



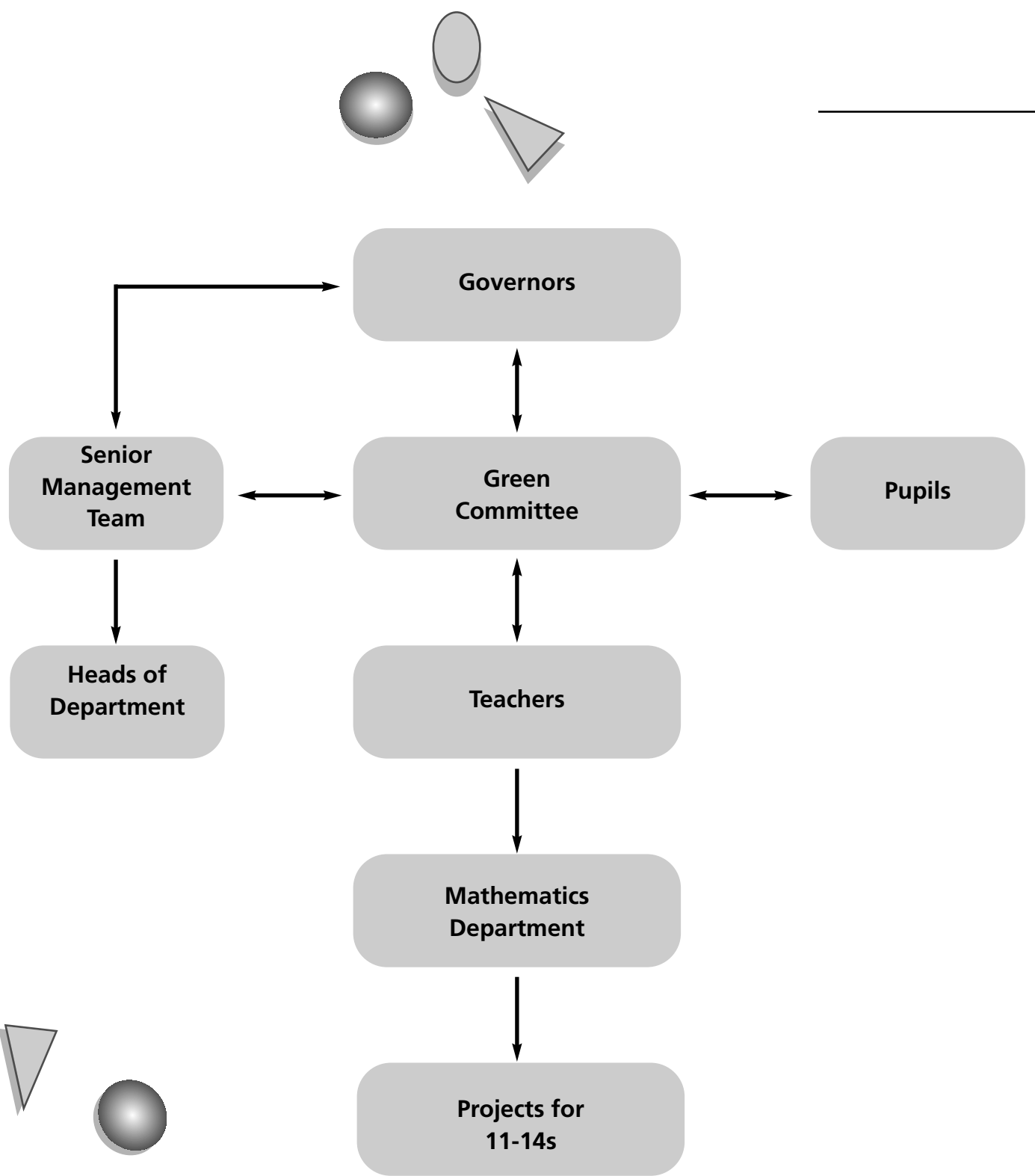
Making Secondary mathematics sustainable

Ask many mathematics teachers what Education for Sustainable Development (ESD) has to do with them and the answer would probably be, "Not a lot". At Crispin Comprehensive School, the response would be very different. For over the past year, teachers at the school have worked together to produce mathematics projects for 11 to 14 year olds with ESD at their core.

