Is there life beyond Earth?

with Dame Dr Maggie Aderin-Pocock

Royal Institution Christmas Lectures Activities

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In this year’s CHRISTMAS LECTURES from the Royal Institution (Ri) supported by CGI, Dr Dame Maggie Aderin-Pocock will take us on an epic voyage through time and space.

Scientists in 2025 detected the 'strongest hint yet' of biological activity outside our solar system on exoplanet K2-18b, sparking growing excitement about the real possibility of extraterrestrial life. In this series of lectures, Maggie sets out on a journey to find it.

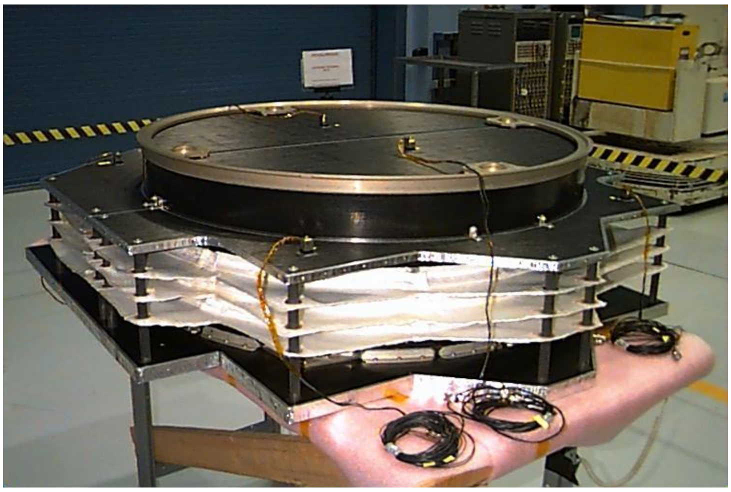
KS3- Shield It, Catch It, Save the Satellites!

Teacher Notes – Space Debris Activities

This is a Key Stage 3 space debris activity where students will learn more about space debris and take part in hands-on activities to learn more about how scientists and engineers will protect satellites and clear-up space debris.

Activity 1: Whipple Shield Engineering

Students will explore how satellites protect themselves from space debris by building and testing "Whipple shields" using everyday materials.



Whipple shield used on NASA Stardust probe. Credit NASA

Materials suggestions:

- *Cardboard sheets*
- *Aluminium foil*
- *Toilet paper*
- *Paper (various thicknesses)*
- *Blu-Tack or soft clay*
- *Small projectiles (marbles, foil balls etc.)*
- *Plastic tray or shallow box (to catch debris)*
- *Ruler / tape measure*
- *Safety goggles*

Safety Notes:

- Projectiles should be small and lightweight.
- Students must wear goggles.

Method

1. Students in groups can create multi-layer shield using combinations of paper, foil, toilet roll, and cardboard
    a. Can use blue tack to create air gaps between materials by placing in the corners of the layers
2. Students can make predictions about which combination will stop the most debris
3. Drop small projectiles at the shields in a tray
    a. Observe whether the satellite would be protected or damaged
    b. Ensure that the projectile is dropped from the same height each time for a fair test

Questions to consider:

1. Which materials absorbed the impact best?
2. Did multiple layers work better than a single layer?

Discussion

- Real satellites use Whipple shields – thin outer layers to break up debris, inner layers to absorb any remaining fragments
    - Even small debris is dangerous in orbit

Activity 2: Active Debris Removal

Students will think like engineers designing missions to actively remove space debris. They will brainstorm, sketch, prototype, and test debris capture methods.

Materials (per group)

- *Cardboard, paper, plastic bottles, straws, rubber bands, string, tape, magnets*
- *Ping pong balls, Clay, Blu-Tack, or soft balls (will act as debris)*
- *Scissors*
- *Rulers / measuring tape*

Safety Notes

- Keep scissors and sharp objects under supervision.
- Test mechanisms on a table or in a tray, not in open space.

