KLOMP: Knowledge from Landing and Orbiting the Moon Program (Dutch boots on the Moon)

Description:

Soon humans will return to the moon, but until then we can still do science without humans. In this project, teams will work as moon mission engineers designing instrumentation meant to do various specific science experiments on or around the moon.

Each team member will choose a different engineering role and meet specific **thermal**, **electrical**, **communication**, and **structural** constraints.

You will be free to choose how you present the final prototype using the full range of your O&O lab, computer software (including CAD, VR design, and Minecraft Education edition), and classical art techniques.

On the presentation day groups will be assigned booths in a project information fair where they will be assessed by other groups as well as the instructor and instrumentation engineers from SRON.

Science missions (Max 2 groups per mission):

Surface biology lab/farm pod (stationary)
Permanent shadow region properties (stationary with little rovers)
Searching for water ice/soil analysis (rover)
Tardigrade spill - collection and check up (rover)
Highest levels of earth's atmosphere (satellite)
Moon 5G (satellite)

Suggested project milestones:

Week 47: Introduction Workshop day: Friday 22 November
Week 48: Ideation - think of lots of crazy solutions and pick 3 to follow up on
Week 49: Research thermal, electrical, comms, and materials
Week 50: Start prototyping
Week 51: Design, test, revise. Choose best idea
Week 52/Week 1: Kerstvakantie
Week 2: Revise, test, check prototype. Begin preparing information for presentation
Week 3: Toetsweek(?)
Week 4: Finalize prototype. Create visuals, explanations of design choices, selling points. Practice explaining to your friends/parents/strangers
Week 5: Presentation Day: Thursday 30 January

Engineering Solution:

A moon mission for one of the specific concepts (ground stationary, ground mobile, orbital) that:

- Fits within a weight and size limit (for launch)
- Uses materials for a durable design to have minimum lifetime of 5 years
- Has the lowest possible cost to still achieve the results
- Functions within thermal, electrical, and communication constraints
- Will be able to perform the scientific mission

Skills and Concepts:

- ★ Working to constraints
  - Thermal
    - Moon environment has a 28 day cycle of extreme temperature differences
  - Electrical
    - power requirements for experiment and all systems
  - Comms
    - Does it need to communicate when it is on the far side from earth?
  - Size limits for launch vehicles. Minimize weight for fuel costs.
    - 200 kg max for piggyback on Ariane 6.
  - Material
    - Not damaged by temperature extremes, durable, least expensive option that still fulfills those requirements.

- ★ Budget optimization
  - Material and launch cost
  - Human labor cost(!)
  - ESA small moon mission cap €50 million

- ★ Collaboration
  - Communication within team
  - Division of tasks
  - Re-combining tasks into whole

- ★ Reporting result
  - Design prototype (2D or 3D physical or digital)
  - Pitch for information fair
    - Explain features and special selling points
    - Defend material/power/comms design choices
    - Explain budget decisions

Resources:
ESA labs
https://technology.esa.int/labs

NASA mission design
https://www.nasa.gov/smallsat-institute/space-mission-design-tools/

Lunar and Planetary Institute (LPI) previous instruments
https://www.lpi.usra.edu/lunar/instruments/

New example missions
https://www.nasa.gov/planetarymissions/lunar-surface-instrument-and-technology-payloads-lsitp/

Materials for space
https://www.elementdefense.com/blog/materials-survive-in-space

Open source NASA software
https://opensource.gsfc.nasa.gov/index.php
https://www.mystran.com/

ESA small moon mission
https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/To_the_Moon_ESA_seeks_ideas_for_small_lunar_missions
https://ideas.esa.int/servlet/hype/IMT?documentId=9904aa3d71cbae0c8d3d86503095f607&userAction=Browse&templateName=

Material database
https://spacematdb.com/

Tardigrades on the moon
https://en.wikipedia.org/wiki/Tardigrades_on_the_Moon

Free 3d Design software:
Blender
Unity
Tinkercad
Spline
Tekla Structures Educational free 1 year subscription