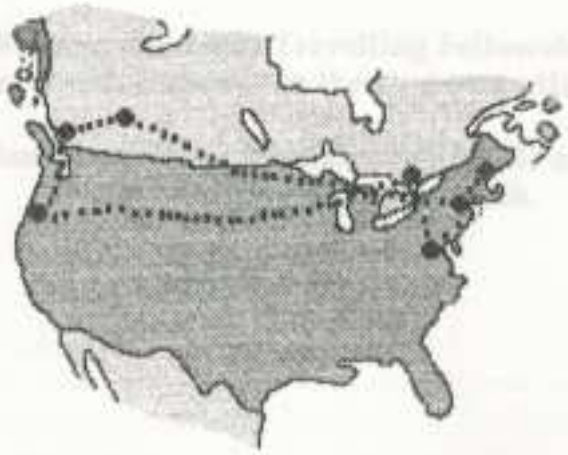


Winston Churchill Travelling Fellowship 1997
Information Technology in the Understanding of Science

Understanding science through multimedia and animation: A student centred approach.

Vivi Lachs

Churchill Fellow 1997

Wolfson Foundation Award Fellow 1997

Winston Churchill Travelling Fellowship 1997
Information Technology in the Understanding of Science

Understanding science through multimedia and animation: A student centred approach.

CONTENTS PAGE

Vivi Lachs can be contacted on 0171 923 4592 or on e-mail vlachs@rmplc.co.uk

Winston Churchill Travelling Fellowship 1997
Information Technology in the Understanding of Science

Understanding science through multimedia and animation:
A student centred approach.

SECTION ONE

The purpose of my Fellowship was to gain a more global perspective on the growing use of IT in science, to share ideas on the practical development of making multimedia programs by children and to find out how software manufacturers are developing their repertoire for multimedia authoring programs in science.

I certainly feel that I have been given a wider perspective. As the US and Canada are so large and varied, I do not feel able to generalise from what I saw, but I saw a variety of different methods to use IT in science and gained new insights in this area. It was a mutually beneficial experience to meet other teachers making multimedia programs with pupils as a way of understanding scientific concepts. As there are not so many people doing this, we were all very keen to keep in touch, keep sharing ideas and possibly collaborating on projects. In terms of software development, most of the interesting ideas I saw were in developing Internet potential, which seems particularly useful to bring back to this country.

I made good e-mail contact before I went and found this extremely useful. I also carried a very small laptop computer with me which had a modem, so that I could be contacted during my travels, although admittedly, this stopped working after the first three weeks. I had been given a complimentary account for three months with America On-Line which meant that I could check my e-mail from other peoples' computers. It is important to point out, however, that in Canada it was difficult to retrieve my e-mail.

I found making contacts to be much easier than anticipated, indeed, while I was there I often got new contacts as a snowball effect. Without exception I was greeted with warmth and hospitality. At times people took a whole day of their time to show me around their school or district, taking me out to lunch and generally treating with the utmost respect.

I found the grant generous and sufficient to cover my needs with ease.

I have already disseminated information through several articles in the Times Educational Supplement. Some of these articles I sent back from the US and they appeared on the weekend of my return in a four page spread entitled "Stateside". These are included as Appendix 2. I have also spoken at professional meetings, in Hackney and beyond my local area, about the trip, and still have further engagements. I have reported back to interested software companies and will be sending them copies of this report.

I would like to thank the Winston Churchill Memorial Foundation for awarding me this Fellowship, and with it, the opportunities to take the time to explore and extend my ideas and to bring back new ones. It was a most enriching experience.

The trip was stimulating and inspiring and also a lot of fun. I saw many places and people but still had time to explore Big Sur in California, the Rockies in Canada and sights in the cities I visited. It is an experience which will stay with me in memory and in impact, and I am very grateful for it. I would particularly like to thank Sir Henry Beverley and the staff of the Churchill Memorial Trust for their good humoured correspondence and support along the way.

I would also like to thank the Wolfson Foundation for selecting me as the Wolfson Foundation Award Fellow for 1997. I feel honoured to have been given this award.

I would like to extend a big thank you to Farquhar McKay of the Hackney Education Business Partnership, Richard Simmons of Dalston City Partnership, Hackney Urban Regeneration Projects and Focus Central London for giving me leave to take up this Fellowship. I particularly thank Geoff Strack, the Hackney Adviser for IT and science who gave me invaluable advice and contacts.

Finally I would like to thank the people I met in the schools and institutions I visited in the US and Canada who welcomed me, took time to show me around, tell me about their work and were extremely hospitable. The photographs of pupils are from Dalton School and I appreciate their agreeing to being photographed.

Winston Churchill Travelling Fellowship 1997
Information Technology in the Understanding of Science

Understanding science through multimedia and animation:
A student centred approach.

SECTION TWO

INTRODUCTION

The aim of this fellowship was to explore how science is learned in the classroom using information technology. In particular seeing the student as creator, presenter or organiser of scientific data and ideas through making multimedia and using the Internet. During the course of my planning, this aim extended to include organisations offering support to classroom science teachers in assisting the pupils to achieve these ends.

