Study Group 2

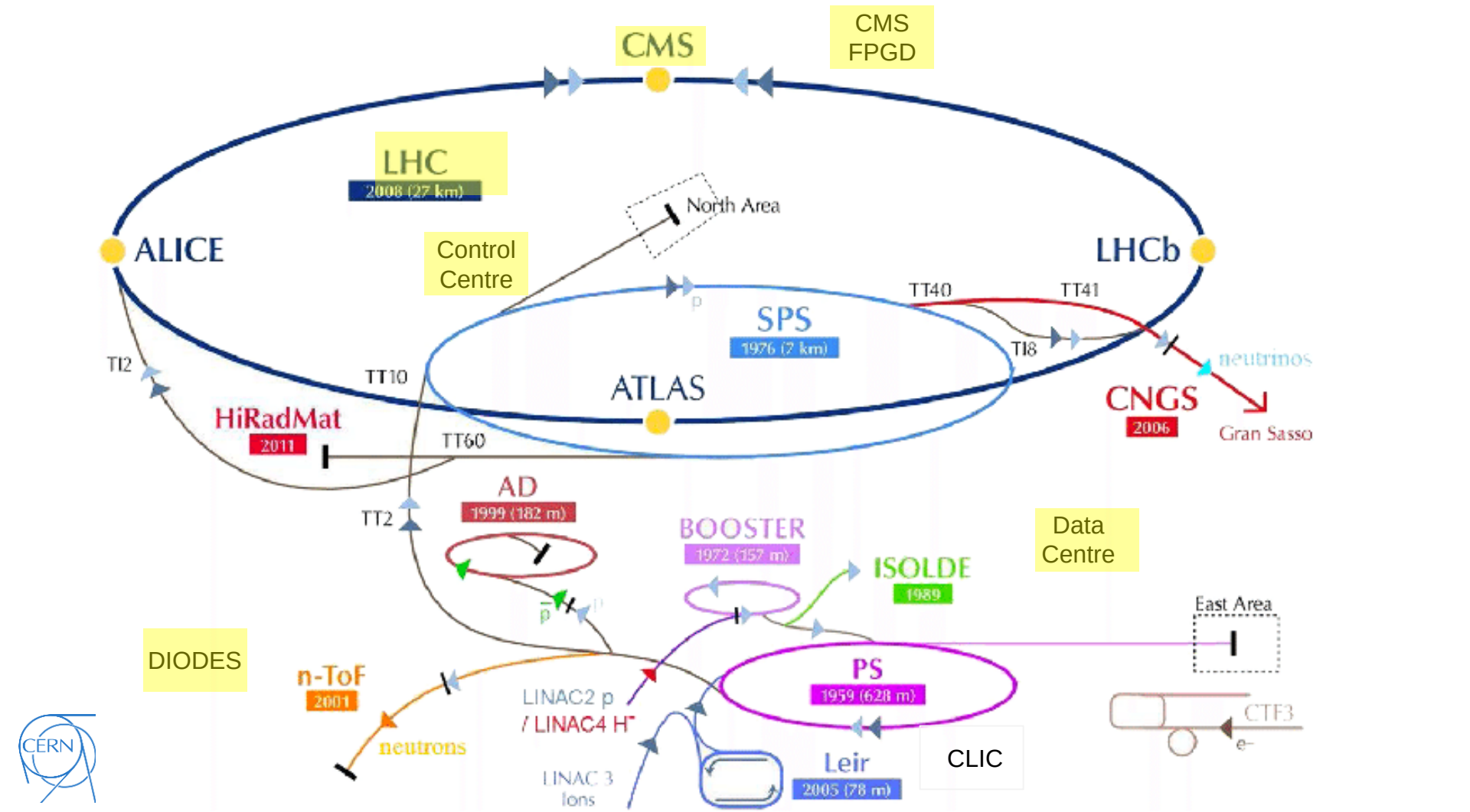
Daniel Kallenberg, Nadia Renzo, Urszula Rybałtowska,
Simon Sutter, Deborah Ward

Can you guess what the question was?

