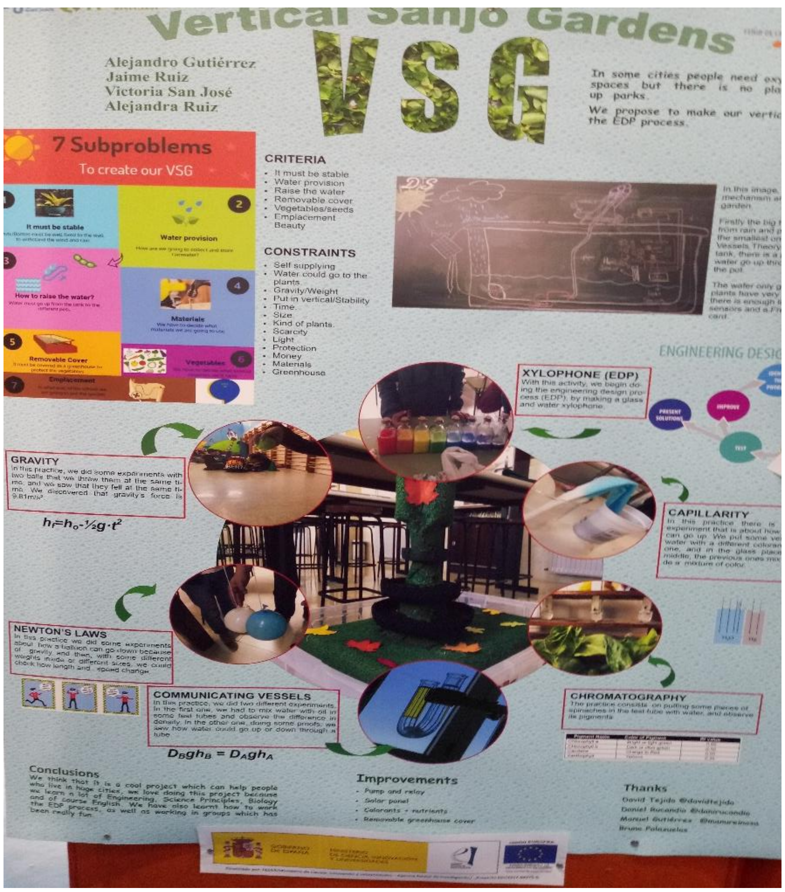
Vertical Sanjo Garden

Biology 1º ESO

Curso 2018-2019



Colegio San José – Niño Jesús, Reinosa

Autores: Daniel Rucandio – David Tejido

INDEX:

A. PROJECT JUSTIFICATION

In this challenge, students explore agricultural and architectural engineering as they design a vertical kitchen garden for the school to get a more kind and natural space for our playground. They learn to use the scientific principles of fluids, more specifically of pressure, communicating vessels, density, Archimedes Principle, greenhouse effect, and will get acquainted with the science investigation process.

General Objectives: In this challenge students will

- Understand the principal role of the materials and their properties in engineering solutions
- Get interested in phenomena found in daily life
- Develop the ability to predict and verify results
- Realize how buoyancy works
- Understand how ships float
- Realize the difference between natural and man-made objects
- Conceive that goals are achieve by collaboration among scientists and engineers
- Experience the importance of team-works as well as individual responsibility as a member of the team
- Experience the satisfaction of success
- Discover and experience the relationship between theory and practice
- Develop a spirit of inquiry
- Develop the ability to accomplish a task from start to finish
- Develop design skills
- Develop the ability to turn designs into reality
- Acquire technical skills on using tools properly and safely
- Get familiar with the process of finding means to overcome difficulties and problems
- Develop the ability of perform experiments and interpret results

Specific Objectives:

- Realize how pressure works, its effects on capillarity
- Gravity influence in real life and Newton laws
- Explore the greenhouse effect
- Agriculture: plants, uses, cycles

B. RELATIONSHIP BETWEEN THE PROJECT AND THE CURRICULUM

B.1. KEY COMPETENCES:

- Linguistic communication.
- Mathematical competence and basic competences in science and technology.
- Digital competence.
- Learning to learn.
- Social and civic competences.
- Sense of initiative and entrepreneurial spirit.
- Awareness and cultural expressions.