In visiting schools, my primary focus was on the science curriculum, although this was occasionally broadened to include scientific aspects of related subjects such as technology, mathematics or geography. IT advisors, co-ordinators and teachers were often keen to show me aspects of IT in their schools without particular relation to science but which contributed to the general atmosphere and ethos of the school and was therefore pertinent to what was going on in the science labs. I considered this important to explore and see, as often the specific ways the computer was being used in science were indicative of a general trend across the school curriculum. In elementary schools the science was sometimes cross curriculum, that is the science was integrated into other subjects.

I visited eight cities in all, New York, Boston Washington DC and San Francisco in the US and Toronto, Vancouver, Victoria and Calgary in Canada. In all these places, besides Calgary I visited a mixture of Elementary, Middle and High schools, educational organisations, museums and software companies. I also met key national and district education officers in both the US and Canada. In Calgary I attended a conference on multimedia and the Internet in education, and gave a poster/demonstration session on work done in Hackney.

I am an advisory teacher for Information Technology working in Hackney, London. I work training teachers and supporting them in the classroom. Much of this work has been developing different areas of the curriculum through pupils making multimedia presentations. A CD ROM entitled **The Moving Picture Science Show** records the science work using animation to present dynamic concepts by 165 pupils in 14 primary and secondary schools in Hackney. I took copies of the CD ROM to give to schools I visited. I was also asked to run a number of staff meetings or "brown bag" meetings for schools and organisations.

I was hoping to find new inspiration for developing current work, and also completely new ideas for further development. As we in Britain are just now getting our schools connected to the Internet, I further thought that we could learn much here from how this has been happening in the US and Canada. This report is not a chronological description of my Fellowship. Appendix 1 gives my itinerary with places and institutions visited. I will rather follow a

thematic approach taking examples from the schools and institutions I visited. I will begin by looking at different aspects of Internet use in the science classroom either as whole projects or as parts of projects. Following on I will describe two projects using video conferencing before I describe organisations that are creating structures to help teachers communicate in developing ideas or data sharing. I will then move on to look at other uses of pupils making multimedia presentations and other technology in science teaching and learning.

During my stay and on my return I wrote a number of articles for the Times Educational Supplement (TES). These give in-depth details of particular places I visited. Rather than duplicate too much of this material in the main section of the report, I give only an outline of these projects and include the articles in full in Appendix 2.

THE INFRASTRUCTURE

"What does connection mean? I think it is that all of a sudden the classroom or the community of learners is different...What if you could go out and collect real scientific data that could be helpfully interpreted and useful to other scientists, and could be connected to other classrooms collecting similar data. We could start to see that this little phenomenon, whether it was trash or acid rain is something we could all be concerned about because we're part of a global environment." Linda Roberts, technology adviser to the US Department of Education in Washington DC
(See *"Setting Out The Superhighway"*, Appendix 2).

Fred carrig, head of academic programming and curriculum in the **Union City district of New jersey** said:
"Any change needs a catalyst to keep it going or it can't be sustained".

The National Science Foundation (NSF) is a governmental organisation which is one of the main funding sources for much of the work I saw. They are forward thinking and imaginative in their funding of new and quite inspiring projects. Barbara Sampson, President and Chief Education Officer of TERC, an organisation dedicated to "Hands-on math and science learning" told me that the NSF *"tries to fund curricula that are leading edge"*

The NSF funded the Union City District to develop on-line projects in their schools. This money went into setting up an infrastructure of wires to connect schools to the Internet and put computers into the homes of pupils of a particular age. This resulted in much research and extra learning and communication out of school hours. It has had far reaching effects. and is a good example of how some schools saw science funding as so connected to technology that it became a cross-curriculum project.
(See *"Downtown leaps to top of the leagues"*, Appendix 2).

INTERNET PROJECTS

"It's going to change the way teachers teach and that's what's important about it" Doug Player, Superintendent and Chief Education Officer of the West Vancouver School District (See *"No more surfing. Now we're mining the Net"*, Appendix 2).

The Internet was used in a number of ways. Some projects were essentially Internet projects, that is, they relied on the World Wide Web for their materials, their research and their communication.