"Mathematics is where Education for Sustainable Development meets the real world." *Mathematics teacher*

So how has the school got to this point? Environmental Education has developed over a number of years. Starting with interested volunteers, the Green Group has grown into a recognised Green Committee with governors in its membership. INSET has been carried out with the whole staff and, of course, teachers in the Committee have also promoted Environmental Education in their own curriculum areas. Crucially, however, the enthusiasm and conviction that what they are doing is important has brought them more and more into the mainstream of school life, helping teachers to develop their understanding of sustainability by integrating it into their teaching.





Talking to colleagues in the staff room proved to be an important way of stimulating more ideas. The mathematics department already knew they wanted to develop ICT work on spreadsheets in the lower school. They had a history of success with similar work undertaken with able mathematicians at Key Stage 4 (14-16 year olds). Every year these pupils take an additional GCSE in statistics and as part of their coursework develop a project based on the use of spreadsheets. The choice of topic is up to individual pupils: past topics have included the performance of cars compared with their prices, sporting achievements and even the dimensions of body parts. One KS4 project was entitled “How pregnant

women's foot size relates to time spent in labour"! For the Key Stage 3 (11-14 year olds) work, the mathematics department's thinking had already begun to crystallise around the topic of population growth. The chance to integrate Education for Sustainable Development as well could not have been better timed.

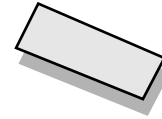
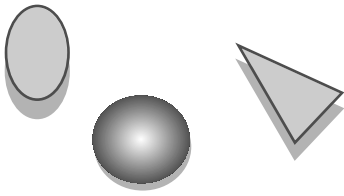
One idea sparked another, and in the end two projects were developed. The one for Year 9 (13 year olds) is the "Population Explosion".

In Year 8 (12 year olds) an existing investigation into the transport of oil, which only considered the problems associated with transport costs, was entirely revamped and has become "Oil Spills".

Education for Sustainable Development through mathematics projects

The structure of both the Year 8 and the Year 9 projects is the same.

Time needed	<ul style="list-style-type: none"> ● 4 double lessons of 70 minutes each
Teaching methods	<ul style="list-style-type: none"> ● Teacher-led whole class discussion ● Individual research using spreadsheets (and other resources for faster working pupils) ● Group work to put together a presentation of findings
Resources	<ul style="list-style-type: none"> ● Pupils' booklets that outline the tasks, give hints on how to make use of the data, and set challenging follow-up questions ● Teachers' booklets that support the teacher in a similar way! ● Spreadsheets for the mathematics area of the school's ICT network ● For the "Population Explosion" project, current information was researched of the internet. It had to be used carefully because different sites use population figures measured at different times of the year. ● For "Oil Spills", the WWF publication <i>Maths Matters</i> proved an invaluable source of data for teachers.

