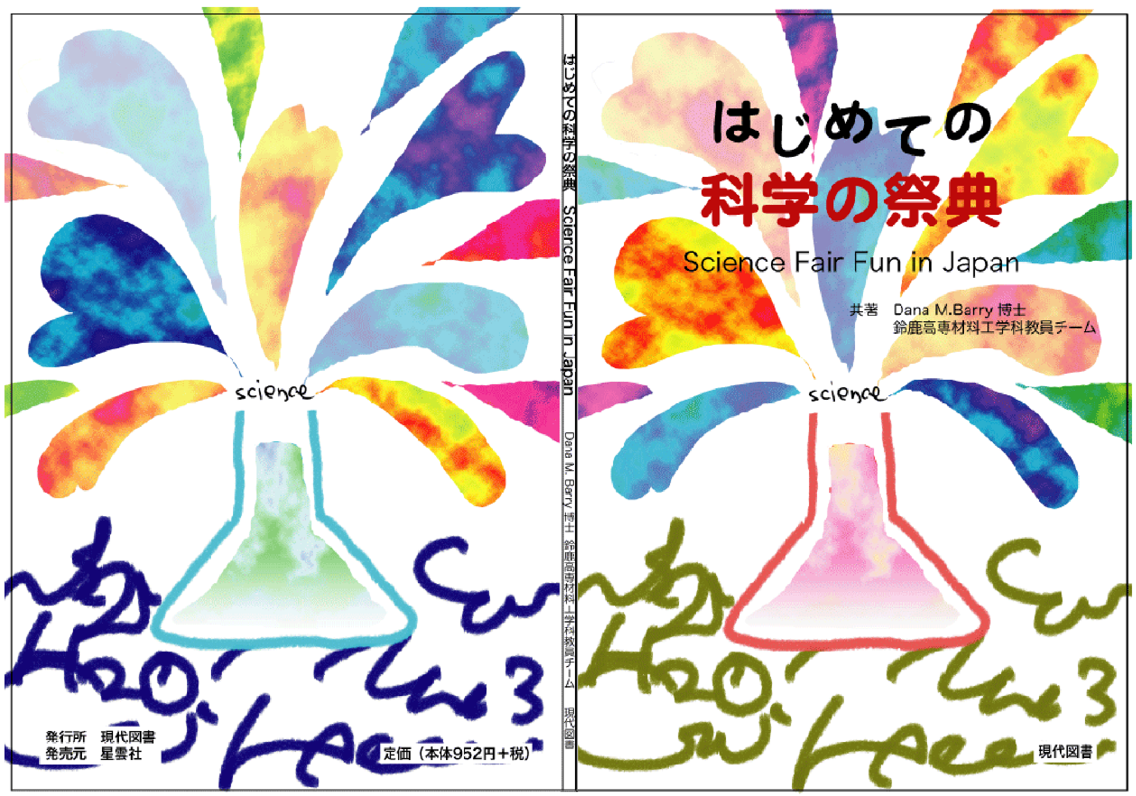
- The Science Fair is an event held at a School, College, or other organization. Here students display and share their research projects and results with their friends, parents, teachers, local community members, etc.
- Judges interview the students and evaluate their projects. A perfect score is 100 points. Students with the highest scores usually receive award ribbons or certificates.

Science Fair Judge Barry interviews student participant.

Science Fairs

- **The Science Fair idea was introduced into the Japanese Society through a novel textbook (written in Japanese) by Barry and Kanematsu. The book titled Science Fair Fun in Japan is published by Gendai Tosho of Japan (2005, 2009).**

Novel Textbook by Barry and Kanematsu



Novel Textbook

- **This book includes a problem solving model, a sample research project, many science project ideas, and exciting activities.**
- **It helps students plan, design, carry out, and present their research projects and results.**

Textbook Uses

- **Barry, Kanematsu and others have successfully used the book to carry out science fairs at elementary Schools (examples: Kitarissei, Katada and others) and at Colleges (example: Suzuka National College of Technology) in Japan.**
- **Kanematsu also uses the book as a textbook with his students in a hands-on experiments class.**