B.2. CONTNETS OF THE CURRICULUM:

Overview of the challenge:

Participant age: 12-15	**Number of participants:** Groups (3-4 students)	**Module length:** App. 25 to 30 hours
Level of knowledge: intermediate	**Number and type of personnel:** Teacher/ external science experts/ science museum staff/ students and their parents	**Type of venue:** Classroom/ outdoors/science museum
Technological needs: Internet/computer/tablet	**Topic as per formal curricula:** capillarity, pressure, communicating vessels, buoyancy, gravity, greenhouse effect, volume, plants, farming	**Estimated Cost:** Low (250 € per all teams) It is looked forward that all the materials are reusable.
Specify learning methodology: Engineering Design Process (EDP). Inquiry Based Learning (IBSE)	**Engineering Field:** Agricultural- Architectural- Environmental Engineering	**Type of activity:** Hands on activity

B.3. ASSESMENT CRITERIA:

Each activity has a rubric associated with it, as well as the final product. In addition, the student has to make a portfolio thinking about their daily work. They also co-evaluate among themselves.

B.4. INTERDISCIPLINARITY:

- *Biology / Technology / Physics / Chemistry / Engineering*

C. BASIS OF THE PROJECT

Activity 0-What is engineering?

The word engineering is of Latin origin; its root is “ingeniere“which means to design or to devise.

Engineering is the application of scientific knowledge (natural sciences, mathematics, economic and social), practical knowledge and empirical evidence in order to solve everyday life problems. More specific, the purpose of engineering is to invent, innovate, design, build, research and improve structures, machines, tools, systems, components, materials, processes and organizations under specific constraints. The field of engineering is very broad and encompasses a great range of more specialized fields [1], [3] such as:

- » Aerospace & Aeronautical Engineering
- » Agricultural Engineering
- » Architectural Engineering
- » Biochemical Engineering
- » Biomedical Engineering
- » Chemical Engineering
- » Civil Engineering
- » Computer Engineering
- » Electrical Engineering
- » Environmental Engineering
- » Geoscience Engineering
- » Indris trial Engineering
- » Marine Engineering
- » Materials Engineering

- Mechanical Engineering
- Metallurgical Engineering
- Ocean Engineering
- Petroleum Engineering

What is the work of an engineer?

Engineers identify a problem, and come up with a solution – often creating something completely new in the process.

"Scientists investigate that which already is; engineers create that which has never been" Albert Einstein.

The most famous engineering fields, in more detail [2], [5], are the following:

Aerospace engineering: the field of engineering is *concerned* with the development of aircraft and spacecraft. Aerospace engineers design, develop, test, and supervise the construction *of aerospace vehicle* systems. Such systems are aircrafts, helicopters, space vehicles and launching systems.

Architectural engineering: the field of engineering that uses engineering principles to the construction, planning and designing of buildings and other structures. Architectural engineers work in several areas such as: the structural integrity of buildings, the design and analysis of light, heating and ventilation of buildings, energy *conservation issues*.

Biological engineering (bio-engineering): the field that applies concepts and methods of biology, physics, chemistry, mathematics and computer science *to* solve problems which are related to life sciences. Bioengineers solve problems in biology and medicine by applying principles of physical sciences and engineering while applying biological principles to create devices such as diagnostic equipment, biocompatible materials, medical devices, etc. In general bioengineers try to mimic biological systems in order to create products or modify and control biological systems.

Chemical engineering: the field of engineering that applies physics, *chemistry,* microbiology and biochemistry along with applied mathematics and *economy* in order to transform, transport and use chemicals, materials and energy. Traditionally chemical engineering was linked to fuel *combustion* and energy systems, but today's chemical engineers work in medicine, biotechnology, microelectronics, advanced materials, energy sand nanotechnology.

Civil engineering: the engineering field that deals with design, construction and maintenance of constructions such was roads, bridges, dams, buildings, tunnels. Civil engineering is probably the oldest engineering discipline which deals with the built environment. Civil engineers use their knowledge on physics and mathematics to solve society problems.

