

People

We've looked a lot at the environmental aspects of Sustainability but the Garden does a lot for the social element too.

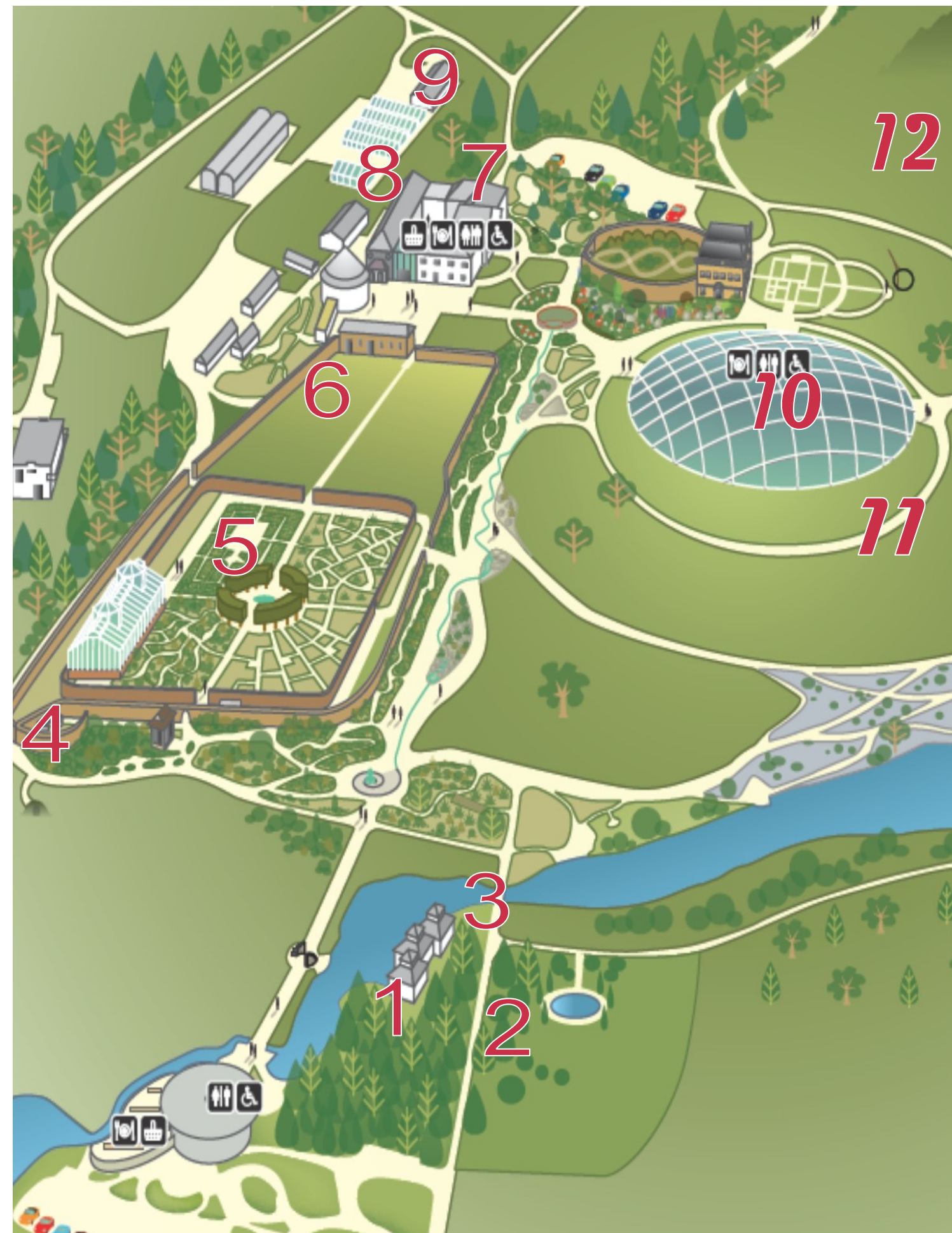
We engage volunteers in every department who help us with everything from filing to foliage. We wouldn't be able to do the work we do without them and in return they have opportunity to meet new people, keep active, learn new skills and share existing ones.