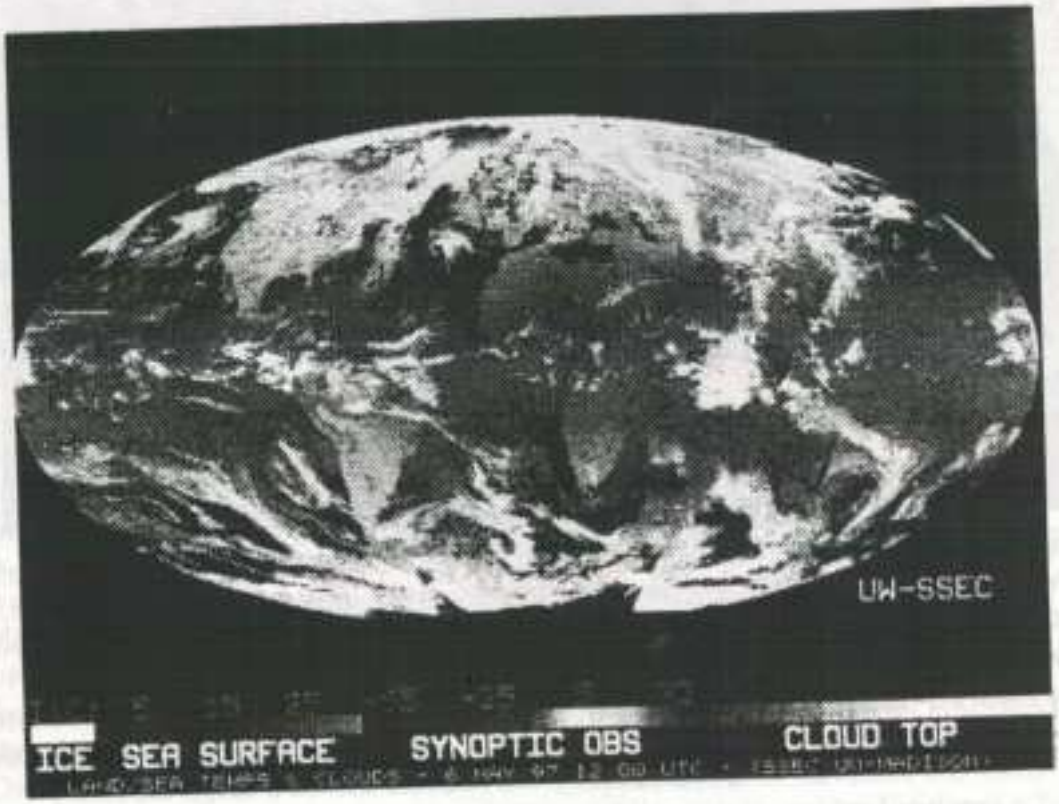
In **Gonzaga High School, Washington DC**, a private Jesuit High School. The school put in a proposal to NASA to make data more accessible over the Internet. In the classroom pupils would make up a hypothesis and then gather data to prove it using visualisation tools to view various stars and galaxies from different angles, able to rotate them and enlarge them. The results were published on the Internet with graphs and descriptions.

Bill Gates' "Road Ahead" programme funded **Alvarado Elementary School, Union City, California** to the tune of $30,000 to establish "Power thinking through science and technology". This has resulted in a science discovery centre, an after school computer academy and staff development.

The science discovery centre is a room with tables at one end and computers at the other. On the computers a group of pupils were visiting the website of the Monterey Aquarium for a virtual trip before they were to have an actual school trip later in the week.
It has a host of other equipment, a link from the computer to a large television screen, and impressively a magnification panel where anything from computer images from the Internet to small artifacts can be shown on a large screen. I watched a teacher looking at a small bone to the class, magnified it and described and identified parts to the class.
Sharon Chambers, Media Specialist of the school confided;
"It's kinda weird, it's all moving faster than we are at the moment" (See App 2)

Montgomery Blair Magnet School for Science and Technology, Maryland is a wonderful example of technology being used across all areas of scientific research, modelling situations and formulating scientific ideas. Satellite images of the Gulf Stream were downloaded from the Web to be used to measure width, radius of curvature and wavelength. The pupils were counting pixels on the image to ascertain the exact measurements, and had been in e-mail contact with the producer of these images to verify the exact pixel size he'd been using. Using real images rather than those reproduced was very motivating for the students who were all engaged and talking with animation about the project.
(See *"Magnetic Maryland"* , Appendix 2)

TERC in Boston is a research institute which uses the Internet as a medium for science teaching and teacher support. One of their projects uses satellite images of the Earth to show cloud cover at different times of day. These are downloaded from the Web every 6 hours and are then animated by 9-13 year olds into a flowing sequence where pupils can see the cloud movement and analyse those images and make predictions. They can see multiple representations from different angles and zoom in or out to change the scale. They may see something unexpected which causes them to try to understand what they have seen. This may be a storm sequence watching the build up and spread or it may be looking at seasonal changes. The pupils can also create a "fly through" which is a 3D virtual reality image. Sue Doubler, researcher at TERC described the notion that you can step back and look at the Earth as "pretty powerful" for these youngsters.
(See *"How do you send a single crisp in the smallest packet possible across the US so that it arrives intact?"*, Appendix 2).



PROJECTS USING THE INTERNET

Other science projects didn't use the Internet as their main source of information, but it was used as a constant encyclopaedia or for data sharing.

Dalton School in New York is a private school on the Upper East side of Manhattan. There is a calm convivial working atmosphere throughout the school. The corridors are colourful with posters and pupils' work. The science laboratories consist of a central area with large tables and computers around the edges of the room. The classes are very relaxed, some pupils working on the computers, some working on experiments at the tables. The computers seemed to be a very well integrated part of the lessons. It is a good model for science labs, although it must be stressed that classes were small and the pupils well motivated.

The school had developed its own software, which was particularly up-to-date as it linked with on-line information sources. For example, there was an open Internet link and pupils could use the software, then go and find information on a database on the Internet, then return to their program and use that data. I was impressed by this software, its ability to motivate the pupils and direct their thinking around problem solving.