Computer engineering: the discipline that integrates electrical and *electronic* engineering and computer science in order to design and develop hardware, software, computer systems and other technological devices. Completer engineers embed computers in other machines and systems, build networks to transfer data and develop ways to make computers *faster* and smaller. Furthermore, computer engineers have expertise in a variety of areas *such* as software design and coding and are trained to design software and perform and integrate that software with hardware *components.*

Electrical engineering: the field of engineering that deals with the study and application of electricity, *electronics* and electromagnetism. Electrical engineers conceive, design and develop circuits, devices, algorithms, systems and components that can be used to sense, analyze and communicate data. Electrical engineers work on a variety of projects, such as computers, robots, cell phones, radars, navigation systems unit all other kinds of *electrical* systems.

Materials engineering: the field that involves the discovery and design of new materials. Material engineering incorporates physics, chemistry, mathematics and engineering. Materials engineers develop *process* and test materials used to create a wide range of products *such as* computer chips, medical devices, aircraft components etc. Materials engineers are concerned with the structure and properties of materials used in modern technology so they study the properties and structures of metals, ceramics, plastics, *nanom*aterials and other substances in order to create new materials that meet certain mechanical, electrical or chemical needs.

Mechanical engineering: the engineering discipline which applies the principles of engineering, physics and mathematics for designing analyzing manufacturing and maintaining mechanical systems. Mechanical engineers create machines used in manufacturing, mechanical components of electronics, engines and power-generating equipment, vehicles and their components, artificial components for the human body, and many other products.

Ocean (Marine) engineering: the branch of engineering study that steals with the design and operations of marinade systems in the ocean and other marine environments. Ocean engineering includes the engineering of boats, ships, oil rigs and any other marine vessel or structure. Ocean engineers apply their engineering (mechanical, electrical, electronic engineering) and scientific knowledge in order to design and develop systems and structures in marine environments. An ideal ocean engineer has to achieve a proper tandem between the marine eco-system and the developed human world.

Robotics: the interdisciplinary branch of engineering and science that treats with designing, constructing, programming, controlling, operating and using robots. Robots are used in a wide range of applications which include industrial, military, agricultural, medicine robots etc.

- Industrial robots - take over work that is dirty, dangerous and degrading to the human spirit (e.g. arc welding, grinding, sanding, polishing and buffing, palletizing etc.). Typically these robots are articulated arms particularly created for applications like material handling, painting, welding and others.

- Medical robots – robots that are employed in medicine and in clinical institutes such as surgical robots, rehabilitation robots and bio robots.
- Domestic or household robots — These types of robots are used at home and consist of robotic pool cleaners, robotic sweepers or robotic vacuum cleaners.
- Military robots These types of robots are used for offensive or defensive purposes and include bomb discarding robots, ballistic shield robots, inspection robots, attacking drones etc.
- Space robots - Robotic devices used to aid, augment, or substitute astronauts in order to do difficult or rote tasks such as exploration or repairs in dangerous environments (e.g. space station robotic arms, Mars rovers Spirit and Opportunity).
- Deep Sea robots – Robots that have long-term presence in the deep ocean and carry equipment to measure various parameters that scientists are interested in (e.g.

Benthic Rover).

» Engineering Misconceptions

- Plumber
- Electrician
- Carpenter
- Auto Mechanic
- PC (Personnel Computer) Technician
- Welder
- Machinist

What is technology?

Engineering mid technology are intertwined terns in society. In order to disentangle the two terms, one needs to understand what their meaning is. Engineering is both a field of study as well as application of scientific knowledge to create or produce something. On the other hand, technology is the collection of techniques, skills, methods and processes used in the production of goods or services or in the accomplishment of objectives, such us scientific investigation. Technology can be the knowledge of techniques and processes, or it can be embedded in machines, computers, devices, and factories, which can be operated by individuals without detailed knowledge of the workings of such things.

Engineering Design Process

The teacher introduces the EDP steps to the students. A short description of the Engineering Design Process follows.

