Project: STEM

Science, Technology, Engineering and Maths

Task 1: Complete as many challenge cards as you can.

Can you complete them all?

STEM Challenge Cards

Make a marble roller coaster which brings a marble down from a start height of 1 metre without any drops of longer than 5 cm.

Competition - Which marble takes the longest to successfully descend 1 metre?

STEM Challenge Cards

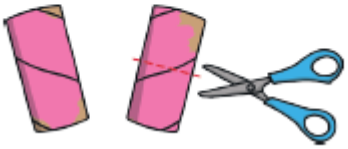
Make a boat which floats successfully in a tank of water and can carry a cargo of at least one penny.

Competition – Which boat can carry the most pennies before it sinks?

STEM Challenge Cards

Make the tallest tower you can which is capable of standing freely and not attached to anything.

Competition – Which is the tallest tower?



STEM Challenge Cards

Design and make a trophy which could be awarded to the winner of a STEM challenge.

Competition – Which trophy would other contestants be most delighted to win?

STEM Challenge Cards

Design and make a wheeled vehicle which will travel independently from the top to the bottom of a slope angled at 30 degrees.

Competitions – Which vehicle travels the furthest? Which vehicle reaches the bottom of the ramp in the quickest time?

STEM Challenge Cards

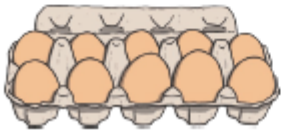
Make a structure which you can fit completely inside and are then hidden from the outside world.

Competitions – Which structure covers most of a body? Who can get into their structure in the fastest time?

STEM Challenge Cards

Make a safety container for a fresh egg to be dropped from 2 metres high in without breaking.

Competition – Which container can be dropped from the highest height without the egg breaking?



STEM Challenge Cards

Make and design a device which can be used to tell whether or not an intruder has entered a room in an empty house.

Competition – When the designers of each device set up their equipment by a door, can they tell whether someone has entered or not?

STEM Challenge Cards

Construct a pair of glasses designed to fit the wearer safely and securely.

Competition – Which glasses stay on for the longest when worn by a test pilot performing a sequence of standing long jumps?

STEM Challenge Cards

Set up a sequence of linked events so that an initial movement in your creation leads to another and then another.

Competition – Which sequence contains the most linked events?

STEM Challenge Cards

Design and make a desktop organiser.

Competition – Which would consumers buy if all of the desktop organisers were the same price?

STEM Challenge Cards

Design and make a bridge spanning a gap of 30cm which can hold as much weight as possible.

Competition – Which bridge can hold the most weight before it fails? (Use actual weights, books, blocks etc.)

STEM Challenge Cards

Use the materials you have been given to make a creative sculpture. It can be abstract or a 'thing' – you decide!

Competition – Which sculpture would other learners pay most for? Hold a ballot.



STEM Challenge Cards

Design and make an umbrella or any device to keep the user dry during a rain shower.

Competition – Which device would keep the user the driest? You can judge this by inspecting the quality of the materials and the seams (does any daylight show through?) or wait for it to rain and try them out for real!

STEM Challenge Cards

Construct a zip wire or a similar thrill seeking experience for a chosen type of mini figure.

Competition – Which experience would have been the most thrilling for the mini-figure (i.e. the best compromise of excitement and safety)?

STEM Challenge Cards

Create a catapult which can be used to fire a chosen projectile without the operator either touching the object or propelling it forward with their own power.

Competitions – Which catapult can launch the projectile the furthest? Which catapult is the most accurate when firing at a given target?

Task 2: *Choose a STEM Activity from below*

Option 1: Cleaning our Oceans

RESOURCES AND PREPARATION

- materials for the booms:
  - nylon tights - 1 leg or old sock
  - paper towels
  - cotton balls
  - feathers
  - wool - natural or knitting
  - foam makeup sponges
  - tissues / lavatory paper
  - other absorbant materials
- experiment materials:
  - cooking / vegetable oil (50-100ml)
  - food colouring (optional)
  - glass tumbler
  - spoon to stir
  - water (in a sink or large deep tray etc.)
  - washing-up liquid
  - glass bowl
  - paper towels
  - Extension: strips of cardboard or straws

Your challenge

Oil spills are pretty nasty. They can harm the environment, animals and even people living nearby. It's therefore vital that we keep the seas clean! Floating objects called booms (like a floating sock) help us today, but what materials are best to use and are there even better methods we should be using in the future?