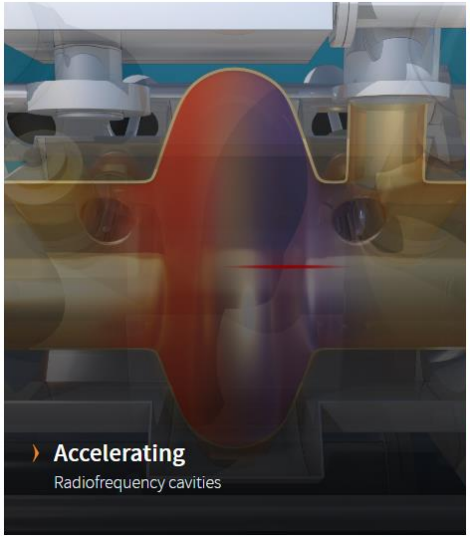
What is engineering (at CERN)?

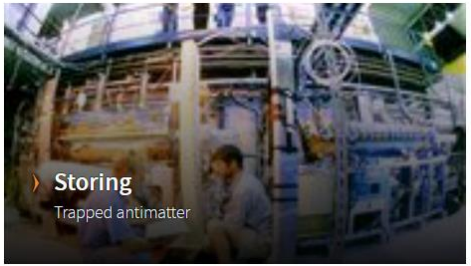
“There are no show stoppers, it’s all just engineering.”

- Dave Barney’s boss


CMS
CMS FPGD
LHC
2008 (27 km)
North Area
ALICE
Control Centre
LHCb
TT40
TT41
SPS
1976 (7 km)
TI8
TI2
TT10
ATLAS
neutrinos
CNGS
2006
Gran Sasso
HiRadMat
2011
TT60
AD
1999 (182 m)
TT2
BOOSTER
1972 (157 m)
Data Centre
ISOLDE
1989
East Area
DIODES
n-ToF
2001
PS
1959 (628 m)
LINAC2 p
/ LINAC4 H⁻
neutrons
CTF3
e⁻
LINAC 3
Ions
Leir
2005 (78 m)
CLIC
CERN