The Engineering Design Process (EDP) is a series of steps that engineers follow when they are trying to solve a problem they are facing mind consists of a methodical approach. However, there is no simple design process which is universally accepted. In general, each individual design process begins with identifying the problem in and its requirements and ends up with a proposed solution. The intermediate steps, however, can vary. It is very important to point out that EDP is not a linear process. Since, engineering problems can have numerous correct answers; the process may require backtracking and iteration. The solution to an engineering problem is usually subject to unexpected complications and changes as it develops. In this project we propose a series of steps which are describes below.

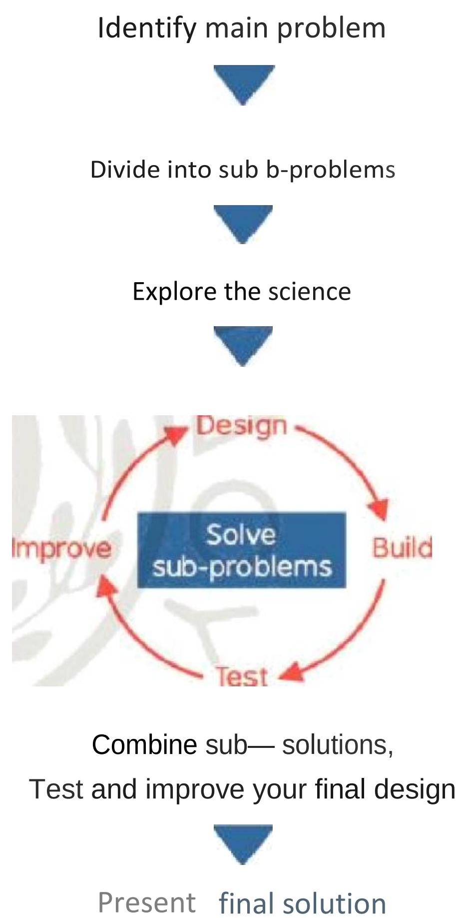


Figure 1: EDP steps

Identify the problem

Engineers ask critical questions about the problem and what they want to create, whether this is a space station, a skyscraper, a car or a computer. These questions include:

What is the problem?
Define the problem in specific terms. Be as specific as possible.
Which are the available materials?
What do we need to know in terms of scientific principles that underlie the problem?
What are the constraints of the problem? (Budget, time etc.)
Which are the criteria that must be met so that the solution is acceptable?

2. Divide problem into sub—problems

Usually big problems consist of a series of sub —problems. So, engineers analyze the problem in order to plan their work.

Is the solution to the main problem straight forward?

Does the main problem consist of smaller and simpler problems?

Engineers do not attempt to plan the whole thing at once. Large projects have many variables that you do not know and can affect the whole plan.

Engineers set smaller goals. Instead of trying to plan everything from the beginning, they figure out the first obvious step and then move to the next one.

3. Explore the silence

After dividing the main problem to the sub—problems it consists of, engineers investigate the scientific principles that underlie each sub—problem. The fundamental background science is essential for solving sub—problems and designing the optimum solution.

What areas science cover my project?

Which are the scientific principles that underlie each sub-problem?
Research background theory
Perform experiments-tests to understand the theory´s applications

4. Solve sub-problems

Generate as many solutions as possible by brainstorming and examine the advantages and the disadvantages of each possible solution. Evaluate all the solutions in order to identify the optimum.

- *Design: Design the application of the chosen solution, carefully and with as much detail as possible. Draw a diagram of the solution and make a list of materials you need.*

- *Build: Follow your design and develop your solution of each one of the sub-problems.*

- *Test: Test whether the solutions of individual sub-problems are compatible with each other.*

- *Improve: Make the necessary corrections and improvements.*

5. Combine sub-solutions, test and improve

Test and if it is necessary improve your final design:

- *Does it work?*

- *Does it solve the need?*

- *Does the final design meet the criteria set?*

- *Analyze and talk about what works, what doesn´t and what could be improved.*

- *Discuss how you can improve your solution.*

6. Present final solution

Review and evaluate your work and present your final solution in front of an audience.

Preparatory Activity: Build a xylophone

This activity is designed as a way to introduce students to the EDP in order to have a common understanding of how it works and help teachers who are not familiar with engineering and technology in their classrooms.

Can you build a xylophone to play Radio Gaga of Queen?

