

DIY Earth



UNIT A1

This unit looks at the problems encountered when a sealed environment, Biosphere 2, was set up. It contrasts this environment with the tremendously complex one of Biosphere 1 (Earth).

Links with KS3 programme of study

- ◆ The benefits and drawbacks of scientific and technological developments, including those related to the environment, health and quality of life (breadth of study).
- ◆ Habitats support a diversity of plants and animals that are interdependent (Sc2 life processes and living things).

Using this unit

The unit covers some basic science involved in studying the balance of nature and photosynthesis but it considers them from an unusual point of view.

Useful resources

Biosphere 2 has an excellent web site (<http://www.bio2.edu/index.html>) with visitors' information, the history of the project and a site tour.

Extension idea

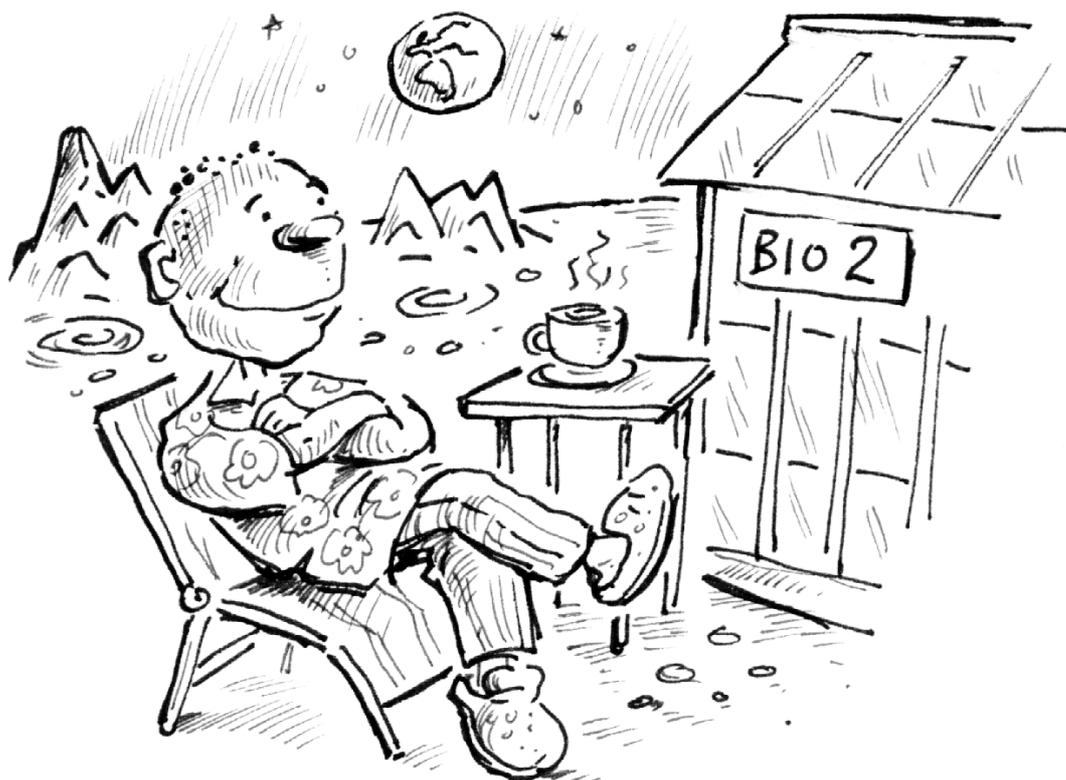
Pupils could design their own Biosphere 3 and present it on a large poster.

Moral and spiritual aims

- ◆ To promote an appreciation of the wonderful complexity of our planet, including its ecosystems and the delicate balances involved.
- ◆ To show that care of the environment is required to maintain these balances on Earth.
- ◆ To show that rules are required to organise a community.