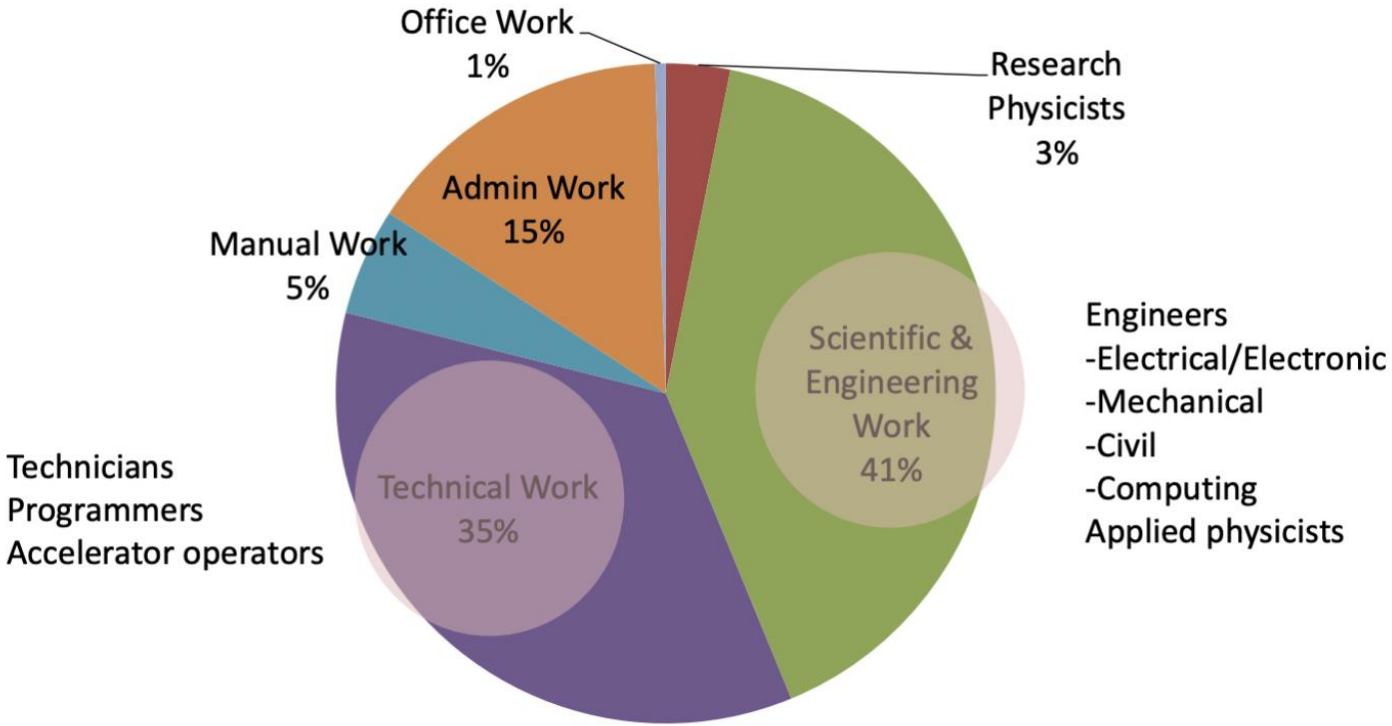
Engineering at CERN





https://home.cern/science/engineering

CERN Staff by job description



Slide from Ray Veness

1. Curriculum & classroom connections

1) Can be integrated into the curriculum as a tool for learning

The stories that we have been told during this program can be used as examples of the challenges that the engineers meet at CERN.

Pressure and mechanics: how to move the CMS detector?

Computing: how to save and store so many data?

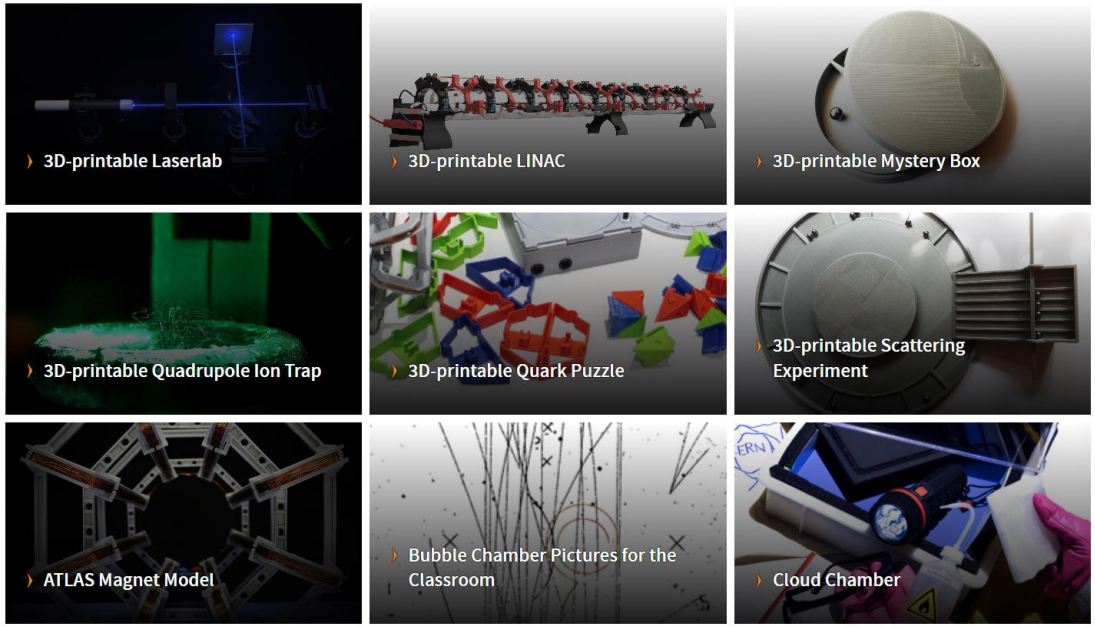
Thermodynamics: How to dig through an underground river?

1. Curriculum & classroom connections

2) Can be exploited in class for the context of a project

A challenge can be given to students and they have to find a solution following the Engineering Design Process.

A Fab Lab can be very interesting for designing!