Sheet music

Student are asked to follow the design process to build a xilophone made of glass bottles filled with water. Find a way to make real the chorus of the song.

Criteria

- The chorus of radio gaga should be recognizable

Constraints

- You could read the sheet music. You will have it on paper.
- Available materials: pen, eight different bottles, tempera and water.
- Available tools: funnel, bar and metronome
- The available time is 45 minutes

***-Tip:** From the criteria the main problem can be divided into sub-problems*

- *How many different notes are there?*
- *How long every note sounds?*

Activity 1- Identifying the problem (what is the engineering problem?)

Duration: 20 minutes

Objectives: In this activity students will

- Familiarize with materials and tools such as pliers, screw drivers, ropes, zip ties, etc.
- Reflect the role of materials in designing a solution to their problem
- Specify the constraints they have
- Determine the criteria that their solution must meet
- Describe the problem by writing a problem statement

General Context

In this activity the teacher sets the engineering problem that students have to face. Student teams ask questions concerning to the problem they are facing and discuss with their teacher the criteria that their solution must meet as well as the constraints they have. Afterwards, each team prepares a problem statement i.e. a brief description of the issues that need to be addressed by a problem solving team and should be present to them (or created by them) before they try to solve a problem.

Finally, student teams discuss with their teacher about materials that could be appropriate for their challenge. Different types of materials and tools are provided to student teams and the teams explore and become familiar with the materials.

- Working in groups

The teacher briefly introduces the Engineering Challenge: **"Each team has to design and construct a vertical kitchen garden will serve as a little agricultural area where they learn the principal characteristics of the plants".** The teacher states that engineers who face and deal with problems such as the three under study are called Architectural- Agricultural- Environmental Engineeres. (Description of this fields are provided in activity 0).

The teamas are encouraged to ask questions concerning the problem:

- What is the problem or need?
- Which are the criteria that their solution must meet?
- What are the constraints of the problem?
- Which are the available materials, tools, resources and technologies?
- Which are the scientific principles behind the problem?
- Which every day materials that can be found at home or at a local hardware shop that can be useful for solving the problem?

Each team is asked to prepare a problem statement. A good problem statement should answer these questions:

1. What is the problem? This should explain why the team is needed.
2. Who has the problem or who is the client/customer? This should explain who needs the solution and who will decide the problem has been solved.
3. What form can the resolution be? What is the scope and limitations (in time, money, resources, technologies) that can be used to solve the problem?

The problem must be specific enough to allow each team to design a solution.

The teacher then provides student teams with different materials (the teacher can provide student teams with extra materials that are not appropriate for the final design) and tools. Student teams are given some time to become familiar with the materials and tools and then discuss with their teacher about possible uses of them. The teacher should encourage student teams to ask questions concerning the criteria that their solution must meet and the constraints of the problem.

Constraints

- Available materials
- Available tools
- Available time
- The kitchen garden´s size
- Cost
- Security Issues

Criteria

- It must be stable
- Water provision
- Raise the water

- Removable cover
- Vegetables
- Emplacement

Activity 2— Divide into sub-problems

Duration: 15 minutes

Objectives: In this activity students will

- brake the main problem to simpler problems
- organize their goals
- schedule their work and set time limits
- draft a plan how they will work

General Context

In this activity, student teams move to the second step of the Engineering Design Process which is to divide the main problem into sub -problems. Strident teams try to analyze and divide the bigger problem to smaller and easier to handle sub-problems. They also try to match materials to each sub-problem. Student teams write down and justify their thoughts. The teacher reminds the criteria and constraints that should be m e t .

- Working in groups and whole class discussion

Teacher initiates a discussion about the fact that an easy way to deal with a large project is to break it into smaller tasks which are more manageable and easier to face. However, he/she should point out that the task of getting a large goal divided into smaller and achievable ones is not very easy and in fact it *can* be something quite hard to no. The teacher can propose some simple guidelines that if followed can make the process of breaking the problems, easier. After that student teams should be prompted to propose possible sub-problems.