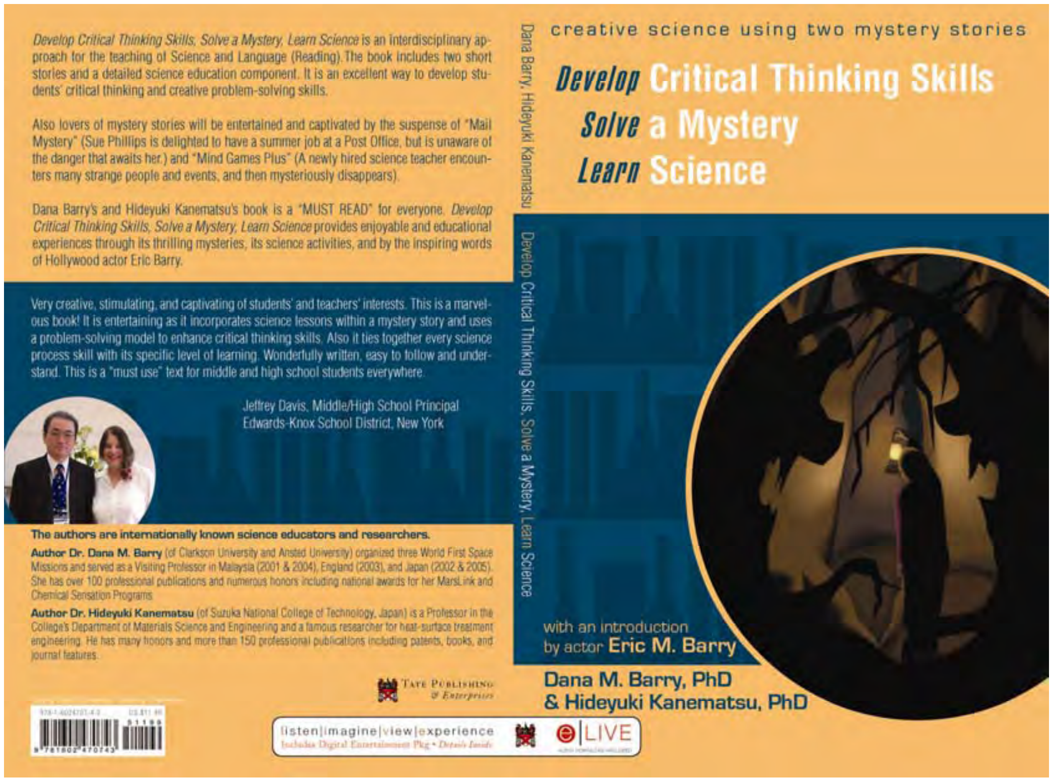
Reading and Solving a Mystery Teaching Approach

- This method allows students to read a story and solve its crime (problem).
- The approach was the result of Barry's desire to add a very creative component to the international program.
- Barry also wants to capture the attention of students who enjoy reading and to turn them onto science and engineering.
- Mystery stories are like research projects. They both have problems to solve.

Reading and Solving a Mystery Teaching Approach

- **Barry prepared several exciting mystery stories and incorporated them into a creative textbook (by Barry and Kanematsu) for engineering students.**
- **This creative textbook (Develop Critical Thinking Skills, Solve a Mystery, Learn Science) exists in three different formats: an audio book, the English paperback, and the Japanese version.**

Creative Textbook



Book Contents

- **Introduction.** To enhance the creativity of this book, an introduction is written by a Hollywood actor. He addresses the themes of the book's mystery stories.
- **Mail Mystery.** This story is about a young female college student, who is kidnapped soon after discovering a dead body.
- **Mind Games Plus.** This story is about a newly hired science teacher. She encounters many strange people and events, and then mysteriously disappears.

Book Contents

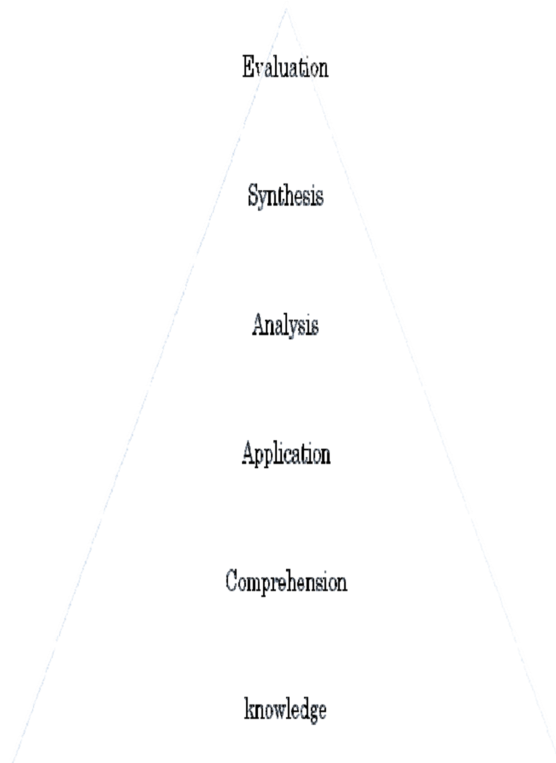
- **Creative Problem Solving Model.** Students (as detectives) carry out this set of logical steps used by scientists and engineers. They obtain evidence (data) to solve the crimes (problems) in the mystery stories.