We work hard to educate our visitors about plants, sustainability, biodiversity to name but a few. We do this through the mediums of English and Welsh.



We try to make learning at the Garden accessible to all. Almost all of the site is wheel chair accessible and you might notice posts around the ornamental garden with brail for our visually impaired visitors. As you move through the trail you will meet Lily Lloyd; a character that was developed to engage younger visitors in our sustainability trail.

We also employ local people and bring trade and tourism into Carmarthenshire.



How Green is the Garden?

Sustainability at the Garden

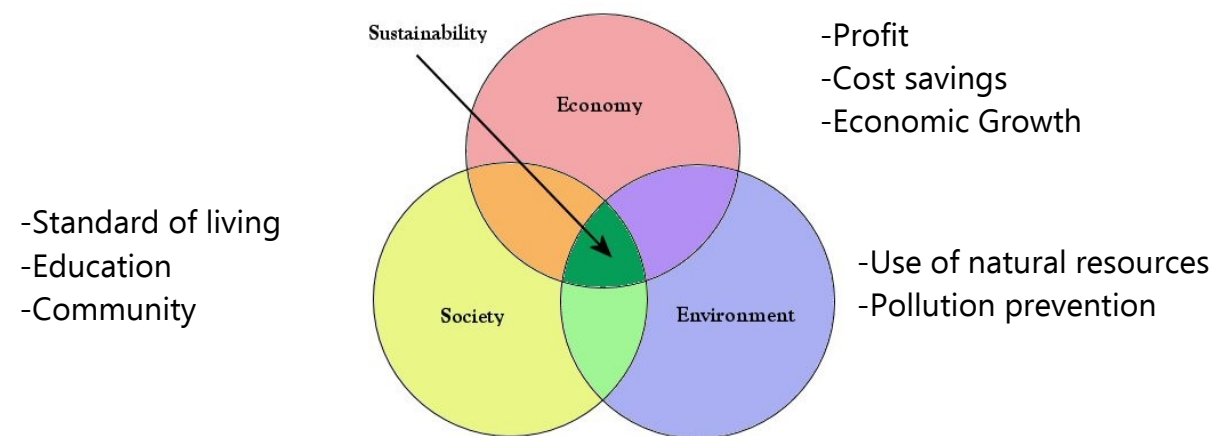
This booklet provides information on how we're helping to reduce our carbon footprint. Some of our methods might give you ideas to take back to your school/work/home to help you join in with millions of others world-wide to live a more sustainable lifestyle.

You can use the map to find each site – the **(numbers)** in the booklet refer to places on the map on the front. You don't have to visit the sites in any particular order but you will need to visit all the sites to answer questions in the **red** boxes. You might want to think about the questions in the **green** boxes once you've finished the trail or back at school. We encourage you to take lots of pictures as you move through the Garden.

So what is Sustainability?

The Brundtland Report (1987) defined Sustainable Development as "...development which meets the needs of the present without compromising the ability of future generations to meet their needs."

We talk about the three pillars of sustainability:



Which of the three elements of Sustainable Development do you think we prioritise in our society?_____

Redraw the diagram to represent how our society prioritises the three elements:

Nature

Waun Las National Nature Reserve (12) boasts 400 acres of organic working farm that is managed to encourage biodiversity. A network of footpaths will take you through flower-rich meadows, historic parkland and beautiful pastures.

You can also pass through Pont Felin Gat, a magical valley with ancient woodland, meandering streams, a dramatic waterfall, historic remains and the chance to see otters and pied flycatchers. Pick up a map leaflet at the NNR entrance and explore the wildlife-rich Welsh countryside. At the right time of year, you can taste our organic free-range lamb and beef in



our Season's Restaurant.

What do we mean by biodiversity? **Why is it important to promote biodiversity?**

Plants

The Ghost Forest (11) is made up of 10 giant hardwood tree stumps from Ghana in Africa. The largest is 300 years old and weighs 19 tons. The trees were brought to Europe from a commercially logged forest by the artist Angela Palmer. Her aim is to encourage people to reflect on the problem of deforestation and the depletion of the world’s natural resources after learning that a tropical forest the size of a football pitch is destroyed every four seconds.