I visited an archeology class where pupils were working on a program called archaeotype. This simulated an archeological site where they "dug up" artifacts, and using a set of on-line tools, measured, weighed and recorded them. These artifacts could be rotated and magnified to find small bits of writing or marks, to help the pupil date the artifact, find out what it was used for and eventually guess what the site could be. The pupils used on-line libraries, commercial databases as well as their school library of books to aid their research. This could all be accessed from the same computer, yet pupils collaborated by wandering around the class, checking with each other and going to the school library.

Pershing Intermediate School, Brooklyn has a medical magnet programme called "Health and Wellness". They link with the local Maimonides hospital. They use the Internet for project research and hope to use e-mail to be in contact with similar magnet programmes.

Pupils in **Robert Brent Elementary School, Washington DC** were taking part in the Tulip Project. Different schools had planted tulips in different areas of the world. They were following the tulips' growth and putting the data onto the Internet. They then collected data from other places and could do comparative analysis.

In a similar vein **The Jason Project** in collaboration with the National Geographic set up virtual expeditions for elementary schools to different places such as Florida, Yellowstone National Park or Iceland. The pupils would send data to each other by satellite and communicate by e-mail about what they had found.

GLOBE, Global Lab and CLEO are three projects by **TERC.** GLOBE is motivated by scientists work, where pupils collect data to add to the sample and are then kept in touch with the outcomes. Global Lab allows schools to run collaborative science projects where the data is shared across the Internet. CLEO is a forum for pupils to post up their own science projects to present information or try to find partners to work with. (See article in Appendix 2).

VIDEO CONFERENCING

Together with wiring schools up for Internet access some schools had video conferencing facilities. This is still early days, but I came across some interesting use.

Washington Irving High School, New York is in the heart of the business district in Manhattan. They have a video conferencing suite which they use to teach a joint calculus class with another school in New York. This class is supplemented with e-mailed notes, and assignments.

"I don't know if I'm going to say it's the best thing in the world, but I'm working on it" said Ed Susse, head of technology
(See *"Hitched up to Wall Street"* Appendix 2).

Claremont School, Vancouver Island has a theatre with video conferencing facilities. A science project connected their school and others to divers diving off the Berkeley Sound, off the west coast of Vancouver Island. The pupils sitting in the theatre were watching the divers on a large screen. Other schools across Canada had a similar setup. The pupils asked questions and the divers answered. Pupils had prepared questions, yet when it was one child's turn, a strange fish swum across the screen in front of the diver, and instead of the prepared question the pupil asked, "Isn't that a Hegfish?" They then had a split screen where there was a marine biologist in a studio discussing this with the the diver underwater. The pupils could see the studio, the diver and a close up of the fish and hear the discussions.

TEACHERS ON THE INTERNET

Another use the Internet is as a way for science teachers to communicate with each other to share ideas, data and projects.

TERC has a conference space on the Web called LabNet which allows teachers to run collaborative projects and discuss their methods and ideas. One project looked at how you could send a single Pringles crisp in the smallest package possible across the US so that it arrives intact. The teachers were able to share their worries as well as their excitement about the project. For many, this was the first time they had used the Internet, and the contact with other science teachers proved most fruitful for them in terms of professional support as well as for the pupils in terms of ongoing contact with other pupils and motivation for the scientific measurement involved in the project. (See article in Appendix 2).

Apple Computers of Tomorrow (ACOT), **Cupertino, California** are also keen on offering teacher support and training in integrating computers into curriculum subjects. They have a showcase school where teachers can ask questions and see the practical implications of using computers well.

"It's a sandbox, people make things together. It's messy, but that's where learning happens," said Brian Reilly, Multimedia Ethnographer
(See *"No more surfing. Now we're mining the Net"*, Appendix 2).

Maryland Virtual High School is a wired up community of high schools in Maryland who can run collaborative science projects where pupils make measurements and share data. This is just at the beginning and is currently being used more as a teacher support and communication tool than for pupil projects. This is a positive start. Teachers contact each other through making web pages. (See *"Magnetic Maryland"*. Appendix 2).

Morgan Media on Vancouver Island, British Columbia is a company that is finding interesting ways to get simple, safe and well structured Internet access for both teachers and pupils across the curriculum. The implications for science in "planIT Teacher" are for communication and lesson planning. If a teacher is planning some lessons on earthquakes, they can link to example data, look at this week's earthquakes, see maps and co-ordinates (in longitude and latitude) and map it out. They can then download this and use it as a lesson plan.

Internet use in schools is not without problems. One school I went to was all wired up but doing very unimaginative work on the Internet, which I felt could have been done better in other ways. However, these things take a while to settle. In another school, the head of science told me, *"The Earth science room does in fact have five computers all wired up, but they have trouble going on-line"*.