Student Detectives

Book Contents

- **Science Education Component.** This section directly relates to the mystery stories. It includes the problem solving model, science process skills, science lessons, and activities in creative thinking at all levels of learning (Bloom's Taxonomy).

Bloom's Taxonomy



Book Contents

- **Creative Engineering Design Activities.**

Some examples are provided.1. **Creatively design healthy cookies**. Design or modify an existing cookie recipe to prepare healthy cookies. (Hint: Reducing the amount of eggs and oil used in the recipe will lower the fat and cholesterol in one's diet.) 2. **Creatively design a periodic table.** 3. **Creatively design, build, and test boats made of aluminum foil**.

Space Science Teaching Approach

- **Barry had the honor of organizing three World First Space Missions (educational components to the NASA Missions) with support from Space Explorers, Inc. and the National Aeronautics and Space Administration (NASA).**
- **Barry believes that using space-related activities is a great and exciting way to learn science and creative design.**

Activity in Creative Design Relating to the Planets

- **Looking at the traditional Solar System, one sees that the planets Earth and Mars are next to each other.**
- **First obtain information and pictures of both planets. For example, Earth includes land, water, plants, animals, and people (who breathe oxygen to stay alive). Mars is a cold planet with two Moons and an atmosphere of about 95% carbon dioxide gas.**

Activity in Creative Design Relating to the Planets

- **Next creatively design an imaginary planet existing between Earth and Mars. Provide a sketch of your newly created planet and information such as planet size, life forms, the presence of gases, Moons, etc. Name your planet.**

Traditional Solar System

Creative Engineering Design: Lunar Greenhouse Project

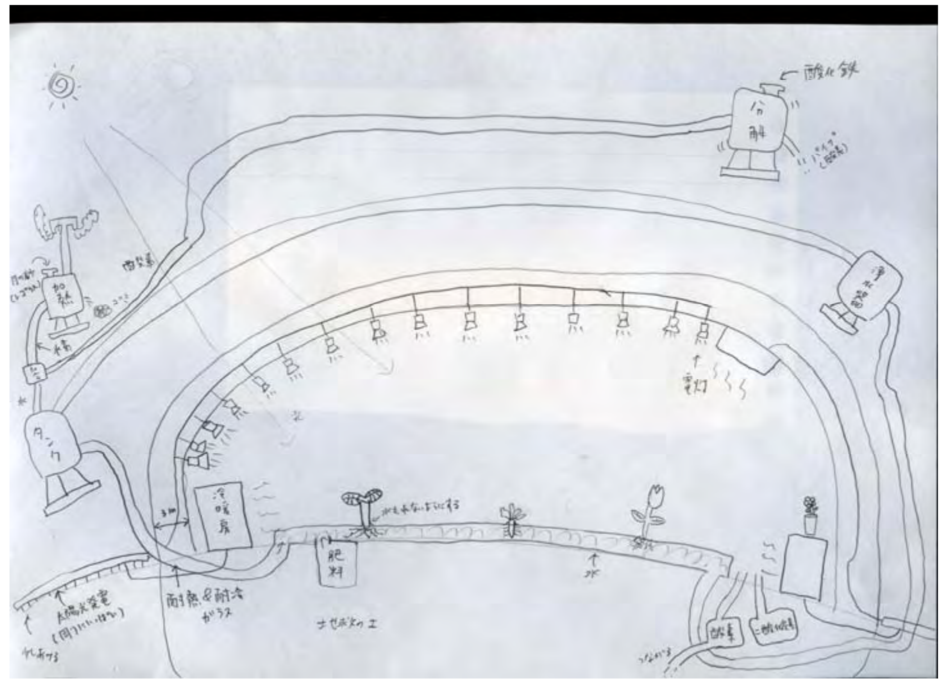
- Students in the United States (led by Barry) and students in Japan (led by Kanematsu) took part in NASA’s (the National Aeronautics and Space Administration) Creative Engineering Design Challenge. It was a Lunar Greenhouse project, in which the students were to design, build, and test a greenhouse (a chamber for growing plants) for use on the surface of the Moon.
- This exciting activity is briefly described.

