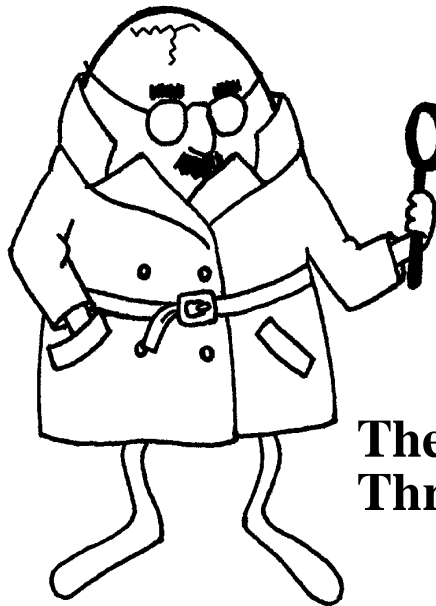


MCGYVER SCIENCE



operation: Humpty-Dumpty

The Development of Science Skills Through Scenario-Based Problems

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McGyver Science

Science Skills Development Through Scenario-Based Problem Solving

Operation: Humpty-Dumpty

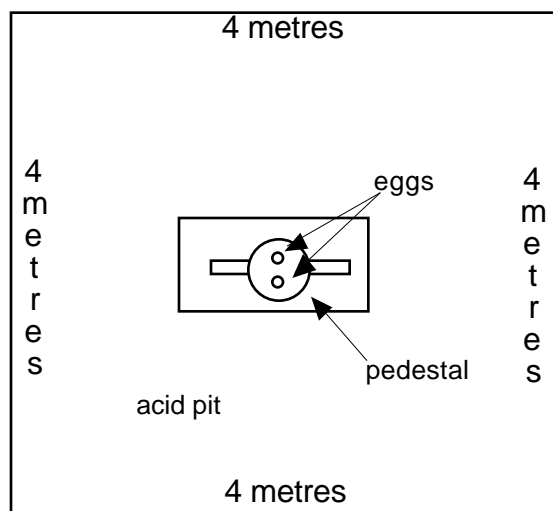
Introduction

Imagine, if you will, that you are part of a “Special Ops” team that has been brought together to plan and execute the retrieval of a set of rare and invaluable Faberge´ Eggs. Armed with only your collective wit and a jumble of seemingly innocuous materials, you must work together with your team to accomplish this mission.

This sets the scene for this workshop, which blends role-playing with problem solving and team work skills development. McGyver Science is heavy on science process skills, excitement and fun.

The Challenge

Student teams of four are presented with the above scenario and challenged to rescue the eggs from a display pedestal suspended in the middle of a 4 metre square pit of “concentrated sulphuric acid.” The team members may not enter the pit (for obvious reasons) and if the eggs fall into the pit they will sink to the bottom where they are unrecoverable. The ultimate goal is to be the first team to retrieve both eggs safely from the pedestal. However, since this mission is near impossible, even one safely retrieved egg may prove to be a success.



The size of the acid pits requires a large space and so this event is best set up in a gymnasium or outside on a sport field.

Rules and Judging

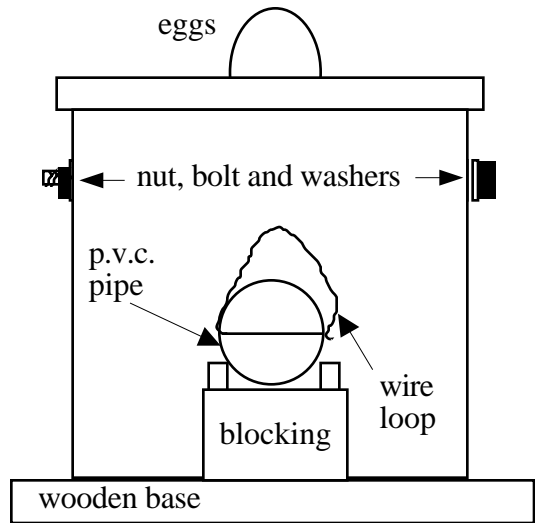
1. Teams must not step inside the pit area. If any member touches the ground inside the pit area, they will incur an acid burn. Their screams will alert security and they will be captured. In other words, the team is disqualified from further action. If any materials or equipment touches the acid pit it is rendered useless.
2. Teams may use any of the materials given to them in their “Special Ops” Kit.

