CONSTAT 2019: K-4 seminar; Friday, March 29,

Celebrating the 1969 moon landing

This unit is:

a. Designed to use balloons to be amazed at the achievement of landing people on the moon;
b. The substance of the 2019 Tasmanian Science Talent Search STEM challenge and is included at the end of the document;
c. Is larger in scope than the TSTS STEM challenge; and
d. Contains exercise, challenges and investigations which have to be adapted to individual teaching styles and desired outcomes.

It is based on:

a. Constructivism,
b. Hands-on activity,
c. Teaching and learning outcomes, and
d. Starting points for an in-class theme to be fitted to your teaching style.

Balloon rockets in the classroom

1. What is to be learnt/taught?

- Conceptual overview: an enormous amount of energy is required to launch a person into space (launch a rocket).
    - 2million litres of liquid hydrogen and kerosene in the first 165 seconds
- Problem solving: what must be done to launch a (balloon) rocket vertically?
- Measuring: how big was the Apollo 11 in real terms?
    - How is the amount of energy required for a balloon lift-off to be measured?

2. Constructivism

- What do they know? oral or written responses - whole class, small group, individual. The question:
    - What happens to a balloon when I blow it up and let it go? or
    - How might I make a balloon fly in a straight line?
        - (Note: this is the preferred question and assumes that all children will have had some experience with balloons.)
        - The question is given pre-teaching and post-teaching

- Typical Structure of the Observed Learning Outcomes - SOLO
    - Pre-structural – blow it up and let it go (merely repeating the question)
    - Uni-structural - tie a string to it after it has been blown up; do something to it so that it won't fly just anywhere; put something on the front so that it looks like a rocket;
    - Multi-structural – tie it to a fixed line after it has been blown up; stick a straw on it, blow it up, thread a line through the straw and it will fly along it.

    - Relational: because the end of the balloon is not fixed, the air coming out goes in any direction and so it will not fly straight it needs to be tied to a line.
    - Extended abstract: the air in the balloon is recognized as a general fuel/energy source and the action of the balloon is seen as an energy source in rockets and other moving vehicles; explanations of Newton's first (inertia) and third (action & reaction) laws;

3. STEM starting points with hands-on activities

- <u>Science:</u>
  - Whole class discussion leading to the construction of a child-initiated activity.
    Concept understanding: How is it that we inflate (blow up) a balloon?
    Problem: How might we make a balloon rocket? Or
    Problem: How do we make a balloon rocket travel in a straight line?
    Exercise: How far might a balloon rocket travel?
    Exercise: What type of balloon makes for the best balloon rocket?
    Exercise: How long does it take a balloon rocket to travel from A to B?

  - Explorations and challenges based on blowing hard
    Problem: How much is a lungful of air?
    Problem: How might you discover the amount of energy in a lungful of air?
    Exercise: How far can you blow a ping-pong ball with one breath on a carpet/lino surface?
    Exercise: How might you improve on the performance?
    Exercise: What difference would blowing through a drinking straw make to performance?
    Exercise: How might I make sure that the ping-pong ball travels in a straight line?
    Exercise: How many lungsful of air does it take to make a balloon rocket fly?
    Problem/exercise: Is there a better way of measuring input to a balloon than lungsful of air?

- <u>Technology: working from a demonstration</u>
  - Release an untethered balloon; observe, formalise observations from several attempts then challenge;
    - What must I do to make this balloon fly in the direction I want it to fly?
  - Demonstrate a purchased/constructed device - balloon rocket, balloon car, balloon helicopter, balloon boat – then make your own
  - Demonstration of balloon on a string followed by formalised skills-development such as observations, measurements, inferences and probable explorations (maybe hypotheses). Note - no use of the word prediction because of specific meaning
    - Going further
    - What alterations might be made to have the balloon fly further, faster in a straight line? Set up ways of testing the idea.
    - What might happen when the balloon rocket flies at (angle 1, 2, 3) and vertical? Set up ways of testing the new conditions.

- What way might be constructed to have the balloon reach its maximum size without exploding?
- Further still:
  - How can the energy in an inflated balloon be controlled to make a rocket vertical take-off rocket or retro-rocket?

- English 1: the story's the thing (the play, the lexicon)
  - The story precedes the video because of the emotion.
    Three men were awoken at 4am to eat bacon and eggs, put on their space suits and 5 hours later be on their way to the moon.
    The walk to the lift, the rise of over 100m -36 storeys- to the space module, lying on your back strapped into the capsule seats, the nervous tensions when the rocket fired; the apprehension of the lift-off, are all better said before the video
    Search engine: "moon landing 1969" 3 videos; 2 mins, 4 mins, 10 mins; in the 10-minute version, the control centre in Houston and the capsule pilot are calling the descent – it's magic.
    The other parts of the story are:

    The voyage; how long did it take and how did they go to the toilet?

    Entering the lunar module, firing the retro rocket and the descent

    Michael Collins left alone – his thoughts

    The ladder descent, the moon-walk (hop or jump), the specimen collection

    Re-entering the lunar module and return to the command module

    The re-entry – how hot is hot?

English 2: from a picture: Why do people wear space suits on the moon, or in space etc?