IN-CLASS COMPUTER USE

"Students using professional-level materials in a discovery format, develop a feeling of kinship with the scientific community", said Malcolm Thompson, head of science at **Dalton School, New York**

The school has developed its own science software which is very impressive. In chemistry, I saw a program that looked at the effect of pressure, temperature and volume on a number of gases. The pupils would choose the gas to work on and alter the pressure and temperature gauges to see what effect this would have on the gas. I was assured that this software was not used instead of laboratory work. Some lab work could be done, but the more dangerous gases were explored through computer simulations.

In an astronomy class pupils were working on project Galileo. The pupils are working on "real astronomy" using software showing sky simulations where pupils can view the universe, stars, galaxies and find out information. The images are mainly from NASA. The course is designed as a series of inquiries that the pupils answer by using this software.

River-Oaks Elementary School, Toronto is very technology rich. There are no computer labs but each subject area has a number of computers all connected up to the Internet. They work an integrated system, so projects may include science, technology, art, English and mathematics. An example was groups had to market a product. They needed to understand how the product would work (science, Internet, questions to scientists), build it (technology), scale it (mathematics, spreadsheets), draw it (Art/computer assisted drawing), write a business letter (English, wordprocessing), and finally write it up as a report (multimedia authoring).

The Exploratorium, San Francisco is a hands-on museum of science. Many of the exhibits contained computer-based scientific ideas. Here are some examples.

1. DNA code put into musical notes. Parts of the DNA where the coding was important had melodic music. Other parts had chaotic sounding music. There was a visual representation of this on the screen.
2. Pick a molecule and rotate it, examining it from different angles.
3. Seeing time either slower or faster, slowing down a butterfly flying or speeding up a flower opening.
4. Changing and mixing colours to make other colours.

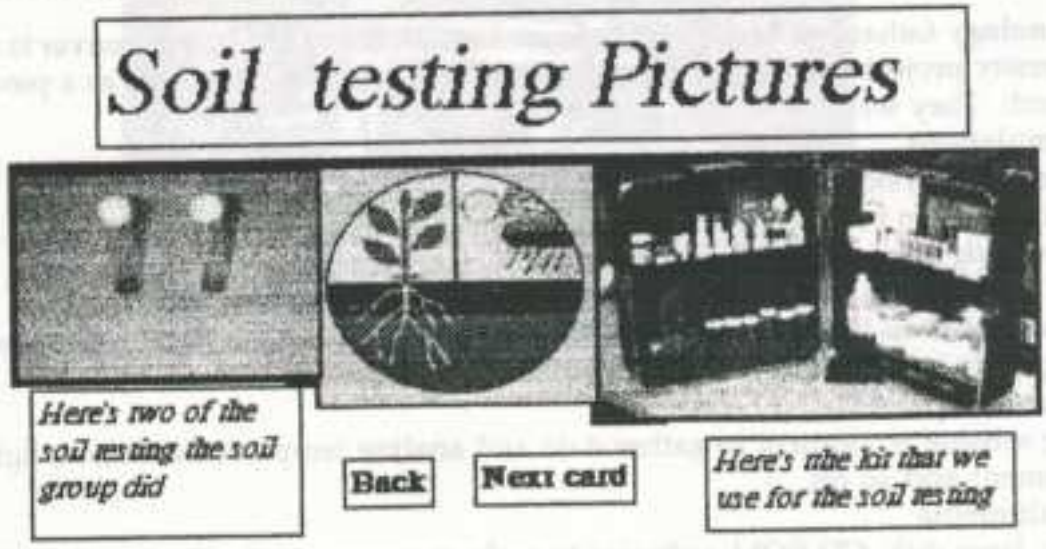
The education workers at the Exploratorium work in classrooms with teachers helping them design and make similar computer models to those in the museum. They also write books of lesson plans to help teachers use this information well.

PUPILS MAKING MULTIMEDIA

I was particularly interested in seeing pupils who had developed multimedia presentations (non-linear representations using text, graphics, sound, animations or photographs) on scientific concepts. These contacts proved particularly special, as much of their work complimented the work I do in Hackney. This work was not happening everywhere, in fact the teachers felt as if they working in a vacuum. This gave me the added opportunity to share this information amongst those teachers.

In **Robert Brent Elementary School, Washington DC** pupils were working on a project called "Inventions and Innovation". They researched from the on-line Smithsonian and visited the museum with e-mate portable computers. While at the museum, they sat with their portables and sketched artifacts they were interested in and wrote information and their comments which would then be edited in class. The pupils contacted scientists and specialists with questions and were working on a report of the project in a multimedia format which would include their sketches, their ideas and even their voice-over explanations.

Davidson Middle school, Marin County, California ran the Creek Project. This was led by James Gonzalez, an ex-science teacher and freelance advisory teacher. The project looked at a polluted creek that surrounds part of the school. The class were split into teams exploring different aspects of the creek such as plant life, insects, water, soil. One group worked on mapping the area and another on creating a multimedia representation of the data. They worked in a large double classroom science lab with sinks and surfaces around the edges but dominated by huge oversize tables with 12 computers and lots of space. Some groups were outside wading in the creek collecting data, others were inside rinsing out test tubes, some were attempting to classify data they'd found and others were putting information onto the computers. Therese Hopkins, one of the teachers said that pupils often needed help, they'd not be able to find what they wanted on the Internet. She said that the nature of the project meant that the pupils needed to motivate themselves and think of questions to explore. The kids particularly enjoyed the technical parts of the program and even came in on a Sunday, *"I think the best part is that over time the kids really take ownership of it"*, she said.