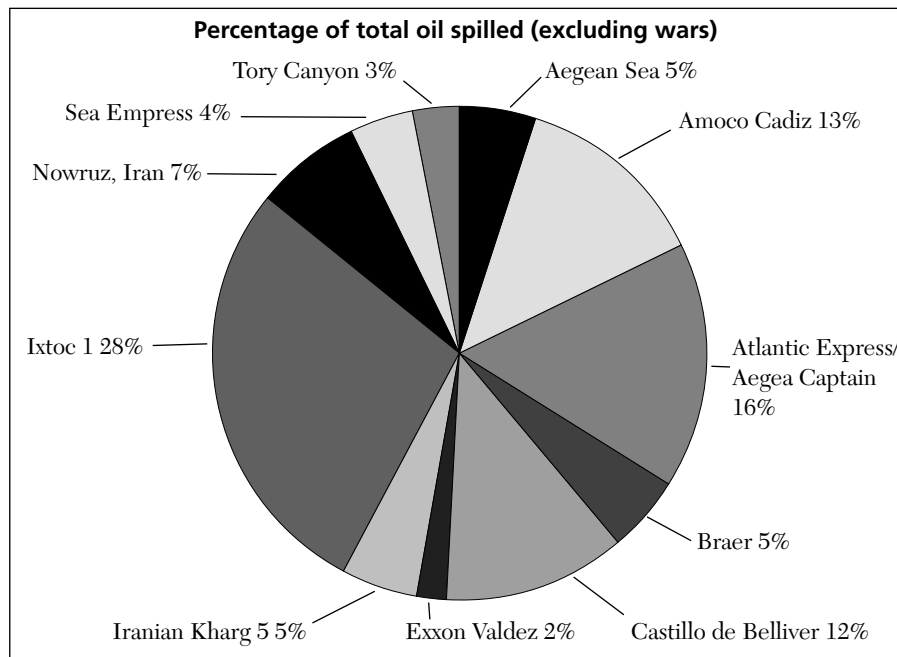


The "Oil Spills" Project for 12 year olds

"Oil Spills" looks first at the environmental impact of spilled oil through background reading and brainstorming to elicit existing knowledge.

Each pupil then chooses a particular incident to investigate in detail. Its cause is an important piece of information. Possible causes include tanker spills or crashes, pipe-line failures, oil-field accidents, problems at refineries and wars.

The teachers have set up a spreadsheet which allows pupils to examine a number of incidents, some more publicised than others, to find trends and present them graphically. For example, what causes the greatest amount of oil pollution, and is there any trend over time in the size of oil spills?



One of the science teachers has contributed a section to the spreadsheet on the fate of the spilled oil, looking at the different environmental pathways it can take. Faster working pupils are encouraged to research this further on the internet, giving them a more in-depth understanding of the consequences for ecosystems.

"The oil spills project was very eye-opening. I was very surprised at the amount of oil spilt in our oceans every year. I learnt a lot using the computer database and spreadsheet, which I have never used before."

"We did not just learn about the maths side of it but we also learnt a lot about the environment."

Year 8 pupils (12 year olds)

"This was an enjoyable investigation to teach that fully involved the children." *Mathematics teacher*



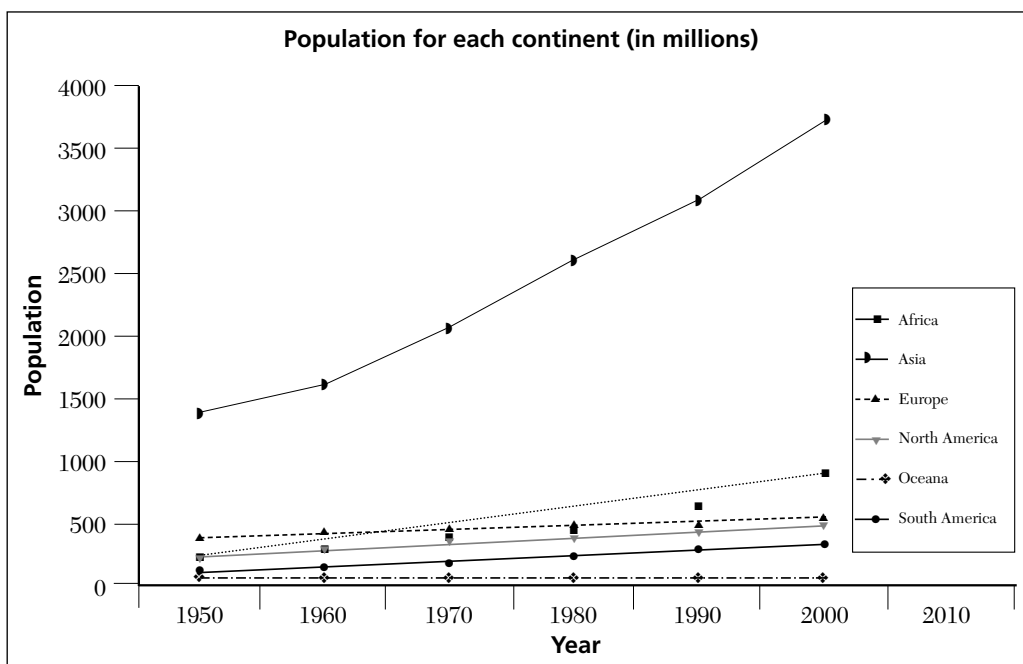
For the pupils, the outcome of their work is a group presentation to the class using their printed tables and graphs together with their research on the environmental effects of oil spills. An important discussion point they must address is what they think could be done to reduce oil spills.