Method

1. Groups brainstorm ways to "catch" or "move" debris
    a. Encourage creativity: nets, magnets, robotic arms, sticky gels etc.
2. Sketch idea and plan materials that will be used
3. Build prototype using available materials
4. Groups can pitch their idea taking it in turns to explain the ideas behind the prototype and demonstrate how it works

Discussion points

- Real-life examples: ClearSpace-1 robotic arms, Astroscale nets, magnetic collectors
- Why satellites need passive (Whipple shield) and active (debris removal) to keep orbits safe
- Opportunity to connect to real-world STEM careers: aerospace engineers, robotics designers, policy makers

Activity 3: Active Debris Removal

Design a poster to keep space clean. Your goals is to communicate what space debris is and why it matters.

Activity 4: Active Debris Removal Robotic Hand

Students will build a robotic hand for active debris removal space mission. They will build, test, inspect, iterate and improve their designs.

Materials (per child)

- *Straws (we suggest plastic, although not environmentally friendly, they would bend easier and be easier to manage)*
- *String*
- *Peper clips*
- *Small rubber bands*
- *Modelling clay*
- *Cardboard tube*
- *Scissors*
- *A small needle or pin – something that could make a small hole in the straw*
- *Assorted objects to grasp*

Instructions

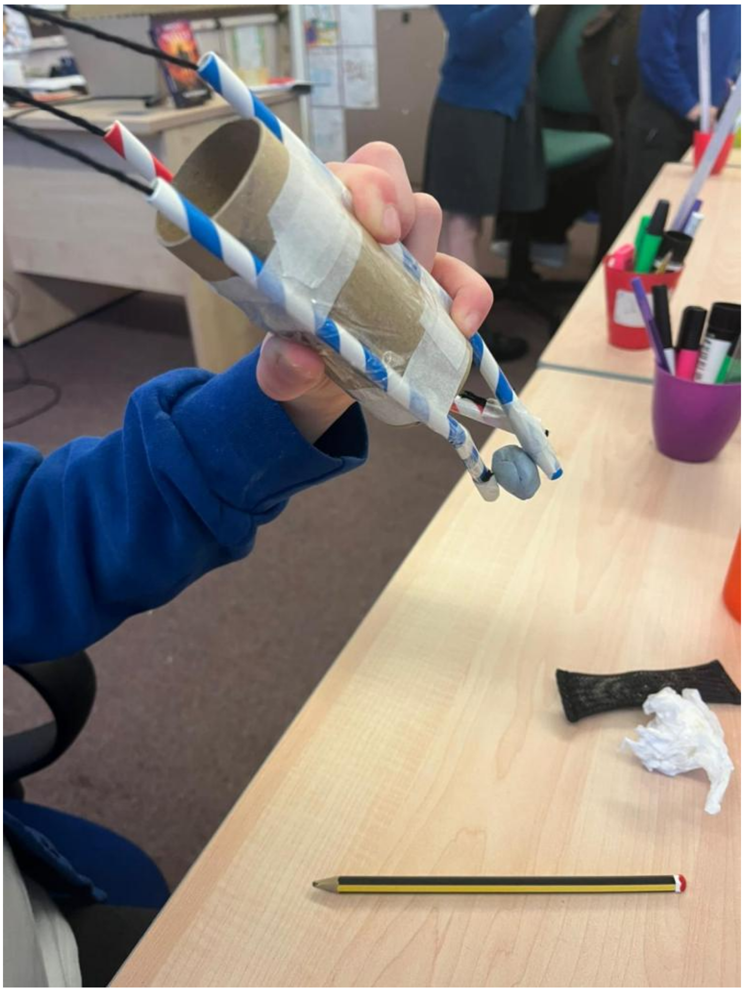
1. Cut the straw to represent finger segments
2. Create "joints" by notching the straws at intervals
3. Thread the string through the straw – this will act as tendons
4. Attach the paper clips at the end of the string. The straw should be straight and bend at each joint when the string is pulled.
5. Add decorations such as clay, cardboard tube, etc.

Allow students to test their robotic hand as they build it and adjust their designs for improved functionality.

Testing and Optimisation

- Testing parameters:
  - Try picking up objects of different shapes, sizes, and weights (e.g. foam blocks, table tennis balls, paper cups, etc.)
  - Assess how well the hand grips and lifts various objects.

Students should come up with something that looks like this



This resource was developed in collaboration with:

https://louno.space

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