Guidelines

- Do not attempt to plan the whole thing at once. Large projects have many variables that you do not know and can affect the whole plan.
- Set smaller goals. Instead of trying to plan everything from the beginning, figure out the first obvious step and their move to the next one.
- Do not hesitate to re-divide. If you procrastinating on any of the smaller task, do not hesitate to analyze to simpler ones.

- Set time limits. Usually, when engineers deal with a complex problem, apart from the problem itself they have to face time limitations. So in order to be effective manage your time as good as possible.

The main problem can be divided into seven sub-problems:

1. Stability
2. Water Provision
3. Cover
4. Raise the water
5. Materials
6. Vegetables
7. Emplacement

Activity 3 - Explore the science

Duration: 50 minutes

Objectives: In this activity students will

- Perform experiments concerning the principles floating and sinking
- Organize and classify their observations
- Predict and verify results
- Familiarize with the third step pf the Engineering Design Process

General Context

The purpose is to get students in touch with the process of exploring the science behind the problem and/or sub-problems. Student teams start to think the necessary knowledge they need in order to solve the engineer problem. Student teams are encouraged to pose investigate questions which if answered will help them in the process of dealing with the problem. They perform specific experiments that will guide answer their questions about the science that underlies the problem. Student teams are guide through the process of acquiring the necessary scientific knowledge they need for solving the problem. As this activity progresses, students discuss with the teacher the science that underlies the problem. In addition, students organize their observations and answers.

- **Working in groups**

The teacher´s goal is to introduce students to the third step (Explore the Science) of the EDP and to motivate them start thinking about the scientific knowledge they need to know and to star brainstorming on how this knowledge can be applied by imagining possible solutions to the engineering problem. Teacher should focus on the scientific principles that underlie the challenge.

Student teams are asked to brainstorm and pose questions concerning the science behind communicating vessels, capillarity, gravity and action-reaction.

Here you have five laboratory practice to learn by yourselves this physical concepts.

Communicating Vessels

Cromatography

Capillarity

Gravity

Newton Laws

Activity 4 – Solve sub-problems

Duration: 50 minutes

Objectives: In this activity students will

- Solve each sub-problem based on their plans
- Use tools properly and safely

General Context

In this activity students are introduced to the core of the Engineering Design Process and apply the corresponding steps of EDP to face their challenge. After completing Activities 1, 2, and 3 they move to the constructions process. In order to face and solve each sub-problem they follow the circle: design-build-test-improve. As a part of the whole EDP process students need to recall the scientific knowledge they gained in Activity 3.

- **Working in groups**

The teacher summarizes the conclusions of Activities 1, 2 and 3. As student teams have already defined the individual sub-problems, the teacher encourages and guides student teams to gradually solve each one of the sub-problems that the main challenge has been divided into. Student teams are also asked to classify the available materials according to the sub-problem they believe that are suitable for. The teacher encourages the teams to draft a plan of their work and a simple design illustrating the different components of the final design.

Students should take into account the following:

7 Subproblems

To create our VSG

1

It must be stable

Pots/Bottles must be well fixed to the wall to withstand the wind and rain

2

Water provision

How are we going to collect and store rainwater?

3

How to raise the water?

Water must go up from the tank to the different pots

4

Materials

We have to decide what materials we are going to use

5

Removable Cover

It must be covered as a greenhouse to protect the vegetables

6

Vegetables

We have to decide what kind of vegebles we´ll farm

7

Emplacement

In what wall of the school we are going to put the garden

D&D TM

Activity 5 – Combine sub-solutions, test and improve

Duration: 45 minutes

Objectives: In this activity students will

- Combine solutions of individual sub-problems to end up with the final design
- Use their design to probe whether are met or not
- Make all the necessary changes to improve their design
- Have fun with their design

General Context

By the end of Activity 4, student teams are supposed to have constructed the main body of the vertical kitchen garden, and they have chosen that will provide capillarity and work as communicating vessels to the VSG. The next step is to combine the different components that will compose the final device. The student teams test their construction in order to confirm that it is functional and meets the criteria set in previous steps. In the case that the final design has some problem, student teams are encouraged to perform improvements and then test it again.