3. The first team to successfully retrieve the Faberge' eggs and escape the enclosure is the winner.
4. In the event that two eggs are not retrieved, the first team to successfully retrieve one egg is the winner.
5. If two teams are tied (highly unlikely), then the first team to correctly explain what Faberge' eggs are will be declared the winner. Research may be required.

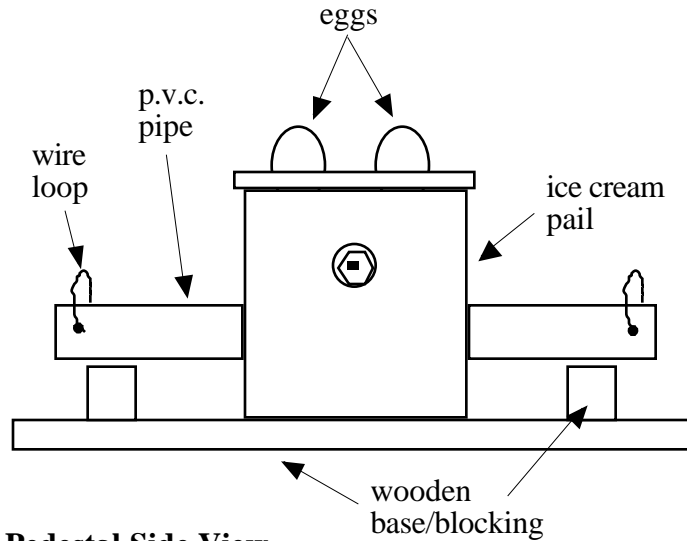
Materials

The Pedestal

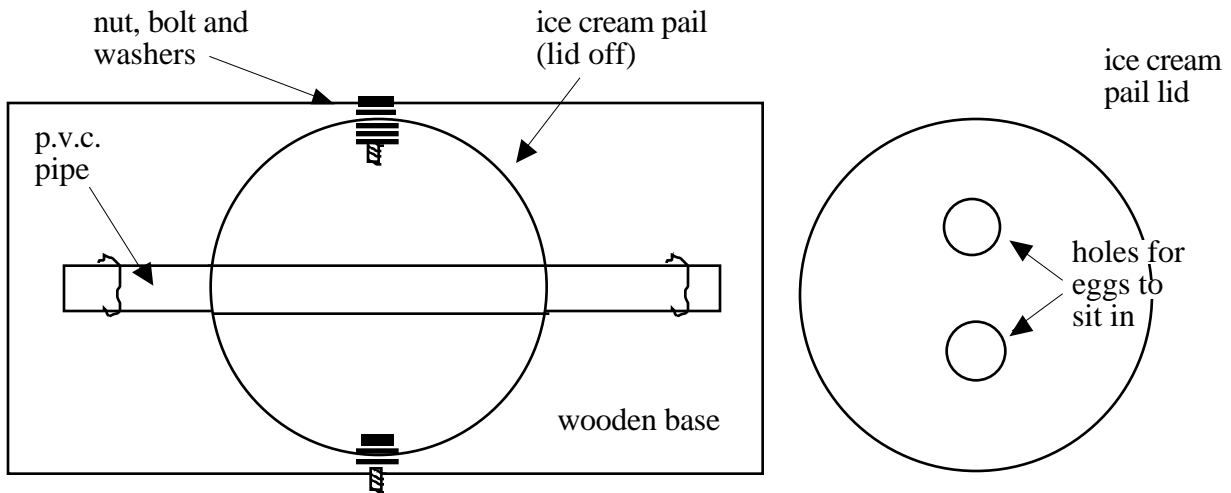
- ice cream pail & lid
- p.v.c. pipe--4 cm (1.5 in.) dia.
- 2-2 in. bolts (3/8 in.) (3/8 in.)
- 12 flat washers (3/8 in.)
- blocking (see below)
- 2 eggs (real or virtual)
- 40 cm
- 2 nuts
- 2-30 cm pieces of wire
- wood for base (30 cm x 50 cm)
- 16 m of string or surveyors tape (acid pit)



Pedestal End View



Pedestal Side View



Pedestal Top View

Note: One side of the ice cream pail has ten washers while the other side has only two. This is to ensure that the pedestal is unbalanced. If a team tries to lift the entire pedestal by the wire loops or by the p.v.c. pipe, it will tip over, spilling the eggs into the acid pit. Care must be taken to conceal this booby trap by creating the illusion that one continuous bolt passes through the pail.

Special Ops Kit

Each team of four students should receive identical kits of creative materials. Some suggestions are below.

