Ecological and Carbon footprints: Teaching advice and guidance

Relating ecological and carbon footprints to the curricula of geography, science and citizenship

As has been pointed out many times before the teaching of ESD fits most comfortably with Geography and Citizenship. Geography has had a substantial emphasis on development education for many years and ESD clearly prepares students to become more active citizens. However Science and Design and Technology are both underrated when it comes to delivery of ESD and eco and carbon footprints work especially well with elements embedded in the curriculum and specifications at all Key Stages for each subject. What is outlined below is how best to use the eco and carbon footprint calculators based on exam specifications and QCA/DfES schemes of work.

Geography

As the QCA ESC website so succinctly states “Geography is a focus within the curriculum for understanding and resolving issues about the environment and sustainable development. It can inspire pupils to think about their own place in the world, their values, and their rights and responsibilities to other people and the environment.” Eco and carbon footprint calculators are an excellent way of introducing those responsibilities.

Enquiry skills are encouraged at all Key Stages in Geography. Both types of footprint calculators give students the chance to set up their own enquiry, pose questions and discuss potential solutions.

Using footprints also helps to meet NC/5:
Knowledge and understanding of environmental change and sustainable development
a) recognise how people can improve the environment [for example by reclaiming derelict land] or damage it [for example, by polluting a river], and how decisions about places and environment affect the future quality of people’s lives.
b) recognise how and why people may seek to manage environments sustainably, and to identify opportunities for their own involvement.

Two units within the QCA/DfES schemes of work would also benefit from including footprint calculators, namely Unit 14 Can the earth cope? Ecosystems, population and resources and Unit 23 Local action, global effects.

Specifications vary at GCSE and A Level but footprint calculators would be useful within People and Environment units at GCSE as the concept of carrying capacity is well illustrated. Also at GCSE the transport, waste and homes elements of the eco footprint can be used to illustrate concepts and ideas in Places and People and Managing Natural Resources units.

At A Level eco and carbon footprints can be used within the following units:

Citizenship

Participation and responsible action is encouraged throughout the Key Stages in Citizenship. Eco and carbon footprint calculators are participatory in nature and lead students to examine the impact their individual actions have on the environment.

One example given on the QCA ESD website states:
“ KS3/3c
Developing skills of participation and responsible action
c) reflect on the process of participating
Pupils might canvass and share ideas about how their community could become more sustainable. The pupils might prepare a display at the local council buildings, or design a consultation process to involve local people, including young people, businesses and other groups (e.g. through meetings in the town hall and..."
interviews).

As part of this, pupils might ask about how different people are usually consulted, or make their views known to the local authority, and how this process might be improved. Pupils might then present their ideas for improving participation, perhaps involving the use of ICT.

At KS3 one unit in the QCA/DfES scheme of work would benefit from using the eco and carbon footprints to spark discussion; Unit 10 Debating a global issue. At KS4 Unit 9 Consumer rights and responsibilities can use the footprints to illustrate the impact of consumer behaviour on other people - locally, nationally and globally. Unit 12 Global issues, local action can use footprints to help students understand how to contribute to local decisions that will influence quality of life and the environment in the future.

Science

Key concepts in science, such as diversity and interdependence, are also key concepts in ESD. Any work at any Key Stage which emphasises these concepts would benefit from using the eco and carbon footprint calculators. Clearly also work on energy would benefit from using the carbon calculator as outlined below.

In the National Curriculum at KS3 and 4 the following parts of the programme of study can be illustrated by using the calculators:

**KS 3/Sc2/5a**
Living things in their environment
a) about ways in which living things and the environment can be protected, and the importance of sustainable development

**KS3/Sc3/2i**
Materials and their properties, Changing materials
i) possible effects of burning fossil fuels on the environment [for example, production of acid rain, carbon dioxide and solid particles]

**KS3/Sc4/5a**
Energy resources
a) about the variety of energy resources, including oil, gas, biomass, food, wind, waves and batteries, and the distinction between renewable and non-renewable resources

**KS4/Sc2/4b, c**
Living things in their environment
b) how the impact of humans on the environment depends on social and economic factors, including population size, industrial processes and levels of consumption and waste
c) about the importance of sustainable development

**KS4/Sc4/4b**
Energy resources and energy transfer
b) about the efficient use of energy, the need for economical use of energy resources, and the environmental implications of generating energy

Within the QCA/DfES schemes of work two units would benefit from students using the carbon footprint calculators, namely, Unit 7I Energy resources and Unit 8I Heating and cooling.