Answers

1. Light for photosynthesis to enable plants to produce food and for suitable human and animal living conditions.
2. They would need to take some oxygen in the first place to create a survivable atmosphere, then they would need to make oxygen.
3. Plants make oxygen by photosynthesis.
4. Fuels need oxygen to burn, so they will consume more oxygen.
5. 'Dirty water'; then 'Filter...'; then 'Use bacteria...'; then 'Sterilize...'; then 'Clean water'.
6. Examples: electricity to sound (hi fi); electricity to light and sound (TV); chemical to heat (food or coal).
7. The main source would be the Sun; other sources could be taken with them but, apart from nuclear reactions, other sources taken would soon be exhausted. Geothermal sources of energy seem unlikely, but cannot be altogether ruled out.
8. Ticks for batteries and solar panels.
9. Metals, paper, glass or organic material via composting.
10. Burn it, bin it or bury it.
11. Pupils may suggest pesticides but an important policy of Biosphere 2 was to use none at all; predators or traps would be acceptable.
12. Get materials/energy from the Earth; save materials/energy used for other things; or try new ways to make materials and to transfer energy; or grow more plants.
13. Answer needs to have arrows from grain to chicken and from chicken to humans and also from grain to humans.
14. Some chickens may die and humans may lack enough food too.
15. Remove the chickens and humans can derive energy directly from the grain.
16. Time is needed to achieve the correct balance.
17. This is for discussion. It may be helpful to point out that some of their suggested rules might be about practical ways of living while others are moral rules.



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UNIT A1

Biosphere 2

Biosphere 2 was a huge construction project. It was built in the United States. In appearance, it resembled a huge greenhouse or conservatory. It was designed to be a miniature version or model of the Earth. It would give scientists a chance to see whether humans, animals, and plants could live in balance without the problems we see around the world today.

If you and your friends had to set up a space station to live in on Mars, consider what your design would include. (Remember that you would be a long way from the Earth so you would need to have enough food and drink for everyone, and even air to breathe. You would need to live in your space station for a long time, probably ten years, as Mars is about 230 million kilometres away and it might take up to 1 year to travel from the Earth to Mars.)

You would need to include ways of providing:

food; oxygen; water; energy; waste disposal facilities.

Consider each of these in turn.

Food

You would need to grow food, such as vegetables and fruit. Perhaps you could also grow plants for animals to eat. Then you could eat the animals.

1. You would need lots of light in your space station. Why?

Oxygen

Oxygen gas would have to be made for the space station. There is no oxygen in the atmosphere on Mars.

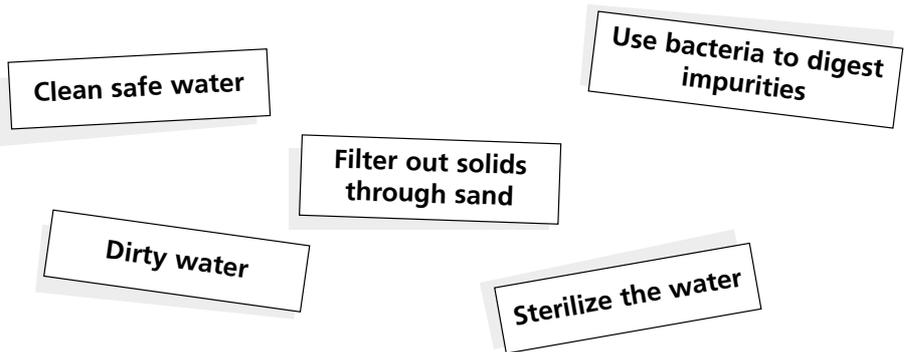
2. Could you carry enough oxygen with you or would you need to make oxygen?
3. How would the plants you grow help to provide oxygen?
4. If you burn fuels like petrol or coal for transport or heat, this may affect oxygen levels. Why?



Water

If you started off with a supply of water, you should be able to recycle it so that you don't run out. Firstly, it would have to be cleaned.

- Put these boxes in the right order and draw a flow diagram to show how you might recycle your dirty water to produce clean safe water.



