

Space survival: How could we survive a year in a dome? Pupils plan to survive for a year in a sealed dome in a desert

Pupils plan a year's survival in a sealed dome in the desert as preparation for possible space colonisation in the future. Satellite communication is possible.

Tell the pupils that they are to imagine that they will be sealed up for a year in a vast plastic dome, rather like a huge poly tunnel.

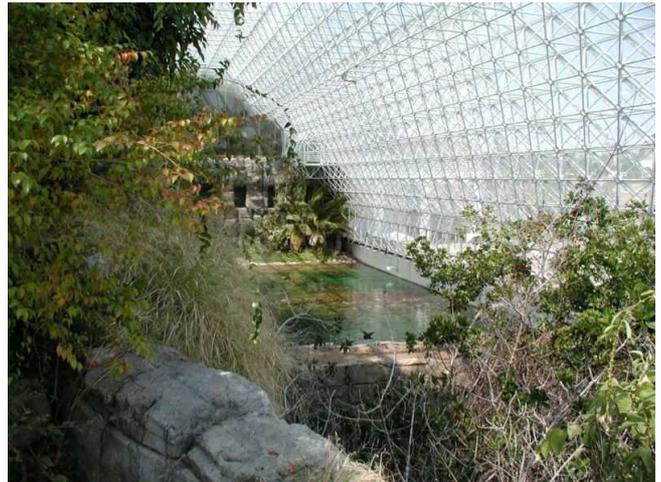
Remind them that the composition of the modern atmosphere is 78% nitrogen, 21% oxygen, and 1% for the rest, including CO₂ (0.03%) with variable amounts of water vapour. The dome is sealed so unless we do something, before we all die inside, the oxygen content will decrease, CO₂ will increase at a similar rate and the sides will steam up due to the water vapour that is breathed out. It is, therefore important to understand the water and carbon cycles. *Copies of these could be given to the pupils. They will also need a copy of the nitrogen cycle.*

Ask the pupils:

What will you take with you? You can order whatever you want but think about the following questions:-

- What are you going to breathe?
- What are you going to drink? How will you collect fresh water?
- What are you going to eat? Will you be vegetarian? If not, how will you get meat?
- What is your likely water/oxygen/food consumption per day?

- How will you dispose of waste?
- What energy source will you use? How will you use it?
- How will you produce power?
- How will you control temperature?
- What will your medical requirements be?
- What are you going to do when you get there? Who will do which jobs?
- What else will you need to consider?



Biosphere 2

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CDO Ranching and Development, LP, Arizona, USA.*

The back up:

Title: Space survival: How could we survive a year in a dome?

Subtitle: Pupils plan to survive for a year in a sealed dome in a desert.

Topic: How can people survive in a closed environment? This activity involves discussions about the carbon, water and nitrogen cycles, the composition of the atmosphere and the nature of scientific experiment.

Age range of pupils: 12 - 18 years.

Time needed to complete activity: 30 minutes plus.

Pupil learning outcomes: Pupils can:

- understand the scientific limitations of living in a closed environment;
- appreciate the applications of the carbon, water and nitrogen cycles;
- plan what to take;
- plan jobs to be done;

- understand this as a model for human survival on Earth.

Context:

What will you take with you? You can order whatever you want

- What are you going to breathe? *You will need plants in the dome so they can provide oxygen. The plants will have to be already there and established when you move in.*
- What are you going to drink? *You will need a source of fresh water. Freshwater can be collected from condensation on the dome at night. Desert nights are cold so there should be sufficient condensation. Remember that, as plants and animals grow, there will be a net loss of available water.*
- What are you going to eat? *You need a balanced diet so you will need vegetables, fruit and meat. You can grow the vegetables and fruit and you can keep animals like chickens for eggs and meat. You will need to take a basic supply with you until your dome-grown food is in production.*
- What is your likely water/oxygen/food consumption per day? *The amount of water consumed per person per day is about 5 litres. The amount of air/oxygen*

consumed per person per day is about 11,000 litres of air which contains about 550 litres of oxygen = 0.55m³. You need an intake of about 2000 calories per day from a balanced diet to stay healthy. Of course, this depends on your age and levels of activity.

- How will you dispose of waste? *You will need to recycle all the waste, including your waste. Knowledge of the nitrogen cycle will help with this. It is important to recycle waste for plant nutrients. Nitrification will take place through bacteria in the soil.*
- What energy source will you use? How will you use it? *You have about 12 hours of energy from the sun. You could ask for solar panels to be fitted to the dome. These would produce hot water for washing and heating. You could ask for photo-voltaic cells to generate electricity from solar radiation.*
- How will you produce power? *You could generate electricity as described above or you could devise a system to create mechanical power by pedalling or by walking animals round and round. This could also provide some exercise for the inhabitants and could generate electricity.*
- How will you control temperature? *You can control temperature by clothes, by making shields for shade in the day or you could devise storage radiators which would release the sun's heat from the day at night. If the dome is well insulated, introducing energy from the exterior as hot water and/or electricity will cause a net gain of energy; the dome will heat up and means of cooling will be required.*
- What will your medical requirements be? *You will need someone who is qualified to look after the community's medical needs and who will organise a stock of all essential equipment to take with you.*
- What are you going to do when you get there? Who will do which jobs? *There will have to be job allocation. Someone must organise fresh water, growing the food, cooking the food, sorting out the waste etc. You will need to elect a leader.*
- What else will you need to consider? *You need to consider people's mental health; some may feel trapped inside the dome and some may miss the luxuries of life outside. You may be able to organise some entertainment system.*

Following up the activity:

- If your year is successful and the dome systems are running well, you will have lived sustainably using only renewable solar energy. Are there lessons from this activity for future sustainable life on Earth?

- What will you miss most?
- What might cause failure? There could be both scientific and non-scientific reasons.
- Think about the size of the dome and numbers of plants needed to sustain an individual/group.

Underlying principles:

- The carbon, water and nitrogen cycles underpin sustainable living.
- Matter is neither created nor destroyed though its form may change, i.e. whatever you take into the dome will still be there at the end of the year in one form or another.

Thinking skill development:

- There is a pattern (construction) to planning to live in the dome.
- Doing one thing causes effects that also require action e.g. the advantage of eggs and meat from keeping chickens means that the birds have to be fed, watered and kept clean, (cognitive conflict).
- There will be discussion of how to make life in the dome sustainable for a year, (metacognition).
- Sustainability of life in the dome can be applied to discussion of future sustainability of life on Earth - (bridging).

Resource list:

- carbon/water/nitrogen cycle diagrams (easily found on the internet with a search engine)
- optional photos of domes (e.g. those of the Eden Project - <http://www.edenproject.com/>) inside and out.

Additional notes: This experiment has been carried out. It was known as Biosphere 2 and took place in Arizona between 1991 and 1993. It failed because oxygen levels dropped from 21% to 14%. 19 out of the 25 vertebrate species died. Pests increased greatly and the humans needed food supplements.

Useful links:

Biosphere 2 Center - <http://www.bio2.com/>, <http://www.biospheres.com/> or by searching for "Biosphere 2" on the internet. The Desert USA website - <http://www.desertusa.com/mag99/apr/stories/bios2.html>. Note: The project was called 'Biosphere 2' because 'Biosphere 1' was regarded as the Earth.

Source:

This activity was devised by the Earth Science Education Unit, as part of KS4 Life, atmosphere and everything. www.earthscienceeducation.com

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