https://scoollab.web.cern.ch/classroom-activities

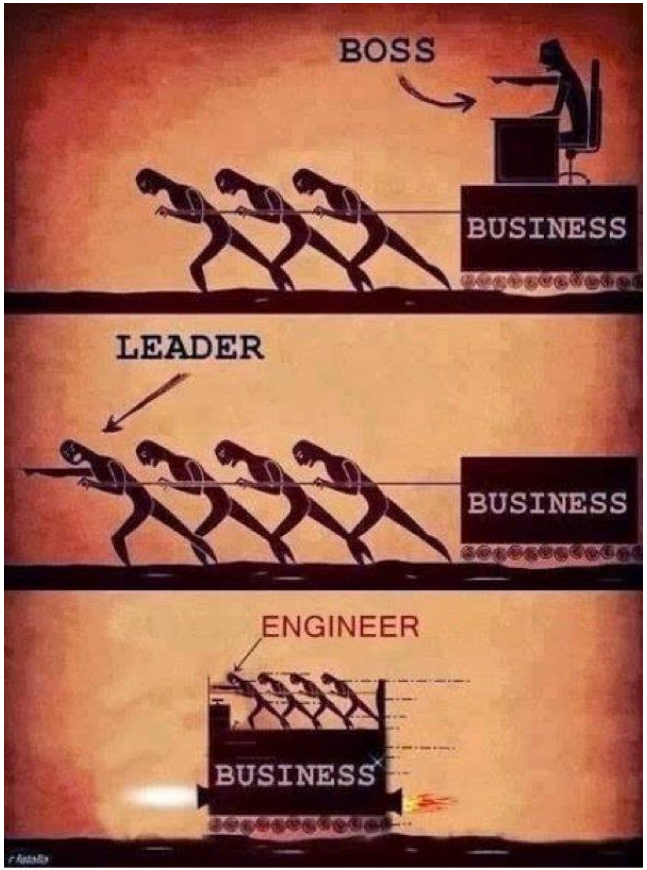
2. Key Ideas

- Broaden the point of view of scientific careers that are available for them.

- Develop the skills of Problem solving, collaboration, creativity and Communication.

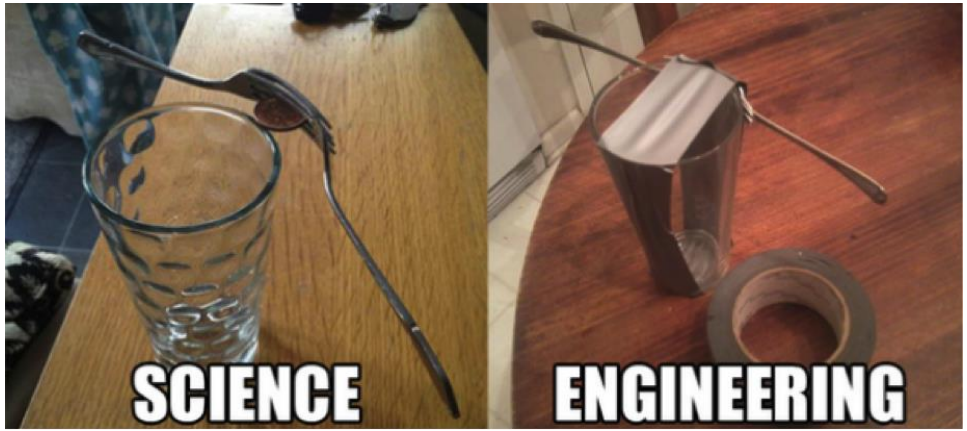
- The engineering skills acquired in class can also be transferred in many aspects in life. Problem solving is for everyone!

- Engineers are in great demand in so many fields! CERN, most of all, needs them!



3) Potential students conceptions & challenges

- Only for boys
- Be the best in maths and science
- Limited interests
- No social or communication skill
- Engineers are failed physicists



3) Potential students conceptions & challenges

- Hard to connect to specific content in class, it's more of a thought process to cultivate through the program.

- The lack of time to explore notions outside the curriculum.

4) Best Practice example

"*When I was a teenager, I took all my money to buy a computer, but there was no money left to buy video games! So I started to program some and discovered that it was more fun than playing them!*"