C-Tec, Environment Technology school within Piner High School, was developed by James Gonzalez. Each year, two weeks before Christmas, the curriculum is suspended for 200 15 and 16 year old pupils to focus on a science project. Last year they looked at the local waterways and followed the routes of the drains to the local creek to river to ocean. The pupils designed a game where the aim was to clean up the creek so that the river is less polluted and the birds can sing. They asked questions such as, how are you going to wash your car, in the car wash or by hand? The carwash was more self contained and so bumped your score up, but handwashing sending soap down the drains was a thumbs down. This year pupils worked on a simulated trip to Mars. They looked at what kind of society they wanted to build on Mars focusing on government, laws, housing and the environment as well as other issues such as birth control. The two rules the pupils were given were that they had to be consistent in their ideas which meant good communication to find out what different ministries were planning, and that the science had to be reasonable, not science fiction. Internet access was vital, finding information from NASA on spacesuit design and details on how to develop Hydrogen fuel cells by mining the ice caps.

In the technology department of **Davidson Middle school** Fredda Caplan, the technology teacher was working with the Social Studies teacher to develop the pupils' own multimedia research projects around topical issues. Three that I saw had science content. **Cloning: Fact or Fiction** used material and pictures from the Internet to inform users (in this case the rest of his class) on different aspects of the Dolly cloning story that had recently been in the news. It also included their own views. One pupil who had severe dyslexia and was about to drop out of school, made a piece on the Monterey aquarium that went on to win a competition. Manuel, age 13 with very little English showed me his project on Jupiter, *"I went to the Internet and books and the teacher got me a newspaper- because it's a really big planet and there's lots of things about it"*. As he spoke he went to the world wide web and found a picture of one of Jupiter's moons. It was a two minute job to cut and paste it into his work.

UNIVERSITY RESEARCH INTO USING TECHNOLOGY IN SCIENCE TEACHING

Technology Enhanced Secondary Science Instruction (TESSI), Vancouver is a university project that puts computers into some school science labs as a piece of research. They were looking at four areas.

1. Simulations.

Interactive Physics. Programs that simulated different concepts. These simulations can be changed by the teacher rather than CD ROMs that are set.
"I don't like pre-built things, and my teachers agree, it's too restrictive, They wasn't to get into it and make it their own." Janice Woodrow, project head
An example was two girls changing the mass, velocity, angle, wind resistance and gravity to maximise projectiles.

2. Microcomputer Based Labs

Using sensing equipment to gather data and analyse temperature, sound, light, movement and so on.

3. Multimedia

Video, laser disk, CD ROM, software to scale, measure, recolour images in 3D.

An example is using animated sequences on video. The pupils put a film of acetate over the monitor and use a protractor to measure the angle on the screen and draw dots onto the acetate to compare projectories. They then remove the acetate and use it off the computer. They repeat this several times.
4. Assessment.
Computerised testing with immediate feedback.

The research had control groups without computers. The performance of students in the government exams was not significantly altered but twice as many students chose to continue physics and a large number of these were girls.

"One thing we find with this approach is the students are continually talking to each other and we think that's an advantage. The room is never quiet and most of it is on-task." Janice Woodrow

Massachusetts' Institute of Technology (MIT) is the home of LOGO, developed by Seymour Papert in the sixties creating a programmable language to move lego robots and draw screen pictures. I met Rick Borovoy, a researcher there who is developing the use of "crickets". Crickets are small programmable boxes that communicate with each other through infra red. They are set up as "communities" where one cricket is programmed to respond to another. This results in music playing dancing little lego widgets, amusing, and hopefully motivating for pupils.
"There's powerful ideas in lots of different objects... beads, cars, crickets" Rick Borovoy ascertained, *"To me, it's about using technology to think about learning. It's a medium for thinking"*

The beads were on a chain where each is individually programmed to have a light going on and off at different signals. The aim is to program the beads so that the light will move up and down the chain. When that is achieved, the pupils can explore different patterns with the lights.

CONCLUSION

Here in Britain we have had computers in our schools for a number of years, but are only just beginning to organise Internet access which is national and dovetailed into the National Curriculum rather than restricted to a few schools. From Union City, New Jersey and the comments from Linda Roberts and Doug Player, it seems to me that the infrastructure being built is much more successful on a district or national level than individual schools. It brings the opportunities for good communication, which will then develop exciting scientific resources from national institutions, museums, government departments or research institutes. It will also bring the world closer and give much scope for collaborative projects that involve sharing data. It is useful for us here that we can join in with some US projects and don't need to keep reinventing. It will also give us connections for data sharing in other climate zones.

The Internet has changed science teaching radically. Rather than it being confined to the lab, it is now shared across the world, and indeed, using images from across the galaxy. This, coupled with the ability to have contact with working scientists, shows that classroom science is a world issue. Pupils are doing "real" science.