- 2 small plastic pulleys
- 6 assorted rubber bands
- wire
- s clips
- plastic tooth brush holder with fishing line wrapped around it (hidden inside the tooth brush holder are more materials that the teams may use if they discover them. These materials include more line, hooks and rubber bands)
- 4 large paper clips
- wood
- package of chewing gum
- rubber dart gun with suction cup darts

Teams may use any of the above materials in any way they determine. They may also use a multipurpose pocket knife, if they have one, but no other materials or tools may be used.

Suggestions and Variations

1. Team Instructions

Explaining the challenge to the teams does not have to be a straight-forward monologue by the teacher/organiser. Outlined below are some creative ways to inform the teams of what it is they are challenged to do.

a) Taped Instructions

With a few sound effects (like theme from “Mission Impossible”) and a bit of humour you can get everyone into the role play very quickly by taping the instructions on an audio cassette and providing each team with a tape player. Besides giving teachers a

chance to display their thespian talents, it allows teams to replay the instructions but not at the expense of other teams' time. This method encourages groups to be quiet and listen carefully to the instructions.

b) Jig-Saw Instructions

Divide the instructions (scenario and rules) into four parts and type them on individual cards. Seal each card in an envelope. Each team member receives part of the instructions and may only convey this information verbally. Members may not exchange cards or read another team member's card. This method promotes cooperation, verbal communication and listening skills.

2. Entry and Escape Challenges

Rather than begin directly with the *Operation Humpty-Dumpty*, you can extend the challenge to include either an entrance challenge, an exit challenge or both. These challenges must be completed before retrieving the eggs or after the eggs have been recovered and are included as part of a team's time. Below are some suggestions for these challenges.

a) Electric Fence

A length of cord is secured 1.2 m above the ground. Teams are told that it represents an electric fence which must be hurdled to gain access to or exit from the egg chamber. Teams must get three of their four members over the fence to enter or exit safely. If any member touches the rope, they must return and try again. If a team can not meet the challenge, the fence is deactivated after 5 minutes and they may enter or exit unharmed.

b) Radiation Maze

Using only verbal instructions, teams must guide a blind folded member through a maze of "radioactive objects" (chairs, benches and gym equipment). If the member touches an object, he or she becomes dazed and must exit the maze and be replaced by a different team member. When more than one team is in the maze at the same time, instructions become confusing. Once a team safely guides a member through the maze, the mission is accomplished and they are justly rewarded.

Possible STSE Connections, Skills and Attitudes Development¹

Although *McGyver Science--Operation: Humpty Dumpty* is appropriate for all secondary school students, the general learning outcomes and specific learning outcomes outlined below are appropriate for students completing grade 9. Some of these outcomes may not directly result from this activity, but require follow-up by the teacher to draw them out.

STSE Connections

The following Science, Technology, Society and Environment connections may be developed through *Mcgyver Science--Operation Humpty-Dumpty*.

1. Nature of Science

GLO 51 describe how specialised approaches and processes are used by scientists and technologists to understand and explain natural phenomena and develop technological solutions

51-2 provide instances of how science and technology can be done by themselves and others in everyday situations

51-4 identify specific science disciplines, and relate them to their studies in science in formal and informal settings

51-6 provide examples to illustrate that science and technology take place in a variety of settings and are done by many groups and individuals

GLO 52 distinguish science and technology in terms of their goals and products, trace the development of scientific knowledge over time, and relate this development to emerging evidence and needs

52-4 describe scientific inquiry, problem-solving, and decision-making processes, and provide examples where they may be applied

52-6 construct a simple device to meet a particular need or perform a task, and evaluate the device on the basis of a limited number of criteria provided

52-7 compare scientific inquiry, problem-solving, and decision-making processes, in terms of purpose, goals, and application

2. Interactions of Science and Technology

GLO 53 apply scientific principals to describe, design, and create products and processes to explore nature phenomena, extend human capabilities, and solve practical problems

53-1 describe the science underlying particular technological products designed to explore natural phenomena, extend human capabilities, and solve practical problems

53-2 identify a system and name its parts

53-3 construct a simple device to meet a particular need or perform a task, and evaluate the device on the basis of a limited number of criteria provided

¹ The STSE connections, skills and attitudes referred to here and the General and Specific Learning Outcomes cited are taken from the Pan-Canadian Protocol for Collaboration on School Curriculum-common Framework of Science Learning Outcomes K to 12 (draft edition)--Council of Ministers of Education, Canada--1997.