Energy

On Earth we all use a lot of energy.

- Think of three items that use energy in your home and write down how they take in energy and change it into another type of energy. For example, an iron takes in electrical energy and changes it to heat energy.
- On Mars, energy will be needed to work the machines, pumps, etc. Sources of energy might be very limited. What sources of energy could you use?
- Think about the following energy sources used on Earth and decide whether you could use them on Mars, giving your reasons.

Energy source	Used for	✓ or X	Reasons
Electricity from power station	Light in the home		
Batteries	Telephone communications		
Coal or wood burned in oxygen	Heat for the home		
Solar panels	Making electricity		
Petrol in a car, burned in air	Movement of the car		

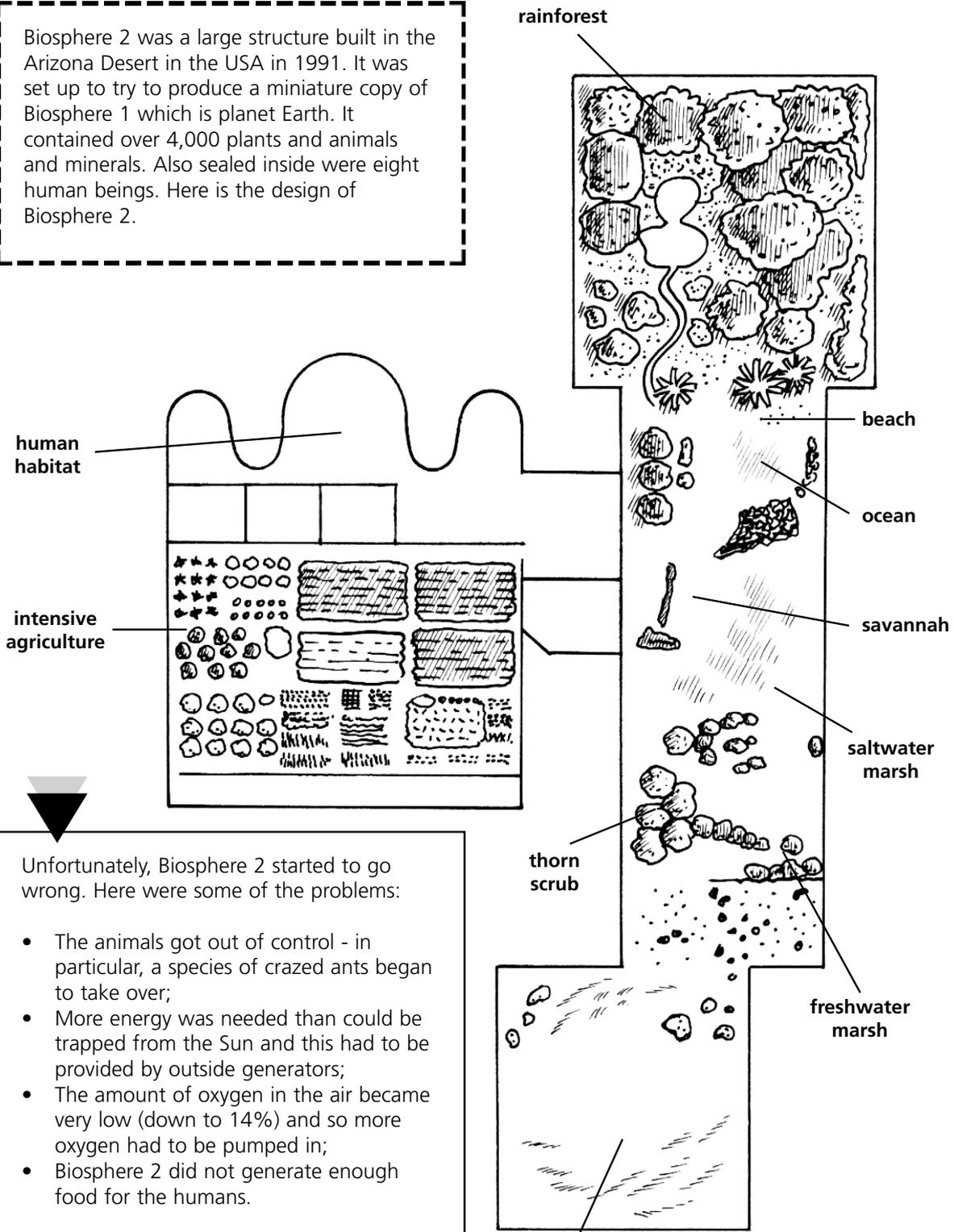
Waste disposal

At home, you throw all kinds of material into the dustbin.

- Name three different types of material that you could recycle.
- What could you do with the litter that cannot be recycled?



Biosphere 2 was a large structure built in the Arizona Desert in the USA in 1991. It was set up to try to produce a miniature copy of Biosphere 1 which is planet Earth. It contained over 4,000 plants and animals and minerals. Also sealed inside were eight human beings. Here is the design of Biosphere 2.

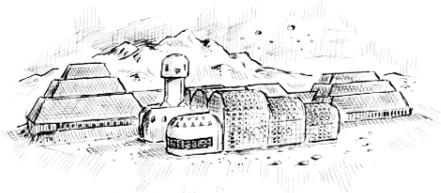


Unfortunately, Biosphere 2 started to go wrong. Here were some of the problems:

- The animals got out of control - in particular, a species of crazed ants began to take over;
- More energy was needed than could be trapped from the Sun and this had to be provided by outside generators;
- The amount of oxygen in the air became very low (down to 14%) and so more oxygen had to be pumped in;
- Biosphere 2 did not generate enough food for the humans.