Although specifications vary at GCSE and A Level there are many units which would benefit from the inclusion of work on eco and carbon footprints especially as the concept of carrying capacity is so well illustrated by using these tools. At GCSE the units which lend themselves to work using the footprint calculators are The Environment, Exploring Energy, Managing Energy and Science and Society. A Level Biology and Chemistry have more opportunities than Physics to use the footprint calculators, especially units on Ecology and Chemistry and the Quality of Life.

Design and Technology

Despite common misconceptions ESD is at the heart of teaching and learning in Design and Technology. As the QCA ESD website states, “At each key stage, design and technology prepares pupils to participate in tomorrow’s rapidly changing technologies. They learn to think and intervene creatively to improve quality of life [developing understanding of the principles of sustainable design and production systems]. At key stage 4 specifically, pupils consider how technology affects society and their own lives, and learn that new technologies have both advantages and disadvantages.”
All units within the QCA/DfES schemes of work could actually be prefaced with a statement such as, “At all times pupils should be asked to consider the environmental, economic and social implications of the resources used. They should take these into account before using or considering the use of particular materials. They should be prepared to justify such use, including instances where it may be appropriate to use materials or practices that are not sustainable (e.g. intensively produced food may be much cheaper and therefore affordable). Pupils should also consider the impact of the final product, including its potential for recycling or reuse where appropriate.” (Source http://www.nc.uk.net/esd/teaching/dandt/schemes_of_work.htm)

At GCSE all the statements above apply even though specifications vary. Also units on Manufacturing Food would benefit from using the eco footprint to examine food miles.

Ecological footprinting and geographical enquiry

This section has been compiled by Daniel Ellison a geography teacher from Little Heath School, West Berkshire. Many of the ideas outlined below have been used at the school with Key Stage 3 pupils. Initially Year 9 pupils worked with ideas before they went on to lead Year 7 and 8 pupils in activities. These activities led to pupils taking formulate individual action plans and group actions such as assemblies, an appearance on local radio to influence their community and then to plan campaigns to influence their local community’s footprint.

If we can see the outcome of an environmental event we can usually understand it, but issues such as sustainable development are hard to grasp as you cannot see them.

The measurement of ecological and carbon footprints of a population or individual allows people to actually see the issue being discussed, making it significantly easier to discuss. Some of the questions below and the suggested activities could be worked through and the pupil’s responses assessed as to their changes before and after undertaking the activities.

Suggested activity (available to download from resource bar)

Excel spreadsheet for use with activities below (available to download from resource bar)

- Introducing the idea – What is an ecological footprint?
- Why calculate ecological footprints?
- Are ecological footprints the same size around the world?
- Do wealth and development change the size of the footprint?
- Have ecological footprints always been the same size?
- Will ecological footprints always be the same size?

The following questions can be answered using the various calculators (see quick links document)

- Why do ecological footprints change in size?
- What can I do to change the size of my footprint?
- What can my community do to change the size of their footprint?
- What are the social, political and environmental consequences if I try to reduce the size of my footprint?
- What is sustainable development? What has it got to do with ecological footprints?

What is an ecological footprint? How much land do I need to survive?

1. City footprint
Time 15-10 mins
Resources: paper, pencils and pens
Idea: Students imagine what will happen if you cover a city with a glass dome through which light and heat can enter but nothing can leave.

In Practice: Draw a city on the board and discuss with the group what makes a city function. Establish the city’s key inputs (food, water, trade, air etc.) and key outputs (waste etc.)

Once these have been established draw a glass dome over the city. In groups ask students to draw their own city with a dome and ask them to label the city showing what will happen. Many of them will pick up on
pollution, lack of access to resources and problems with waste. They can be encouraged to think of secondary impacts such as increases in disease and conflict.

Debrief what students have found by letting them add to the city on the board. Now ask them to draw another city with a dome over it, but this time they must imagine how big the dome will need to be to support it (how many hectares for forest, water, waste, crops, oil?).