- **Working in groups**

The teacher initiates a discussion about the compatibility of the different components of the final design. Student teams are prompted to fit pieces together in order to construct the final artifact. Teacher prepares an open area where students may test their designs. The rain will be simulated with a water hose for long enough to see if the communicating vessel system works, as well as the water resistance of the materials. The teacher can also produce wind using a fan, or extreme heat using a dryer. At the same time the cover will be tested. If one or more of the criteria are not met, then each team should perform modifications in order to improve their designs.

-Tip: *From an educational standpoint, it´s important to allow the children to participate in setting up/cleaning up the room.*

Activity 6 – Present Final solution

Duration: 20 minutes

Objectives: In this activity students will

- Organize their presentation as a team
- Present their team work in front of an audience

General Context

The purpose of this activity is to help students realize that the use the same process that engineers use in solving problems. Students also realize that they posed questions and investigated the science that underlies a problem and used already existing technology (tools and materials) in order to imagine, design and construct the final solution to their problem. Student teams prepare a power point which presents the whole process they followed in order to conclude and construct the final design. Finally, they present their work in front of other people.

- **Plenary**

The teacher initiates a discussion about how important it is to present your work in front of an audience. It is very important for an engineer to make a clear and comprehensible presentation to an audience who can easily be his/her employer. The teacher should point out that in order to explain something to others you must understand it in depth firstly. Have student teams to prepare a presentation where they explain what they did, how they worked and what the result was. The teacher motivates the audience to put forward questions:

- Did you find any difficulties in applying the EDP?
- Did you change your original design? What affect did this/these change(s) have upon the final design?

- How would you change your design if you had to cultivate and consequently to protect and to water more plants?
- Do the suggested materials work properly and safely? Which materials you might substitute?
- What changes did you make to your design in order to improve stability?
- If you had more time what you would add, change, or do differently?

If you can´t explain it simply, you don´t understand it well enough. (Albert Einstein)

Science Careeres and your Future

Agricultural engineers use their engineering knowledge to solve problems in the agricultural industry. They are responsible for designing, developing, testing and managing agricultural machinery and equipment. Most agricultural engineers work in a particular area of the agricultural industry.

Agricultural engineers are responsible of designing, developing, installing and managing machines, buildings, vehicles and systems used in the agricultural industry.

They also work in horticulture, forestry, land maintenance (for example, professionals in sports facilities such as golf courses) and in environmental engineering, in short, they work in any place where land is associated with engineering.

After their initial training, agricultural engineers specialize in the manufacture of agricultural vehicles and machines, in sales and engineering services, in agricultural enterprises or in field engineering.

Agricultural engineers engaged in the manufacture of design specifications plan and test new machines and equipment to help farmers to:

- The cultivation, irrigation and drainage of the soil.
- Sowing, spraying and harvesting of crops.
- Classification and storage of products
- The facilities and food (food and water) of livestock.

Most manufacturing companies are small, so the agricultural engineer is usually responsible for more than one function. In a larger manufacturing company, they work in an area of expertise and work as part of a team of mechanical and production engineers, material scientists and financial experts.

Agricultural engineers can work for local machinery companies. They provide farmers, local authorities and other customers with the right machinery, while at the same time providing advice, information and after-sales service. They can also provide advice and information to producers and manufacturers agricultural machinery and equipment.

Agricultural engineers could also be involved in the organization of a farm, which could involve designing the layout of buildings, such as crop driers and greenhouses, to ensure that agriculture and horticultural processes are carried out with the greater efficiency.

They also select and install computer controlled systems that regulate temperature, humidity and feeding rates.

They are increasingly involved in the conservation of the rural environment, for example, through waste management. Field engineers are responsible for managing rural land and planning for more efficient use of soil and water resources.

Engineers responsible for the design and installation of agricultural systems that irrigate drylands drain marshland and limit the damage caused by soil erosion.

In developing countries there is a great need for agricultural engineers who can introduce methods to reduce crop loss and increase crop yields, while being aware of conservation and sustainable development.

Some agricultural engineers are engaged in research, development and teaching.

They work for specialized research institutes, colleges and universities, as well as for equipment manufacturers. Research engineers are responsible for solving agricultural problems in areas such as environmental protection, food safety and pollution control. They can prepare and present reports on their findings.