English 3: reading for a purpose: make the NASA paper rocket or demonstrate its capabilities.

Manipulate the paper rocket to make it perform better.

Note: Science reading is a distinct genre.

Discussion/writing: What does it mean; "One small step for (a) man, one giant leap for mankind."

Social science: In what other human endeavour might this apply?

- Mathematics
  Research and measure: How big is a Saturn V rocket? – (111m or 36 storeys) mock it up on the oval
  Research and measure: How big were the modules on top of the rocket? – mock them up in the classroom
  Command module: 3.2m tall, 3.9m diameter
  Lunar module: 7m tall, 9.4m diameter; 3 stages- cabin, ascent, descent
  Mass 3920 kg; African elephant 6000kg

This relates to the retro-rocket challenge

Research and make table of comparisons: How hot is hot? Re-entry temperature on the command module was 2760ºC, now find the comparisons; hot day, boiling point, melting aluminium, molten glass, molten steel

Problem: How do I discover the maximum size of a balloon before it bursts?
Problem: What must be done to get a balloon to inflate to the same dimension each time it is blown up?
Exercise: How far does a balloon vehicle (rocket, boat, car) travel at optimum inflation?
Exercise: What happens when I change on a commercial balloon-powered vehicle?
Exercise: What happens when I change the conditions of a commercial balloon-powered vehicle?
Problem or exercise: Make your own balloon-powered vehicle and record what happens.

4. What is to be learnt/taught?

Concept: an enormous amount of energy is required to launch a rocket.

An enormous amount of energy is required to have a capsule make a soft landing.

Note: Hands-on activity is not necessarily in-depth learning. Students need to be asked what they think they have learned.

Energy may be stored

Newton's first law – body at rest or uniform motion in a straight line – the rocket on the launch pad or travelling through space

Newton's third law – for every action (force) there is an equal and opposite reaction - the thrust of the rocket motors against hard surface and atmosphere at the take-off

TSTS 2019 STEM Challenge

50 Years from the first moon landing

Challenge 1: for children up to Grade 2: make a balloon rocket which will fly along a taut fishing line, in a large room like a gymnasium or multi-purpose room, with the starting point 1m above the ground and the potential finishing point being 2.5m above the ground.

Entrants will be assessed on how far the balloon rocket travels.

Limitations:

1. Entries will be individuals, small groups or whole class.
2. The minimum mass of the balloon and any attachments, when dry and before being filled with air is 5 grams.
3. There will be three (3) attempts per entrant with redesigning time allowed between each run.

Report: Students will present a written report in two sections:

1. A log showing the stages of development of the project.
2. A description of reasons that the rocket works as well as it does.

Challenge 2: for children in grades 3 and 4: make a balloon-powered paper-rocket which will make a vertical take-off along a launch stick of up to 1.5m length.

Entrants will be assessed on how high the rocket ascends and measurements (if possible) will be taken from the top of the rocket.

Limitations:

1. Entries will be individuals, small groups or whole class.
2. The paper rocket must be the NASA small paper rockets design found in Rockets Educator Guide – NASA; then 3…2…1…Puff! The first activity only (not the second which is a rocket with a steerable engine).

   https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/3_2_1_Puff.html

3. Entrants should have their own secure launch stick which may be made of wood, plastic or metal, string, fishing line etc and may be treated in any way to reduce friction.
4. There will be three (3) attempts per entrant and redesign time allowed between launch attempts.

Note:

1. The NASA paper rockets are launched by blowing through a drinking straw and this technique should be investigated as the results will vary greatly.
2. For the competition, however, entrants will be required to attach one or more balloons to the prescribed rocket to achieve lift-off.
3. Be aware that there is no such thing as a failure. Not meeting the challenge as anticipated is still part of a valid scientific process and log books and reports should still be entered recognizing this fact and what might be done in further rounds of experimentation

Report: Students will present a written report in two sections:

1. A log showing the stages of development of the project.
2. A description of reasons that the rocket works as well as it does and recognition of the problems and limitations of the launch technique.

Rocket Activity: 3...2...1...PUFF!

Materials

Sheet of A4 paper	Adhesive tape
Scissors	Ruler
Metre stick or tape measure	Fat, round pencil or dowel
Eye protection	Drinking straws
Copy of paper rocket plans	

Procedure

Demonstrate the construction technique for making paper rockets.

- Cut a strip of paper for the rocket body (about 4 cm wide by 28 cm long).
- Use a round pencil as a form and roll the strip around the pencil.
- Tape the long seam.
- Close off one end to make a nose cone.
- Cut out three or four fins.
- Tape the fins to the open (lower) end of the rocket. Bend them outward to space them equally.

After students have constructed their rockets, show them how to perform drop tests to check for stability.

- Hold the rocket horizontally at eye level and drop it to the floor. If the nose of the rocket hits the floor first, the rocket is stable and ready for flight.
- If the rocket falls horizontally or the fin end hits first, the rocket is unstable. Larger fins may be needed to stabilize the rocket.
- Have students perform their own stability tests and make adjustments to their rockets if needed.

demonstrate the launch procedure for the rocket.

- Stand at one end of your launch range.
- Insert a straw into the rocket body.
- Aim the rocket down range and puff strongly into the straw.
- Lift off!