The multimedia I saw showed science in another light. It expressed scientific work as creative and imaginative, which makes the boundaries between art and science less rigid.

Practically, it was useful to see that we are often struggling with similar problems. The most effective multimedia work I saw was where there was either a freelance teacher or a technology teacher working on a project alongside the science teachers. If this is indeed the case, and we do want to make computer use cross-curricular, maybe we require extra funding for schools to have an additional floating teacher to support technology, not as a discrete subject but across the curriculum.

Finally, I am very appreciative of the opportunity I have had to develop my ideas and make so many interesting contacts. This experience will be shared in Britain, and I hope that it will benefit my pupils by maintaining those contacts through collaborative work, showing pupils in London that technologically, the world is a smaller place.

Appendix 1
Itinerary May 1st- June 29th

Most visits took either a day or half a day. In some schools I had direct contacts. In others my contacts from organisations or universities took me to the schools.

May 1st-8th New York
Media Workshop, Melissa Philips
Education Development Centre for Children and Technology, Margaret Honey
Union City District, New Jersey, Fred Carrig
Dalton School, Teresa Gonzalez
Washington Irving High School, Ed Susse

May 9th-14th Boston
Computer Museum
Computer Clubhouse, Stina Cooke
Massachussetts Institute of Technology, Media Lab, Rick Borovoy
TERC, Barbara Sampson
Hastings Elementary School, Lexington, Nancy Gardner

May 15th-21st Washington DC
Carnegie Institute of washington, Ines Lucia Cifuentes
Gonzaga High School
George Mason University, Debra Sprague
Deer Park Elementary School, Diane Painter
Montgomery Blair Magnet School, High School and Maryland Virtual High School, Mary-Ellen verona
Robert Brent Elementary School
Linda Roberts, Technology Adviser to the US Department of Education
The National Foundation for the Improvement of Education, Marylin Schlief

May 22nd-25th Toronto
River-Oaks Elementary School, Brian Alger

May 26th-June 6th San Francisco
Digiquest Learning Centre, James Gonzalez
Davidson Middle School, Fredda Kaplan
The Exploratorium, Linda Shore
San Francisco State University, Rita Yee
Portal Elementary School, Cupertino, Elaine Lowe
Apple Computers of Tomorrow, Ted Olsson
Bryant Elementary School, Virginia Davis
Alvarado School, Liz Jordan

June 7th-15th Victoria and Vancouver
The University of British Columbia, Janice Woodrow
Ecole Pauline Johnson, Cynthia River
Apple Canada, Al McTavish

Rockridge Middle School, Maureen Smiley
Doug Player, Superintendent and Chief Education Officer of the West Vancouver School District 45
TechTots, Dave Allan
Morgan Media, Gerry Morgan
Claremont Secondary School, John Pringle
Braefoot Elementary School, Mervyn Campbell

June 16th-19th Calgary
Ed-Media Conference

June 20th-23rd The Rockies

June 24th-29th New York
Salvadori Educational Centre on the Built Environment, Lorraine Whitman
Pershing Intermediate School

Appendix 2
Times Educational Supplement Articles

These articles are more general than my specific Fellowship brief of information technology in science. My hosts were often eager to show me technology in other areas of the curriculum in their schools and districts. This often had a science input, but I am also enclosing those articles which have a more technological than scientific slant, as I do feel this played an important part in my Fellowship.

Downtown leaps to top of the leagues
Union City District, New Jersey

How do you send a single crisp in the smallest packet possible across the US so that it arrives intact?
TERC, Boston

Setting out the superhighway
Linda Roberts, Washington DC

Hitched up to Wall Street
Washington Irving High School, New York

Magnetic Maryland
Montgomery Blair High School, Maryland
Montgomery Blair Magnet School for Math, Science and Technology, Maryland
Maryland Virtual High School, Maryland

No more surfing, Now we're mining the Net
Doug Player, West Vancouver
Claremont High School, John Pringle
Apple Classrooms of Tomorrow, Cupertino, California
Portal Elementary School, Cupertino, California
Alvarado Elementary School, Union City, California
Ecole Pauline Johnson, Vancouver

Click into place
Techtots, Victoria, Vancouver Island, British Columbia

Downtown leaps to top of the leagues

A learning revolution is taking place in New Jersey where IT is putting pupils at the centre of the process. **Vivi Lachs** reports

The buzzword in the States is constructivism, the idea of putting children at the centre of their own learning, making decisions about what they're learning and when they're ready to move on. Learning through doing, that is actively constructing their learning medium.

Fred is keen that the students run workshops for teachers. 'They are so patient, and staff are willing to learn from them'

Across the Hudson: Schools in Union City, New Jersey, went from bottom scores in the national tests to ...

tional average in two years

HI-TECH USA

Val Lucks is a consultant to multimedia working with schools in Hackney, London. She is visiting the United States and Canada on a Winston Churchill Fellowship looking at information technology in the understanding of science. On these and the following two pages, she reports on developments from the other side of the Atlantic.

How do you send a single crisp in the smallest packet possible across the US so that it arrives intact?