Agricultural engineers often have the responsibility of managing teams, of workers, including other engineers, engineering technicians and mechanics.

The work is carried out both inside and outside, depending on the specialty of the engineer.

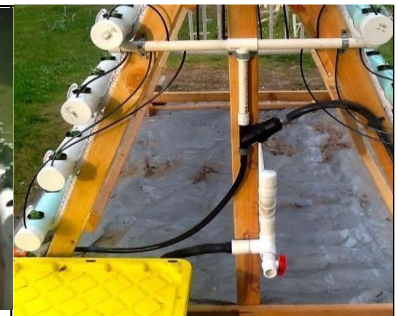
1- Description from educaweb

D. NECESSARY RESOURCES, ORGANIZATION AND CLASSROOM MANAGEMENT

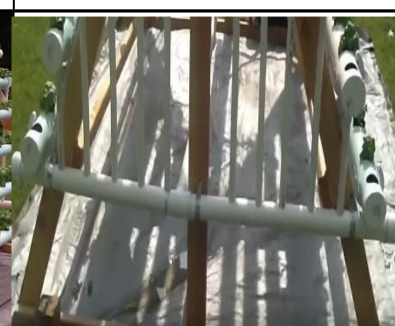
Construction Instructions

Here are some images so you can build your VGS. It's just a suggestion. We hope that your designs give solutions to all the challenges proposed.







The idea is to design a closed circuit and fill it with water in such a way that it falls into a reservoir, which sends the water upwards by pushing until the gravitational potential differential is canceled. Then a pump will have to be worked to restore that potential difference.
Another option is to have access to a water supply and open it from time to time.

People

All students participate. We put both classes together and create groups of three people. We are two teachers with the same role.

In addition, the technology professor has helped remarkably.

Finally, a geographer came to the classroom to give them a talk about why vertical gardens are necessary

E. HOW TO EXHIBIT FINAL PRODUCT AND TO WHAT AUDIENCE

For events (tips on setting up and running the challenge in an event setting)

In this challenge takes place in science festival or science museum as a:

i) Mini-Workshop (90 minutes)

As this is a workshop taking place in a science festival or in a museum, time is relatively limited.

- Skip the Preparatory activity building a xylophone to play radio gaga of Queen. Discuss with the participants the concepts of engineering and technology. Focus on the Engineering design Process only as it consists of the core of the whole project.

- From Activity 1 state the problem and focus on the constraints and the criteria that must be met. Have them pose questions concerning the problem.
- Urge the participants to suggest the physical principles that underlie the problem. Skip the experiments proposed in Activity 3 that concern the scientific principles that underlie the engineering problem. Discuss the scientific principles that will be used.
- Review the other activities in terms of content and time, focusing especially on how to respond to questions that might come up.
- To avoid spending time teaching each person how to make the vertical kitchen garden, make samples that illustrate the process.
- Prepare many copies of the instructions as well as enough materials for 4-5 parallel sessions. Establish a testing zone outside from building areas for the testing and presenting the final designs.
- Skip Activity 6 – Present final solution

ii) <u>Pop-up event (30-45 minutes)</u>

Pop-ups are about creating an atmosphere that people would love to participate in. Focus on the uniqueness of the experience that people will have if they participate.

- Activities 0-3 can be excluded. Review the other activities in terms of content and time, focusing especially on how to respond to questions that might come up.
- Establish a testing zone, with large tables and water supply.
- Estimate how many participants will be at your event. Then add 20%. This figure will help to accommodate a larger than expected crowd.
- Skip Activity 6 – Present Final Solution.
- Have a video of a custom made VSG cleaner in order to draw their attention
- Ask them if they think that they are able to build a VSG, using everyday materials, in just 30 minutes.
- Have a banner explaining in few words the EDP process. Focus on the steps that the participants have to follow and skip the Preparatory Activity Building a Xylophone.
- Focus on the construction part. Prepare many copies of the instructions as well as materials for 4-5 parallel sessions. To avoid spending time teaching each person how to make the VSG, make samples that illustrate the process. In general, get extra materials!

Reinosa, second quarter of the 2018-2019 academic year

Signature of the project authors