YOUR TASK **Simulate an oil spill and work out the most effective way to clean it all up again - what is the best material to be used as a boom?**

WHAT YOU NEED TO DO

1. Take the tights leg and carefully cut off the ankle and foot section. Cut four 5-10cm lengths off the tights leg. Tie a knot in one end of each segment.
2. Fill each segment of the tights with one of the absorbent materials to create a small sausage shape - try not to stretch the tights. Do this for each material until you have 3-4 booms of similar size, shape and density. Tie off the open ends.
3. Measure out 50-100ml of vegetable oil into a glass. Add 5 drops of food colouring - if you have it - it will make it easier to see the oil. Mix with the spoon.
4. Half-fill the large container with cold water and pour 50ml of the oil mixture into the centre. Record your observations. Is there one big oil puddle or separate droplets? Does the oil spread out quickly? Does it sink or float? What happens if you gently blow on the surface?
5. **Phase 1**

   Place one of the booms in the oil and water. Move it around gently to soak up the spill. Squeeze out the boom into the bowl and place back in the water to remove the remaining oil. Record all of your observations. How effective was the boom? How long did it take to remove 50%, 75% and 100% of the oil?

   Repeat the experiment with each of the booms recording your observations for comparison.
6. **Phase 2**

   What happens if you contain the oil in some way?

   a) Repeat the experiment with the booms but use straws or cardboard to form barriers to stop the oil from spreading. How effective is this method? Observe and compare your findings.

   b) Repeat the experiment but tie three of the booms together. Try containing the oil with the three connected booms and use a fourth to soak up the oil. How effective is this method? Observe and compare your findings.
7. Present your findings and compare results for each experiment. Discuss how you could improve the booms to make them more effective and cost efficient.
8. **To clean up:**

   Throw away the booms in the bin along with any other materials contaminated by the oil. Use paper towels to absorb as much of the oil as possible and throw away. Mix the remaining water with washing up liquid and carefully pour down the sink. Thoroughly wash the equipment with hot soapy water to remove the oil residue.

FUN FACTS

1. After the Gulf of Mexico oil spill, a non-profit organisation called "Matter of Trust" used human and animal hair stuffed into nylon stockings as an absorbent to contain and soak up the oil. They obtained the hair from hairdressers and pet stores and sent hundreds of thousands of pounds of hair wrapped in recycled nylon stockings to help clean up the pollution.
2. Scientists have investigated other ways for us to effectively and quickly clean up oil from our oceans. DNA research in one particular investigation suggests that bacteria could be used to eat the oil, cleaning the water. By understanding how to support these natural occurring microbes, we may also be able to better manage the aftermath of oil spills.

Useful Websites:

10 impressive innovations for cleaning up oil spills developed since the Gulf disaster

www.treehugger.com/slideshows/clean-technology/10-impressive-oil-spill- clean-technologies-developed-past-five-years/

Nature: The science of dispersants

www.nature.com/news/2010/100512/full/news.2010.237.html

YouTube video: Making a boom using hair and nylon nets

www.youtube.com/watch?v=aHuWyFVo62o

YouTube video: Hair boom vs. conventional boom demo

www.youtube.com/watch?v=W68L53WkIAw

Option 2: Need a Rope?

RESOURCES AND PREPARTION

- scissors
- bin liners/plastic bags
- ruler
- marker pen weights
- (tinned food) hook or
- coat hanger

Quick Questions:

Consider the properties a good piece of rope has.

What can you build rope from that would help the environment?

What would they need to do to make rope?

What can you make it out of?

Briefing

Want to build a raft or a shelter? To do this, you will require one important thing... rope! But how can you make it with such limited resources?

YOUR TASK

Reuse an old carrier bag to make a rope. It will help protect the environment too!