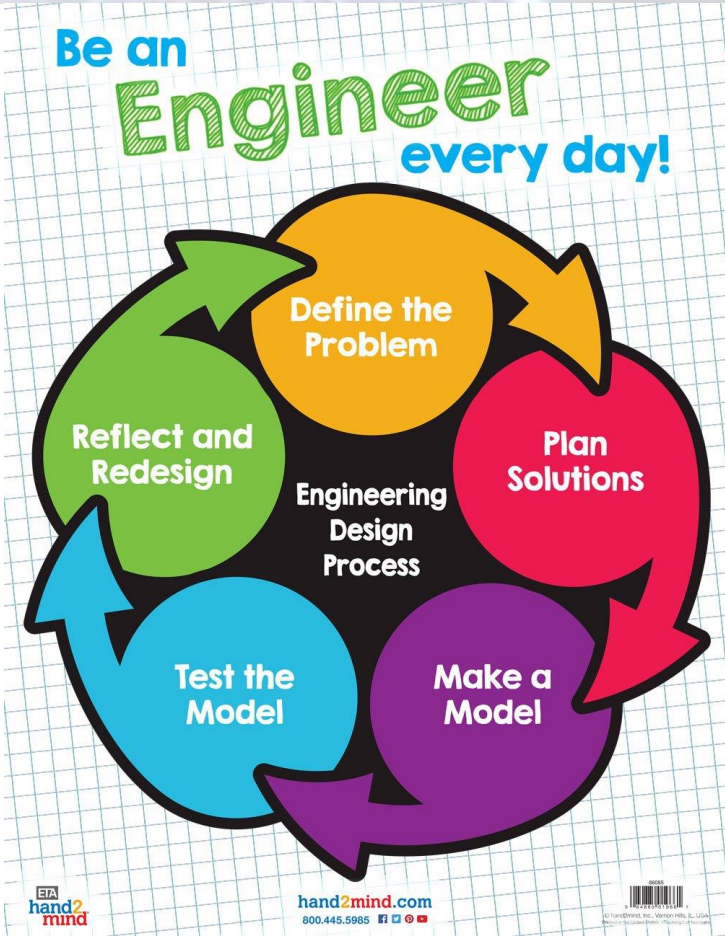
- Markus Joos, engineer (and badass!) at CERN

Let the students create, discover, manipulate the environment around them.

4) Best Practice example

Applying the Engineering Design Process is an excellent way to forge the mind of our students to think like an engineer.

Fab labs and programming can help to elaborate new solutions to a challenge, but let's not forget basic material like cardboard, wooden sticks and legos!



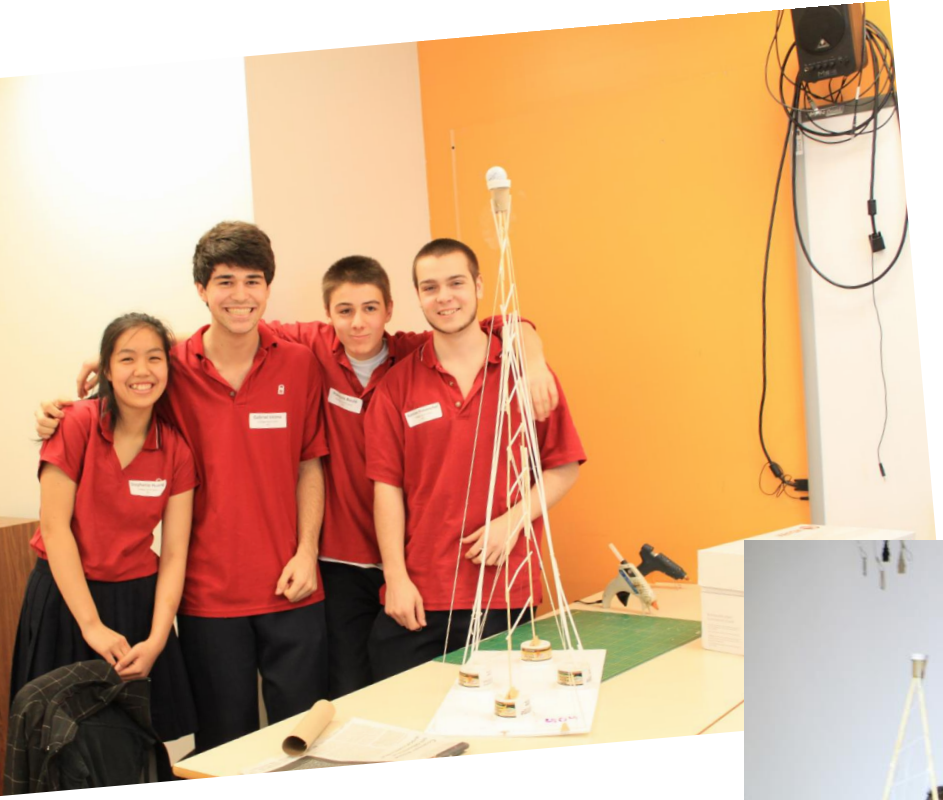
Example: League of improvisation in science and technology

Students from different schools compete in teams.