The "Population Explosion" Project for 13 year olds

"The Population Explosion" uses the same format as the "Oil Spills" project, so that pupils feel confident that they are building on something they have already learned. However, the issues considered are more challenging. They obviously raise questions about individual's life choices and ask pupils to consider differences between more economically developed and less economically developed countries. This project naturally generates a lot of discussion of the data.

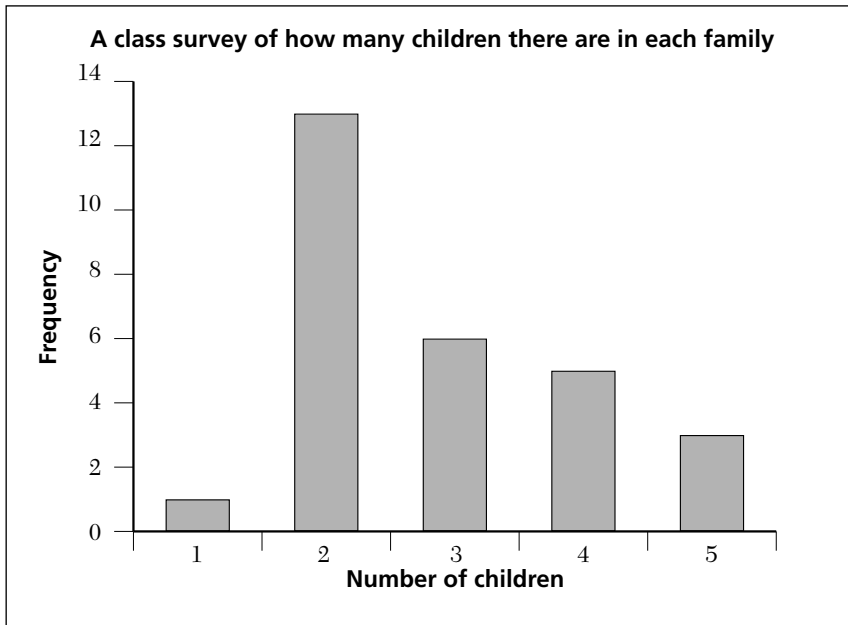
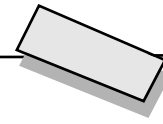
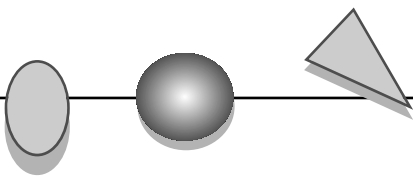
The pupils' first task is to analyse spreadsheet data on the populations of the five continents over the last half century. They are asked to spot trends, predict likely continental populations by 2010, and consider reasons for any differences between the developed and developing world.

"This is just what I am looking for: a database/spreadsheet module that links in with my programme of study that I can teach from an angle I believe in – mathematics with feelings!"
ICT teacher training student on school experience



The next stage is to introduce the idea of population density as a more meaningful measure of the likely pressure of humans on the environment than simple population figures. Pupils generate their own spreadsheets and work in pairs or small groups to discuss ideas about why there are such large variations in population densities.

They are given prompts to get them started, for example: does the physical geography of a country matter? How important might economics be? Could tradition play a part? Will the provision of effective medicine be a factor? The teacher has an important role facilitating discussion but also, where necessary, dispelling false preconceptions.



So far the work has all been on the basis of population data that already exists and pupils have been trying to explain it. The next section of the project challenges them to speculate, but in a very mathematical way. The introduction to this section involves a class survey on the number of children in each family.

This needs handling with real sensitivity by the teacher and raises important questions about the flexibility of family groupings in modern society. It also raises the purely practical problem of how statisticians can count numbers of children in families without getting muddled by counting some children twice. Unprompted, most groups reach the same solution as the statisticians: use the number of children born per woman as a measure of family size.