What type of trees make up the Ghost Forest

- 1.
- 2.
- 3.
- 4.
- 5.

What current pressures face the rainforests around the world?

Discuss some of the effects caused by deforestation.

What we can do to help conserve the rainforests around the world?

Sustainability at the Garden

We are part of an international network of botanic gardens working towards a more sustainable future. We are all science and research centres, helping to conserve the Earth’s plant diversity and educate people in the important role plants play in all our lives – let’s face it without plants there would be no life on Earth!

At the National Botanic Garden of Wales we don’t just invest in plants. As you move through this booklet you will find out about the renewable energy sources and green technologies that employ here. We urge you to reflect on your every day choices to see have you can help.

What are the issues affecting sustainability that we all need to address?

- Water** – source and treatment
- Waste** – production
- Energy** – use and generation
- Food** – source and production
- Transport** – fuel consumption and source
- Biodiversity** – loss of
- Community** – lack of awareness/regard for the needs of others in our locality
- Shopping** – local / global impact
- Animal welfare** – cruel practices in food production, research, zoos etc

Discuss ways that YOU can address these issues. Think small AND think big!

Energy

Sustainable Energy

The Botanic Garden aim’ to be carbon neutral. To help us do this we are looking at different ways of generating sustainable energy.

Biomass Boiler (8)

The In our **Energy Zone** you’ll find our biomass boiler. This was installed in 2012 to replace the first one we had here. This new biomass boiler is a 500kW system that is capable of generating 90% of the sites heat demands. It also saves on 366 tonnes of CO₂ per year and saves us around £40 000 a year on energy bills (2012 prices). It burns approximately 20 ton per week of woodchip that comes from sustainable Welsh sources, so we are also supporting the Welsh forestry industry.



The Garden heats the Great Glass House with biomass. What is biomass?

- Coal ☐
- Oil ☐
- Wood ☐
- Organic materials ☐
- Rubbish ☐
- Gas ☐

Biomass is a carbon neutral energy source if managed sustainably. What does Carbon Neutral mean?

How do we manage it sustainably?

Plants

The Great Glasshouse (10) was designed by Sir Norman Foster and partners and has state of the art technology. It is the largest single span glasshouse IN THE WORLD and holds a display of plants from the planet’s Mediterranean climate zones. Less than 2% of the Earth’s surface has this type of climate but it is home to over 20% of all known flowering plant species. The habitats found in these highly populated areas are as endangered as the world’s tropical rainforests.

There are sensors inside and outside the building to monitor climatic conditions. These sensors inform the central computers and so if something changes, for example wind chill, then the computer sends signals to the motors attached to some of the window frames to close/open the windows to help keep the conditions right for the plants.



Which 6 Mediterranean climate zones can you experience in the GGH?

What are the benefits of conserving plants?

Water

Here at the Garden we are very aware of the importance of conserving water, a finite resource. We harvest water wherever possible including rain-water and excess water from watering the plants. All of our fountains are filled with grey water; we never top them up with mains water.

Sewage, and stuff that's gone down the sink in our restaurant, is pumped into a big underground tank in the **Living Machine (8)** . Whilst the solid sewage drops to the bottom of the septic tank, the watery top is pumped down to a big pond in our Conserving Our Future Zone. Here, tiny creatures eat the nasty bits. These bacteria need lots of oxygen so we pump air across the gravelly floor. Tall reeds help control water flow. Bacteria also



What is the name of this new technology?

What are the pros of recycling water in this way?

...and the cons?

Energy

Water Source Heat Pump (1)

Our school laboratory, the **Aqualab**, is heated by the lake on which it stands.

Cables that run along the bottom of the lake absorb heat from the surrounding water (even when the lake is frozen over). This latent heat is transferred along narrower and narrower cables and eventually to a heat exchanger in the Aqualab.

As the liquid travels through narrower and narrower cables the molecules collide at faster and faster rates, generating the heat. The system is powered by a small pump, the only running cost.



Can a water source heat pump save money?