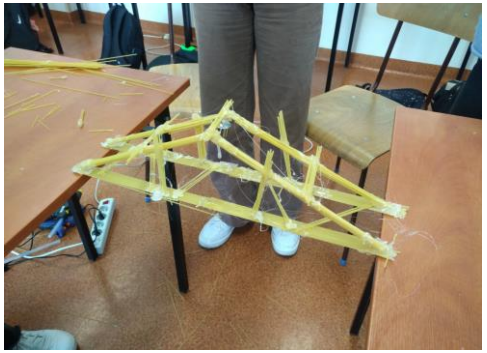
They receive in advance a list of material to bring (popsicle sticks, yogourt containers, etc.)

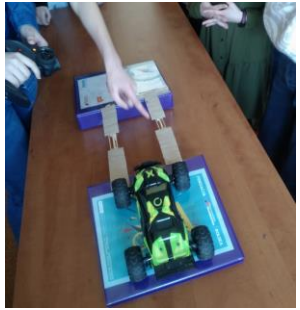
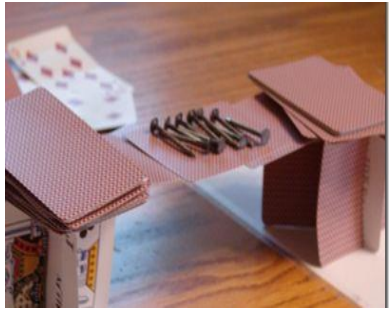
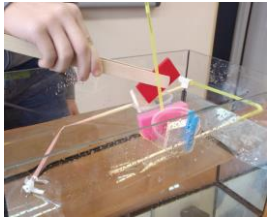
The day of the competition, they only receive the challenge and they have 3 hours to design, test and modify their object. A report is done at the same time.

The final tests are executed by the judges in front of everyone.



Introduction to engineering at school https://www.destinationimagination.org/

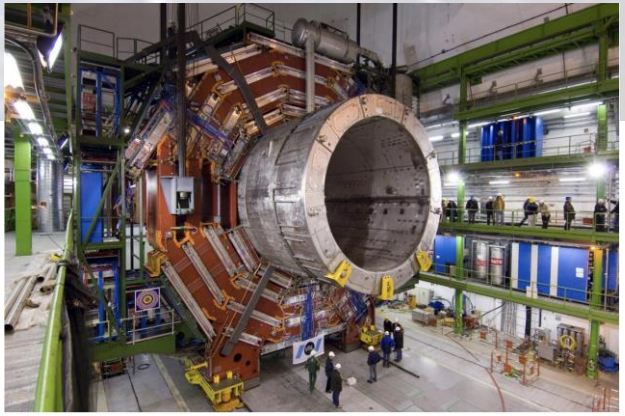




CERN

DESTINATION IMAGINATION

Even more ideas! Putting it in context



Problem:

How can we move the 2000 tonne CMS detector so it can be lowered into the cavern?

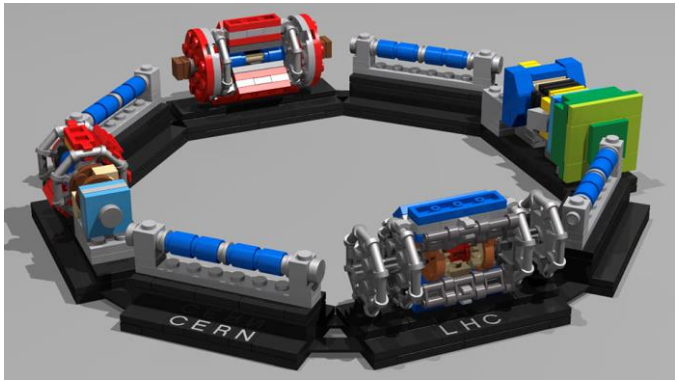
1. Students brainstorm/evaluate solutions
2. Compare their solutions to CERN's solution
3. ***Create and design a hovercraft using the engineering process.***
4. Reflect on design and how it could be improved.

→ Link to curriculum ***Mechanics (pressure, forces etc).*** Builds skills of collaboration, creativity, problem solving.

Even more ideas!