Process for Lunar Greenhouse Engineering Design Challenge

- 1. Recognize the need (to grow plants for food on the Moon & to produce oxygen).
- 2. Write the problem as a question. (How can a greenhouse be designed to grow plants on the Moon?)
- 3. Collect data to solve the problem. (ex. need information about the conditions on the Moon & plant growth requirements).
- 4. Identify design requirements (ex. size & systems such as water to sustain plant life).
- 5. Identify design limits (ex. resources available).
- 6. Generate possible solutions to the problem. Draw & label sketches.
- 7.Evaluate the alternatives.
- 8.Select the best approach.
- 9.Communicate the selected design.
- 10. Implement the design. (Build a prototype greenhouse for the Moon using sketches, ideas, available materials, etc.)

Results of the Engineering Design Challenge

- **Barry & Kanematsu successfully carried out the Lunar Greenhouse challenge with students in the US & Japan. Students designed, built, & tested their lunar greenhouses. The students in Japan designed a virtual greenhouse that was an arch-framed dome made with heat resistant, cold-tolerant, very thick (3 m) glass. It was to be built on the Moon's surface.**



Japan's Results

- **The ultraviolet light could be cut by the thick glass wall. During the two weeks of night on the Moon, lights hooked from the ceiling would be driven by photovoltaic generation to give the plants light. The water for the growth of plants would be made by the chemical reaction of hydrogen and oxygen. Hydrogen would be made from regolith (Moon sand), while the oxygen would come from iron oxide.**

Results of the Engineering Design Challenge

- **The US students used their greenhouses to compare the growth of cinnamon basil seeds flown on the Space Shuttle Endeavour (STS-118 mission) to Earth-based seeds. The Earth-based seeds grew better & faster. Their greenhouse (photo on the right) is to be hooked up to a spacecraft on the Moon.**

US Results

- **This helps store solar energy and to provide a continuous supply of carbon dioxide and water (containing plant nutrients). Solar panels are used to collect and convert solar energy into electricity, heat, etc. The battery (attached to the solar panel) is for storing energy. Aluminum foil is an insulating material. Also this greenhouse is coated with a clear insulating material to protect it from extreme temperatures on the Moon. The flashlight represents a large light source, the pipets represent a water sprinkler system, and the yellow hose is used to provide carbon dioxide to the plant chamber.**

E- Learning Teaching Approach

- Electronic Learning (e-Learning) allows individuals to learn anywhere at any time (ex. provided they have computers with the necessary software, etc.).
- E-Learning levels range from very basic (ex. knowledge database) to the very advanced (incorporating images, sounds, color, interactive games, etc.) to make learning more interesting.
- This Creative Education Program uses advanced forms of e-learning for the Mars Explorer Simulation and for Problem Based Learning (PBL) activities in Metaverse.

Mars Explorer Simulation

- This simulation provides students with enjoyable learning experiences.
- It is an effort between Space Explorers Inc. and the National Aeronautics and Space Administration (NASA).
- It replicates NASA’s Mars Exploration Rover Mission. Here two Rovers (Spirit and Opportunity) landed on Mars on 2004 searching for clues about past water activities on Mars.

Rover as seen on Mars in the Mars Explorer Simulation

Mars Explorer Simulation

- **Students start with a rocket launch and then land their rover on a preselected location on Mars.**
- **They control and move their rovers over the surface of Mars.**
- **Students use instruments aboard their rovers to get information about the Martian soil, rocks, etc. (examples: cameras, magnets to collect magnetic dust particles).**
- **They have a limited amount of fuel, so they must conserve energy.**
- **In 2008, Barry carried out these simulations with hundreds of college students in Central Japan.**

Simulation at Numazu National College of Technology

Activity in Creative Engineering Design

- **After closely observing the makeup and operation of their rovers, the students are asked to modify and improve the design of their rovers. They make sketches of their ideas and later create models of their newly designed rovers.**

Problem Based Learning (PBL) in Metaverse

- PBL is a powerful tool for Engineering Education. Here students work in small groups to solve problems and teachers act as facilitators.
- Barry, Kanematsu and others led such a PBL project in Metaverse. The project was carried out by students in Second Life (SL), a three dimensional virtual community where avatars do things on our behalf. The students met in virtual classrooms on the Japanese Island of Nagaoka University of Technology.
- NOTE: To take part in this activity, students had to perform various functions: basic movements, teleporting, prim building, and chatting.
- Participants: Two Japan teams and one US team (about 4 members per team).

