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| Key Area of Astrobiology |
| Life in Extreme Environments – how does life adapt to extremes and what does this tell us about habitability elsewhere?  |
| Sciences Experiences and Outcomes |
| SCN 2-01a - I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction.SCN 2-14b - By exploring the characteristics offspring inherit when living things reproduce, I can distinguish between inherited and non-inherited characteristics.SCN 2-19a - I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made.SCN 2-20b - I can report and comment on current scientific news items to develop my knowledge and understanding of topical science.SCN 3-01a - I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution.SCN 3-06a - By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe.**SCIENCE SKILLS****Inquiry and Investigative Skills***Plans and designs scientific investigations and enquiries** Formulates questions and predictions (hypotheses), with assistance, based on observations and information.
* Identifies the independent, dependent and controlled variables, with assistance.
* Anticipates some risks and hazards.

*Carries out practical activities in a variety of learning environments** Applies appropriate safety measures.
* Contributes to carrying out all the procedures.
* Makes observations and collects information and measurements using appropriate devices and units. *(Possible link to MNU 2-11b)*
* Manages identified controlled variables to ensure validity of results.

*Analyses, interprets and evaluates scientific findings** Draws basic conclusions consistent with findings.
* Identifies and discusses additional knowledge and understanding gained.

**Scientific analytical thinking skills*** Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.
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| Prior Learning |
| See Teacher notes word document in module folderSuggested Prior Learning – living things. Suggest using the Primary Science Framework from Highland Council, SCN 2-01a planet earth - biodiversity (requires GLOW log-in) <https://glowscotland.sharepoint.com/sites/national/sciences/Lists/Web%20Links/AllItems.aspx> (click on Planet Earth, then SCN 2-01a) |
| Learning Intentions and Success Criteria |
| LI* We are learning how organisms can adapt to live in extreme environments

SC* I can investigate tardigrades
* I can talk about how organisms can adapt to their environment
* I can carry out an experiment which demonstrates extreme conditions and report my findings
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| Suggested Learning Activities  |
| Examples of organisms that live in extreme environments:-Plants: <https://www.bbc.co.uk/education/clips/zhfs34j>Animals: Series of clips highlighted here and could be used widely for personal interest <http://www.bbc.co.uk/nature/collections/p00kf6hs>**Example: Tardigrades*** Introduce Tardigrades - <http://www.slate.com/articles/video/video/2015/11/water_bear_dna_how_the_only_animals_to_survive_in_space_do_it_video.html>
* <http://www.rigb.org/christmas-lectures/teaching-resources/2015-how-to-survive-in-space/tardigrades>. A range of activities on tardigrades. These include video clips with worksheets, an introduction to mutation and the hunt for tardigrades. Suggest that the short activity is best for primary schools whilst the other 2 may be better suited to secondary school.
* Top Trumps Extremophile card activity – looking at 6 extremophiles and the potential exoplanets that they could live on – pupils should map the extremophile to the planet that could support them best and be able to explain their decisions. Idea is to think about the conditions on the planets and what life they could support.
* Make your own tardigrade – selecting chromosomes from each parent and combining together to create your own tardigrade!

**Extremophiles experiment** * Found within the Astrobiology kit – looking at the effect of salt and vinegar on the activity of yeast. Creation of extreme conditions.
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| Resources |
| * Top trumps cards
* Extremophiles experiment equipment – found within the Astrobiology kit boxes. Water bottles needed.
* Make your own tardigrade – chromosome cut outs, play doh, pipe cleaners etc.
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| Safety |
| * Yeast – biohazard – yeast is a microorganism that should not be ingested or allowed to enter cuts or abrasions on the skin surface. Plasters to be worn if cuts exist. Wash hands thoroughly before and after use.
* Salt – irritant – an irritant in the eyes and in cuts, even at low concentrations. Avoid contact with broken skin, use a plaster.
* Vinegar - irritant – an irritant in the eyes and in cuts, even at low concentrations. Avoid contact with broken skin, use a plaster.
* Balloons – potential to burst – monitor the rate of inflation with this experiment.
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| Approaches to Assessment |
| Teacher observation and discussion: Judgements about what exoplanets the extremophiles could live on and why.Further opportunity to write up the experiment and look for progress in the skills involved in experimental reporting. |