11. What would you have done about the ants to stop them getting out of control and taking over?

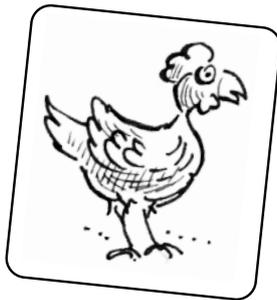
12. If more oxygen and energy are needed, what might you have to do?



Millions of dollars were spent on computers and the latest technology to try to control Biosphere 2 and keep the balance of plants, animals, humans, oxygen, water and food correct. The trouble was that it proved impossible to keep the balance just right!



13. Here are three possible parts of a food web. Draw the web linking the boxes with arrows.



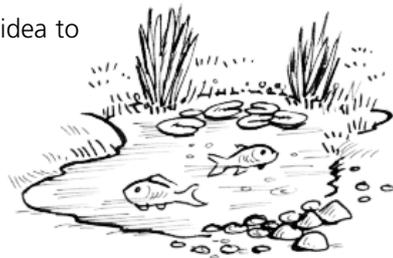
14. Humans eat the chickens and their eggs. What will happen if there is not enough grain grown?

15. What could you do if there was not enough grain in Biosphere 2?

It could be that the only way you can make a large biosphere which is balanced, is to set it up over a long period of time. The only Biosphere that works so far is Biosphere 1 - THE EARTH.

16. If you build a new pond in the garden, it would be a good idea to do the work gradually over a period of time before you introduce fish. The order might be:

- a) Dig a hole and line it with a fibreglass mould or black butyl rubber;
- b) Add water and some soil;
- c) Add plants; and
- d) Add fish.



Explain why it is not a good idea to add water, soil, plants, and fish all on the same day.

Biosphere 2 needed various rules in order to help to establish the community living there.

17. What rules would you make if you were in charge? Give reasons for them.



Biosphere 1 works so much better for billions of plants and animals than Biosphere 2 did for just 4,000 species. Is it that the control was just not powerful enough or that the design was inadequate for Biosphere 2? If so, what might be necessary to sustain or manage the much larger Biosphere 1? Do you ever wonder just how on Earth this happens? Does it amaze you or frighten you? How do you react?