PBL Project Procedure

- **Presentation of the Problem: Students were to design and build the ordinary house of the future (ideal house for global warming era).**
- **Each team met in a virtual classroom to discuss the function and structure of the ordinary house of the future.**

The US team holding a discussion in a virtual classroom

PBL Project Procedure

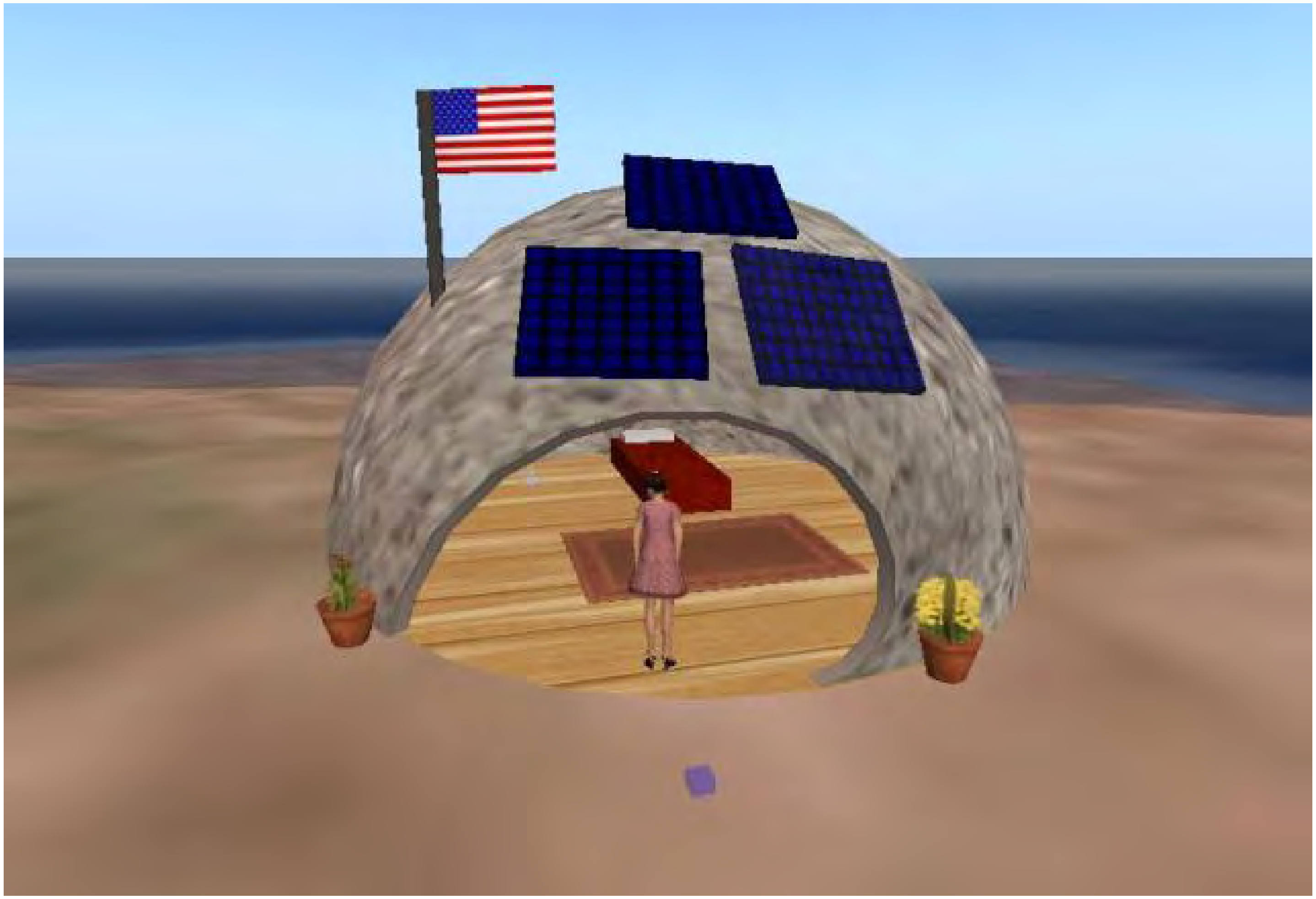
- **Students practice making structures with prims. Prims would later be used to build their ordinary houses of the future.**