Debrief by discussing how Earth is isolated in space and what may happen if we place greater demand on resources than there is supply. Explain what an ecological footprint is (an estimate of the amount of land and water that is actually needed by a population such as a city).

2. My island
Time 30-50 mins
Resources: paper, pencils, pens, what makes up a typical footprint (link 4)
Idea: Students draw an island that shows how much land they need to survive and what it is needed for.

They can then go on to explore the resources needed for their lifestyle by investigating their luxury resources.

In Practice: Students write a list of the basic resources they need for survival and an estimate of what they use each year with a rough estimate how much of each resource they use.

They then draw a scale on a plain A3 sheet or paper or graph paper, with a clear scale of 10cm to 100m.

Ask students to draw out the areas of land and water that they think will be needed to supply them with each of their basic resources. These do not need to be very accurate; it is the idea of the ecological footprint that is important at this stage and not the accuracy.

Now go on to list and map their luxury resources, doing this will give students the chance to explore differences in lifestyle as it is principally the differences on luxury resources that have greatest impact on EF size and especially fossil fuels.

Debrief by asking students what the map shows, how it could be used, what would happen if they did not have enough land for their basic resources? This is a good launch activity for an EF quiz as students are likely to understand and even want to explore greater accuracy in their work.

Why calculate ecological footprints?
1. The carrying capacity of a boat
Time 20-40 mins
Idea: In groups of four, students are given a selection of food and a bottle of water either ‘virtual or real’.

They prepare and show a small play about a group of four people in a boat, at sea with only a limited amount of food. What happens?

In Practice: Students are put into groups of four and given a selection of food and a bottle of water.

Give them parameters by telling them how long it will take to get to land, how much food and water is available and how long they can survive without food and water.

Make sure that it is possible to reach land, but only if at some point one of the group leave the boat. Ask the students to think through the mathematics and then come up with a short play based on what could happen on the boat.

Debrief by making the point that just like their boat, Earth only has limited amounts of resources and people place demands on them.

Explain that when studying the environment carrying capacity is the total population an area is able to support given the resources and technology available, just as the boat had a given carrying capacity. While they could count the supply of food and then demand upon it relatively easily a more sophisticated method is needed for the supply of world resources… the ecological footprint calculator.

2. The carrying capacity of Twister: the supply and demand of spots
Time: 10 mins
Resources: twister Board or something similar

Idea and Practice: Students play a game of Twister, adding one limb at a time to the board. The circles
represent resources. At what point does overshoot (the point where human consumption and waste production exceeds nature’s natural ability to create new resources and absorb waste) occur? What is the carrying capacity (total population that the board can support) of the Twister board?

**Are ecological footprints the same around the world? Do wealth and development change the size of a footprint?**

**Wealth and footprints**

**Time: 20-40 mins**

**Resource: Graph paper, pencils and relevant data from this website**

**Idea:** Students produce a scatter graph by plotting GDP per capita against carbon or ecological footprint sizes of nations.

**In practice:** Give students a table of data that shows the name, GDP and footprint size of several nations. Unless you wish to focus on a particular income group make sure you have a fair spread of countries from different regions and wealth groups, student resource 1 has a range of useful information. Using graph paper ask students to label the axis's GDP per capita (0 to 35,000) on the Y axis and ecological footprint size (0 to 10 if 1999 data) on the X axis.

They should then find the corresponding data for GDP and footprint size for each nation and plot it on the graph with a small cross where they meet. In another colour they should label each cross with the countries name (they could use three colours for country labels that represent high, medium and low levels of development as shown on student resource 1, spatial data).

Once all of the nations have been plotted students can draw a line of best fit. Is there a positive correlation?

Debrief the group by discussing the overall trend and any anomalies. Explain the correlations found by writing a short paragraph. What might be the reasons for any anomalies? Is there any pattern between levels of development and the size of a footprint?

**Have ecological footprints always been the same size?**

**Generations of Footprints**

**Idea:** Students question a group of people about their lifestyle when they were the interviewee’s age. The student records the data and presents it in a graph.

**In Practice:** Students complete an ecological footprint questionnaire for themselves. They then question four people who are at least ten years apart in age. These people must imagine what their lifestyle was like when they were the same age as the interviewee. The participants may well all be family members and this could work particularly well as students explore what life was like for those close to them. Students can now analyse the data by seeing how and why the footprints change overtime. They may also compare there generational footprint to historical data on ecological footprints.