- 53-5 use technologies, including computers, to gather and display data and information
- 53-7 relate parts to the whole of a system
- 53-11 describe how science is applied in a variety of domestic, industrial, and environmental contexts
- 53-12 relate parts to the whole of a system and explain how they work together
- 53-13 design and construct a simple device to meet a particular need or perform a task, and evaluate the device on the basis of criteria provided

GLO 54 describe how science and technology interact and advance one another to explore natural phenomena, extend human capabilities, solve practical problems, and identify questions and problems to which science and technology can or cannot provide answers or solutions

- 54-4 identify examples of problems that arise at home, in an industrial setting, or in the environment that cannot be solved using actual scientific and technological knowledge
- 54-7 distinguish between claims and arguments based on scientific reasoning and those that are not

3. Interrelationships of STSE

GLO 55 illustrate how the needs of society, including business and industry, industry, influence and support scientific and technological enterprises, and relate careers, hobbies, and interests to science and technology

- 55-4 apply the knowledge and skills acquired in the study of science to their everyday lives

Skills

The following Skills may be developed through *Mcgyver Science--Operation Humpty-Dumpty*.

1. Initiating and Planning

GLO 57 ask questions about relationships between observable variables and develop controlled investigations of those questions

- 57-1 identify questions to investigate and practical problems to solve
- 57-2 identify appropriate methods and tools for collecting data and for problem-solving tasks
- 57-4 state a reasonable prediction and/or hypothesis based on given background information
- 57-5 design experiments, identify manipulated and responding variables, and identify other variables that might affect the results

- 57-9 propose and plan one or more design solutions to a given practical problem
- 57-10 define and delimit, with guidance, questions and problems to facilitate investigation
- 57-13 select appropriate methods and tools for collecting data and for problem-solving tasks
- 57-16 propose alternate design solutions to a given practical problem, select one and develop a plan
- 57-17 define and delimit questions and problems to facilitate investigation
- 57-18 state a prediction and/or hypothesis, and support it with background information
- 57-19 design an experiment and identify major variables

2. Performing and Recording

GLO 58 conduct investigations with regard to relationships between observable variables, and gather and record qualitative and quantitative data

- 58-3 estimate measurements
- 58-5 use tools and apparatus safely
- 58-6 test the design of a device or system
- 58-7 evaluate designs and prototypes in terms of form and function as well as efficiency and usefulness
- 58-8 identify and use a variety of sources and technologies to gather pertinent information
- 58-12 improvise practical solutions for problems encountered
- 58-16 identify and correct practical problems in the functioning of a prototype device

3. Analysing and Interpreting

GLO 59 analyse qualitative and quantitative data, and develop and assess possible explanations

- 59-6 evaluate processes used in planning, investigating, problem solving, and decision making
- 59-8 state a conclusion based on the experimental data
- 59-10 draw a conclusion from experimental data
- 59-13 compare data, interpret patterns and trends, and infer relationship between variables
- 59-17 develop theoretical explanations for results
- 59-20 identify new questions or problems that arise from what was learned

4. Communication and Teamwork

GLO 60 work collaboratively on science-related problems, and use appropriate language and formats to communicate ideas, procedures, and results

- 60-1 clearly and appropriately communicate questions, ideas, intentions, and plans, demonstrate skills for receiving, understanding, and acting on the ideas of others
- 60-2 work cooperatively with team members to develop and carry out a joint plan
- 60-3 work cooperatively with group members in trouble shooting problems that arise
- 60-4 evaluate group processes used in completing a task
- 60-5 communicate plans, results using written point form lists, written sentences, data tables, graphs, drawings, oral language, or other media
- 60-20 evaluate processes used in planning, investigating, problem solving, and decision making

Attitudes

The following attitudes may be encouraged or developed through *Mcgyver Science-- Operation Humpty-Dumpty*.

GLO 69 appreciate the role of science in understanding the world

GLO 70 realise that the applications of scientific and technological knowledge and skills can have consequences, risks, and benefits

GLO 73 have a continuing curiosity and interest in a broad scope of science disciplines and in science-related careers

GLO 74 confidently pursue further investigations and readings

GLO 76 consider evidence and ideas from a variety of sources when solving problems and reaching a conclusion

GLO 78 work collaboratively with others in carrying out investigations as well as in generating and evaluating ideas

GLO 80 project beyond the personal, consequences of proposed actions

GLO 81 show concern for safety in planning, carrying out, and reviewing activities

GLO 82 become aware of consequences of their actions