Students work in teams to design different parts of the LHC and Detectors in MINECRAFT, (Or LEGO)

Skills needed: Collaboration, Problem solving, Creativity, critical thinking etc



Using MINECRAFT in the classroom;

By Pusey and Pusey

5) Help material and resources

Many STEM activities from all ages to explore the engineering mindset.
They present the Engineering design process *(discovere.org)*

Article about the engineers who work at CERN and the challenges they encounter *(swissinfo.ch)*
Article written by Simone Gallegari that explain the best approach in engineering at CERN for a successful project. The article also contains some examples of problem/solution encountered *(alumni.cern)*

5) Help material and resources

General informations about Engineering at CERN *(home.cern)*
Lessons from the accelerator frontier *(cerncourier.com)*
The LS2 Vacuum Challenge *(cerncourier.com)*
Engineering Challenges *(starters.co.nz)*
MINECRAFT education *(education.minecraft.net)*
Fab Labs *(fablabs.io)*

https://beamlineforschools.cern/

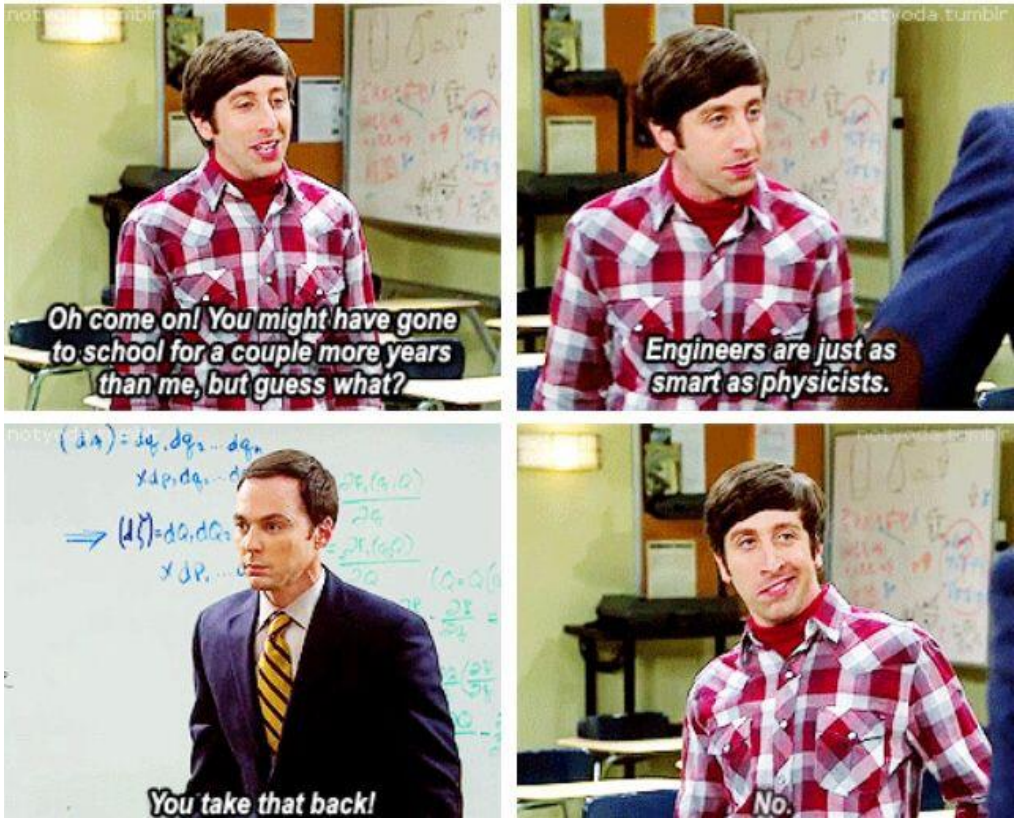

RESER
VED

You know, we were there too!

Special thanks to these people who
answered our questions:

the students of Notre-Dame QuarkNet:
Hadley Jessop, Gabriel Wood, Landon Coates,
Natalie Edmisten, Amelia Martin, Aaron Esparza,
Polish HSSIP2018 participants:
Jan Sobków, Michał Kaczmarek, Karolina Jaszkul,
Mikołaj Miszczak, Krzysztof Druciarek, Jacek Jagosz,
Karolina Klimek, Eryk Siemianowicz and
engineers working at CERN:
Pedro Morales Sanchez, Marcus Joos.

The End


Oh come on! You might have gone to school for a couple more years than me, but guess what?
Engineers are just as smart as physicists.
You take that back!
No.

Engineers Video