1. Take a carrier bag and cut the plastic bag into long strips.
2. Take three strips and tie them together with a knot at one end. Take the knotted end and secure safely so that you can braid your rope, (watch the video demonstration)
3. Devise an experiment to test the strength of your carrier bag rope. Think about:
   - what apparatus you could use to quantify how strong each rope
   - is how to apply weights to the rope
   - what happens to the rope
   - how much weight it can hold before it breaks.
4. Now think about how you could make a stronger rope. Decide what you could change and try your test again.
5. Record your observations and results

FUN FACTS

1. More than half the rope manufactured today is used in the fishing industry.
2. Egyptians were one of the first people to develop rope. They used water reeds, grass and even camel hair! They needed the ropes to pull the heavy stones needed to build the pyramids.
3. Cable is simply a type of rope, it's just made from iron or steel fibres rather than coconut husk! Metallurgists are a type of materials engineer who specialise in creating alloys that make the perfect rope for its purpose.

Option 3: Microflats

RESOURCES AND PREPARATION

- paper squared if possible (1cm squares might be easy as each square can represent 1m2)
- pencils
- pens, ruler
- cardboard or construction paper
- desktop, laptop, tablet etc. (if available)

Watch the following video on overpopulation:
https://www.youtube.com/watch?v=QsBT5EQt348

To deal with the growing population one possible solution is Miroflats (tiny flats).

In this activity discuss and sketch/mock up a microflat – a small, flexible living space where objects can be converted from one purpose to another

Useful Links:

Planner 5D: free demo of a home design tool

https://planner5d.com/ Makespace.

A psychologist discusses why micro-apartments are popular in large cities

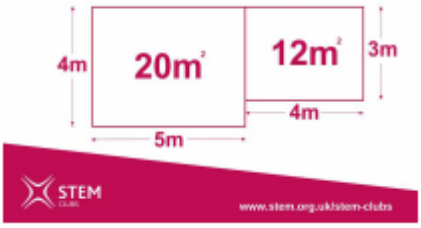
https://makespace.com/blog/posts/why-aremicro-apartments-popular/

The New Yorker: Are Micro-Apartments a Good Solution to the Affordable-Housing Crisis

www.newyorker.com/business/currency/aremicro-apartments-a-good-solution-to-theaffordable-housing-crisis

TIPS

- Give students size options, such as:
  - easy - "large" 32m² home
  - difficult - 14m² home
- You could tell students that their client is very wealthy and money is no object, or you could set them a budget not to exceed.
- Clarify that each square on their squared paper is one square meter, and allow them to experiment with the overall shape of the flat before working out the furniture placement.



Your challenge

Imagine you're in charge of designing comfortable living spaces in a very crowded city. The population is high, so there's not a lot of space available. A new client has come in to ask you to design their microflat. The space is very small, but the client wants a comfortable place to live. Everything inside needs to be considered very carefully so no space is wasted!

YOUR TASK

Think carefully about how you can make use of a very small space, and design a multipurpose microflat! Start with designing a 32m2 space in a shape of your chosing.

WHAT YOU NEED TO DO

1. First, think about what your client will need in their living space. What is absolutely necessary and what is nice to have but not essential? It may be helpful to create a backstory about your client to help you decide. For example, a client who loves cooking might need more kitchen space. Make a list or ranking of what the space must include.
2. Find out how much space is available in the microflat.
3. Think of the shape of your flat. Sure, you can start with a square, but why not an L-shape? Tip: to keep it simple, stick to using square walls rather than circles.
4. Mind map what type of furniture you want to include in your home. Think about what you need as an absolute minimum. Beds that double as tables when folded up? A TV which can be folded upwards and hang up on the ceiling? Moveable walls that slide along the floor when they need to be moved out of the way? Make a list!
5. Draw the shapes of your furniture, sticking to realistic sizes. Sketch important shapes and colour them in before cutting them out.
6. Fill up your flat with your cuttings. Try to find the best fit for your clever furniture to make your house comfortable and original.
7. Once your design is complete, present it to the rest of the group who will act as your client. What is their feedback? Are there any changes you might want to make to your plan?

FUN FACTS

1. While they're not for everyone, microflats actually help you save money and energy (which reduces your carbon footprint, and is good for the environment!).
2. Perhaps the greatest advantage of having a much smaller living space is that it also significantly reduces the time you need to spend on cleaning.

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Task 3: Design your own STEM Investigation

Explore the STEM website (https://www.stem.org.uk/home-learning/family-activities) for inspiration (or to find an activity you would like to complete). There is a wide range of activities from creating floating gardens to coding and learning about the Magic of the Movies