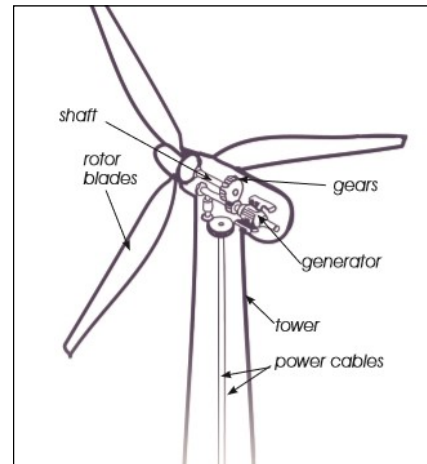
Would you install this technology at home?

Why?

Energy

Wind Power (3)

People have used wind to power things for hundreds of years. Wind mills were traditionally used to power grindstones inside that would grind grains like corn and wheat to make flour.



Now the wind is used to turn turbines that mechanically power generators for electricity.

Their rotor blades are angled so that they turn when the wind pushes against them

The rotor spins a shaft which is connected to gears

The gears are connected to a generator

Coils of wire are spun around powerful magnets inside the generator

This generates electricity which is carried where it needs to be by the power cables

There is a small wind turbine outside the Aqualab. It is part of the weather station where we record different elements of the weather that are fed into a national survey that tracks climate change.

There is a small wind turbine next to the Aqualab. What is it used to power?

List some of the pros and cons of using wind power.

Does one list outweigh the other?

Materials

Where ever possible we use locally sourced materials at the Garden. The **Performance Stage (7)** is a really great example of this. The structure was designed by a group of students from all over the world who worked together who, in the process, learnt about sustainable building practices, Welsh architecture and traditional construction techniques. It was built with the help of local young people giving them opportunity to gain practical experience in traditional building crafts heritage skills.



Where were the materials use to construct the performance stage sourced?

What are the benefits of using locally source materials?

Waste

Here at the Garden try to send as little waste to landfill as possible. We recycle or reuse paper, glass, cans, cardboard, plastic, food waste, printer cartridges and old electrical items. Many of these materials end up at our **Recycling Centre (6)**. Unfortunately we still have to send waste to landfill but are continually trying to reduce this amount.



What materials are collected by the council from our Recycling Centre?

List 3 ways we could reduce our waste further at the Gardens.

List 3 ways you could reduce your waste on a daily basis.

Energy

Solar Power (2)

Here at the Garden we generate our own electricity on site by using the same energy source as plants!

There are two types of **Solar Panels**: piped water, where water runs through and is heated by the Sun and photovoltaic (PV) that is made up of cells that take the Sun's energy and converts it into electricity.

Down by the Aqualab we have two demonstrations of solar power in action. One is a large panel with a reader, the other is a water pump powered by the Sun.

There are 254 PV panels installed behind our nursery polytunnels that will produce electricity that we send back to the National Grid that dramatically reduce our bill.



Watch the dial on the ammeter . What happens when two of your friends lie across the solar panel?

How could the solar powered water pump prove beneficial in Africa?

Food

In the 4th quadrant of the **Double Walled Garden (5)** you'll find a modern kitchen garden, reflecting its original use. Like early 19th century gardeners, we grow our fruit and vegetables organically this means we don't use pesticides or herbicides nor do we grow hybrids. To keep down pests, we use different organic methods including companion plants to draw harmful insects away from crops. Bees from our Bee Garden also help to increase yields.

Have a look in our **Grow Your Own Demo Garden** (between the inner and outer wall on the south side of the DWG) to see some great green growing. We have raised beds so you can get some idea of how much you can grow in a small space. You'll also see a bug hotel, one of the ways we encourage gardening for wildlife. There's a water butt to collect rain water to reduce the use of mains water and a compost bin where garden waste is broken down into compost to support future growing.



List some different growing techniques you can find out about in our demo garden.

Give some advantages to growing your own fruit and veg.

Pollinators

Bee Garden (4)

The main aim of our apiary is to educate people about the importance of bees and other pollinators but it's not the only place in the Garden where they feature. Our Science Department do a lot of work around the behaviour of pollinators and pollinators are probably the most important members of the Horticulture team!

Remember bees aren't the only creatures that do this very important job. Other pollinators include wasps, flies, butterflies, moths, small mammals and birds.



What does the Garden do to help pollinators?

Why are pollinators so important to humans?