This then opens the door to some very interesting modelling. Pupils are given the actual birth rates for six different countries. They then use spreadsheets to simulate world population growth on the present average birth rate. They also find out what would happen if the average birth rate changed. For example, how much difference to world population growth would result if each mother had on average one child fewer, or one child more?

It is not only the mathematics that is of interest to the pupils, who are surprised at the extremely rapid growth in world population that is projected. With some guidance from the teacher they can also see that the 'average mother' does not exist, and that the environmental

"I know about the population explosion now and found it very interesting and enjoyable. I found a lot of data on this by using spreadsheets and printing information off the computer for my project."

Year 9 pupils (13 year olds)

"During the initial lesson one pupil was making encouraging connections between population growth and consumption of natural resources.

However, it was also clear that her plan to have lots of children of her own was seen as quite a separate issue, of no concern to anyone but

her own family. By the end of the project, especially after modelling

population growth worldwide with average families of three or four children, she was thinking a lot

more seriously about the number of children she might have."

Mathematics teacher

impact of another birth in a less economically developed country is far less than that of a birth in a more economically developed country. Questions about consumption and global equity are just waiting to be raised.

Some pupils are even ready to connect what they have been studying to choices they might make about their own lives; they see that, in the end, global population statistics rest on many, many individual decisions.

"The population explosion was a good lesson. I found out a lot about what was going on and what I could do about it."

Capable people

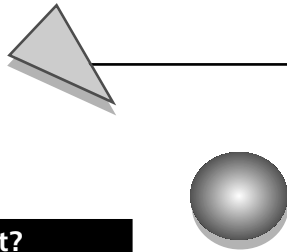
Pupils value highly the mathematics and ICT skills they learn and practise in these projects, and they know society at large does too. They are pleased to be acquiring competencies they will need as self-assured adults. Mathematics has credibility! Because of the contexts in which the skills are used, pupils also gain an insight into the relevance of mathematics and ICT as extremely useful tools for describing, explaining and predicting events in the real world.

But it is not only mathematics and ICT skills that are developed. The format of the projects means that pupils improve their individual research skills, explore ideas through discussion, and co-operate with others. A more open-ended research approach can be adopted to produce a final report.

The projects develop critical thinking too, as pupils come to realise that what is done about the causes and consequences of the events they are studying is then up to people. The survey of their own class builds mathematical models to see the different effects of families having one, two or three children. For some, it may even help them along the road to making better informed choices about their own lives.

For the teachers – from mathematics, ICT and science – developing the projects brought benefits too. Sharing ideas and knowledge with colleagues outside their own departments helped give them a fresh outlook. Amending and improving the projects as they went along encouraged an openness to feedback and constructive criticism.





What's this got to do with Education for Sustainable Development?

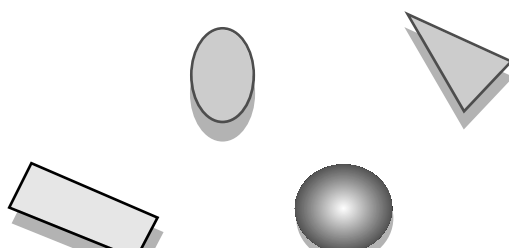
Knowledge and understanding

- globalisation and independence: how pupils' own lives and actions connect with those of others – locally, nationally and globally; past, present and future
- what is involved in different methods of providing for human needs and wants
- how the processes of decision-making work and how to take part in them.

Skills

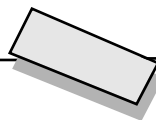
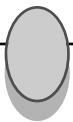
- co-operation and conflict resolution
- critical thinking
- problem solving
- reasoned debate; the ability to argue effectively.