**Global 1: Ecological Footprint Living Graph**

**Idea:** Students use a line graph showing the ecological footprint of all nations as a ‘living graph’ (Leat: Thinking Skills, Chris Kington Publishing; 1998). Students annotate the graph using prompt cards to explain its changes. These may include real events such as changes in oil supply, periods of recession, changes in the number and size of commercial flights or changes to food production, packaging and transport. The cards may also include fictitious experiences of individuals like not being able to afford to go on holiday or loosing their job.

**Will ecological footprints always be the same size?**

**Individual futures**

**Idea:** Students complete an ecological footprint calculation for various stages in their life so far. On a graph with years 0 to 150 students then plot how their footprint has changed in size. Students then predict how their individual footprint will change into the future and why.

**In Practice:** You either need a EF calculator that is sensitive to quantities or imaginative students. Ask students to calculate / estimate their ecological footprint from birth to present. Discuss the key events that make their EF change like eating more food, not needing nappies anymore and having more money. Now establish key events in their futures that may change the size of their footprints like buying a car, travelling abroad more or buying a private jet. Will their footprint change in size again as they get older, have children or retire? Ask students to list the key events, when they will happen and predict how it will affect the size of their ecological footprint. In another colour to their ‘true’ EF ask students to complete the graph by drawing a line that considers when their EF will change size. Ask them to annotate the graph, explaining when it will change and why. They can then go on to plan how to manage the size of their EF.
Global 2: Best, likely and worst futures...

Idea: Students use an incomplete graph from 1960 to 2060 that only shows EF data until 1999. They are given a number of scenarios to sort into best, worst and likely scenarios. Based on these they predict the remaining possibilities by completing the line graph and annotating the outcomes.

In Practice: Handout an EF 1960 to 2060 worksheet to all students. Discuss the trends shown on the graph (possibly with the help of ‘Global 1’ or data on oil, GDP, population etc.) and annotate the key events. Now ask students to imagine what the graph might show over the next 60 years. In groups ask students create a mind map of any key issues or events that could effect the results. You may well want to give cards with scenarios to groups that they can sort into best, likely and worst future events for support and ideas. Now, on their graphs, ask students to draw three EF lines coming from the actual EF data, for the best, likely and worst possible futures. They should annotate and explain their lines, showing clearly the issues or events that have altered their futures over time.

Following this activity students can plan out what actions that could be taken on an individual, national and global level to encourage their best possible outcome and avoid the worst.

Relating ecological and carbon footprints to the seven concepts of ESD

Citizenship and Stewardship – Students can only become good stewards of the environment if they understand the consequences of their own lifestyle choices. Eco and carbon footprints give students a chance to examine if they are good stewards of the environment or if there is room for improvement.

Sustainable Change – Many of the eco and carbon footprints featured on this website (e.g. http://www.cat.org.uk/carbongym/carbongym.tmpl?section=reception) give students the opportunity to examine options for making changes to their individual actions which will lead to sustainable change.

Needs and Rights of Future Generations – Using eco and carbon footprints leads to discussion and debate about best and worst case scenarios in the future which can include examining the impact of today’s actions on future generations.

Interdependence and Diversity – After examining the student’s eco or carbon footprint learning could focus on specific consequences, such as the impact global warming would have on flora, fauna and human society.

Uncertainty and Precaution – Eco and carbon footprint calculators (e.g. http://www.environment-agency.gov.uk/fun/370863) which give students the chance to show how small changes made in their own and their family’s decision making, can illustrate the precautionary principle. This also gives students the opportunity to see that planning for an uncertain future need not mean that their quality of life will suffer.

Quality of Life, Equity and Justice – The difference between needs and wants is illustrated well by examining the eco and carbon footprints from countries at differing levels of development from around the world.

Comparing Eco Footprints Around the World

WWF produce a ‘Living Planet Report’ which examines the state of the world. Follow this link to the latest report where you will find, on pages 4 and 5, some well laid out and easy to interpret graphs and a map to spark debate and discussion in your classroom http://www.panda.org/downloads/general/LPR_2002.pdf.

As more and more schools around the world send in their own results you will be able to view them here.

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Education Department