The Japan team practices making structures with prims

PBL Project Procedure

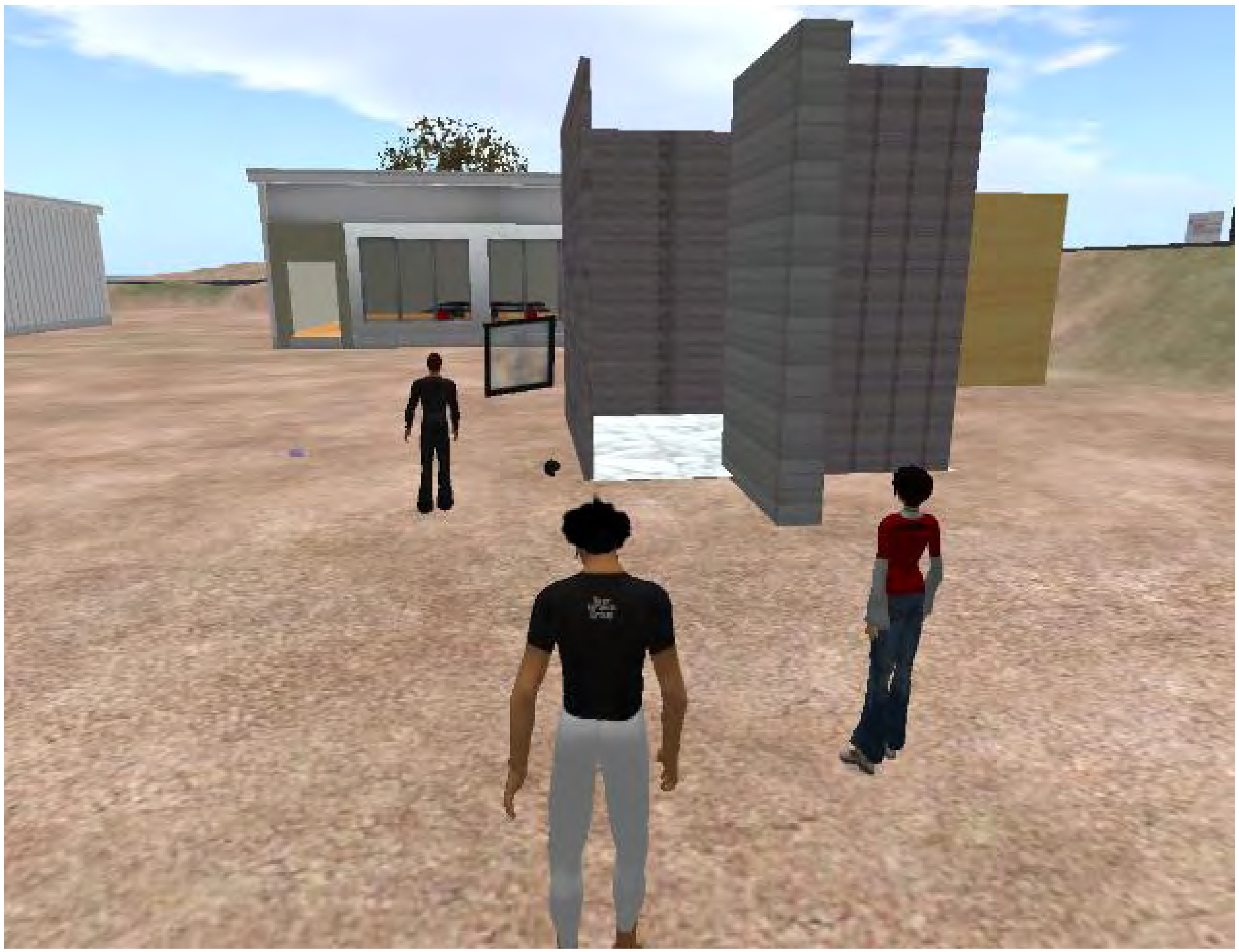
- Students obtain resources online, etc. to help solve the problem.
- They continue discussions about the function and creative design for their house of the future.
- After agreeing on the best final solution to the problem, each team successfully builds a house for the future.

US Dome House



Japanese Dome House

Other Japanese House



Results

- To obtain information about this project, each student completed several questionnaires.
- Students from both Countries gave a relatively high rate of satisfaction for the PBL class in Metaverse.

Acknowledgments

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