Values and attitudes

- a commitment to the well-being of all living things
 - value and respect for diversity
 - a commitment to social justice and equity
 - empathy and awareness of the points of view of others
 - an understanding of the place of individual and collective rights and responsibilities
 - a belief that, working with others, people can make a difference.
- 

Some National Curriculum learning objectives met by the projects

- Using a spreadsheet to construct formulae to model situations
Mathematics, page 63
- Handling data through practical activities
Mathematics, page 90
- Gathering data from secondary sources, including...
lists from ICT sources
Mathematics, page 99
- Processing and representing data
Mathematics, page 99
- Understanding the importance of mathematics in everyday life,
[including] the environment and development
Mathematics, page 57
- Enabling pupils to develop the knowledge, skills, understanding
and values to participate in decisions about the way we do things
individually and collectively, both locally and globally, that will improve
the quality of life now without damaging the planet for the future
Education for Sustainable Development, page 25
- Accepting responsibility for maintaining a sustainable environment
for future generations
The statement of values, page 197



Where to now?

At Crispin, teachers are convinced that Education for Sustainable Development (ESD) should not be restricted to any one area of the curriculum. The issues it deals with are so wide and so central to the education of the whole person that there is scope for it to be included in any subject area. Coming soon on Crispin's own action plan is a project in modern foreign languages with an Education for Sustainable Development theme.

Developing the mathematics projects has highlighted two important principles:

1. The first is that Education for Sustainable Development does not have to be an add-on that takes time away from the 'real' curriculum of taught subjects. It can actually provide the context for curriculum subjects. In addition, there are many teaching and learning strategies which use ESD-related skills to develop a better grounded understanding of curriculum subjects. In other words, ESD should not be about cramming more in. It should be about doing what schools already do, but differently.
2. The second principle is that pushing at a door that is already open is more likely to get you through! There are times in the rhythms and cycles of school life when the moment is opportune for innovation, for example when a department is already committed to reviewing part of its curriculum. It is colleagues talking about teaching that brings these opportunities to light.

Secondary schools have grappled for a long time with the barriers between departments. Cross-curricular themes have been known to wander no man's land, shunned and homeless. The success of recent national initiatives, however, depends on the acceptance that there are important educational issues like literacy, numeracy and citizenship which can only be tackled effectively across the whole school. For teachers committed to Education for Sustainable Development, this is an opening door.



"Crispin pupils are doing more in this work than anyone else I know, and not in an elitist way. This is down to the teachers and I hope it can be shared with others."

*Environmental education
consultant*



The school and its project

Crispin School is an 11-16 mixed comprehensive with just over 900 children on roll and situated on a very pleasant campus site within five minutes walk of the local town centre. The aim of the school is to raise young people's achievements and aspirations in a safe and caring environment, and high standards are expected from all members of the school community. This case study aims to share the insights of Crispin School as it takes up the challenge of ESD: how one department has tried to provide a real world relevance behind curriculum content; how the school has already succeeded in cross-subject working and whole school approaches to 'green issues', and how they hope to stimulate others elsewhere to take these or other ideas forward.

The themes of Crispin's mathematics projects allow them to link naturally with aspects of geography, science, religious education and PSHE. The structured support they offer learners and teachers alike mean that any maths teacher can use them. Staff at Crispin are keen to share success. For anyone interested in the details of these projects, or for more general information about the work of the Green Committee in the school, their web-site can be accessed at <http://www.crispin.somerset.sch.uk/>





Background

The WWF schools' case studies series describes aspects of work undertaken by schools across the UK, whilst involved in WWF professional, curriculum and institutional development programmes.

In England and Wales, support was originally provided through the Curriculum Management Award Scheme, which aimed to stimulate good practice, demonstrating ways to integrate ESD within the curriculum whilst working towards a whole school policy. This is one way in which WWF helps develop ideas for new teaching and learning approaches – equipping educators and students for thinking about and acting in ways supporting the goals of sustainable development.

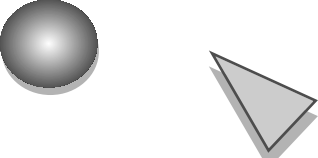
For details of current curriculum development programmes, contact the Education division at the address shown.

Acknowledgements



Written by Monica Allfrey from Crispin School,
Somerset.

Published by WWF-UK, Panda House, Weyside Park,
Godalming, Surrey GU7 1XR.
© WWF-UK, 2001.



WWF-UK registered charity number 1081247
A company limited by guarantee number 4016725
© Panda device 1986 WWF.
® WWF registered trademark owner