As more UK schools are signing up and wiring up to the internet, it is a good time to look at what projects coming out of on-line education in America. TERC is an education research and development centre based in Boston, Massachusetts, whose mission is to improve science and maths learning and technology or, as Barbara Simpson, the chief education officer at TERC, says it engages "creative thinkers who want to devolve their professional energies to those who want change in schools".

So what's new and what's working in collaborative science across the wires? The Boston centre is full of projects aimed at getting children thinking scientifically and collaborating, and at making teachers less isolated by setting up structures for communicating. The best place to start is with the Pringles Challenge.

The Pringles Challenge was a science project, for which students sent a single Pringles crisp across America in the smallest package possible that can arrive with the crisp still intact. It was aiming to look at the relationships between mass and volume. The pupils tested their crisps before sending them, and measured and marked the "fatnesses" of the crisps they received. One teacher e-mailed another: "After days of testing for durability and impact resistance, we sent our package ... our Pringle has yet to arrive in Mississippi ... it seems to have some very real applications to physics and the world of business."

This was part of an on going discussion between the physics teachers of 13-year-old students. They were discussing this over the Internet in a set-up called Labnet. This provides a framework in which science and maths teachers can communicate about projects they want to set up with students and collaborate with other classes.

For example, one teacher wrote to Labnet, "I'd like to do a project on sand." Other teachers responded and, between them, they fleshed out a project. Another teacher in California ran a project on making propeller-driven cars, where 90 per cent of the mass was paper. Through the e-mail collaboration new ideas were added: the chemistry of paper, polymers and glues. The projects themselves don't necessarily use technology, but Labnet provided the opportunity for the teachers to discuss and build projects. "Teachers are afraid to share ideas," says Deborah Muscella, a TERC researcher. "We need to become informed about what goes on in each other's classes. It takes a lot of work to get teachers to expose in that way."

Although the final work can be put on the Web, Labnet is basically a teachers' communication tool. Global Lab is a project that aims to share data collected by students across the world. The class will choose a study site to work on and collect data on the temperature, humidity, acidity of the air/soil/water. They feed this into a database set up by Global Lab and can access data from around the world, where students in different countries have input data in the same categories. Hence answers can be forthcoming to those hypotheses, such as how soil in Birmingham, England, differs from soil in Birmingham, Alabama. "We've got schools from every continent except Antarctica," says project co-ordinator Leigh Peake.

Another project, Globe, also has pupils from across the world collecting data. However, in this project the data is used by scientists. While in Global Lab the pupils formulate some of the hypotheses, here it is scientists asking the questions and pupils collecting data daily. The pupils see the results of the data collection in its real application, so may be able to feel a part of a real-life experiment not just class work.

Clee is an authoring program that lets pupils put their work or projects straight on to the Web without having to transfer it from another program. One pupil has a project on "Which rail works best?" Charlie Hutchinson, one of the developers, said putting pupils' work on the Net can inspire others, and the data can be shared and re-used. He wants pupils to look at the data and say, "I can do better", or "Let's look at these numbers and see what we can make of them."

Finally, a project in the making is one called Using Satellite Images. Images of the Earth from space are taken every few hours showing cloud cover. These are then animated to show cloud movement over a day or two. Pupils can then

'Teachers are afraid to share their ideas. We need to become informed about what goes on in each other's class'

interpret this data. An added extra is that these images are available from the project's Web site, so the pupils can themselves do the downloading and animating.

All these projects are open to UK schools.

Val Lucks

All of these projects can be accessed through the TERC homepage on http://www.terc.edu

She's responsible for easing the Internet into every classroom in the United States. Linda Roberts talks to **Vivi Lachs**

Setting out the superhighway

HI-TECH USA

Linda Roberts (left) smiles at her picture above her computer. It's a photograph of herself and Oscar the Grouch from *Sesame Street*. "My first foray into technology was to help think about the role of television, helping young children learn and be ready for school," she says. "In this town, if you start to know anything you become an instant expert, so I've been an expert ever since."

Dr Roberts has been the technology adviser in the US Department of Education in Washington DC for the past four years of the Clinton administration. Her job is to work closely with the President's and Vice President's advisers to develop a strategy for the nation on technology in schools. "The timing is right," she says, "the technology is there, the capability is there, we're building an infrastructure . . . more pieces of the puzzle are starting to come together."

The puzzle she is referring to is in four parts. She wants teachers trained to use technology, schools renovated with modern computers, schools connected to the Internet, and good — including on-line — software. She is confident a number of schools are already achieving these goals but says, "The real challenge is to build out from these innovative examples and create the kind of exciting learning opportunities not just in demonstration schools but in every school." This, Roberts agrees, is harder to do.

She cites the feedback that she gets in letters from teachers who want to use the technology in their schools but are crying out for extra time, release time, planning time, time with experts and peer mentoring. Sounds familiar?

They need the computers in their classrooms, not in labs they have to book. Roberts sees the next 10 years as an incredible opportunity to change this situation, as a massive infusion of new teachers is forecast. Of the three million US teachers, two million will be replaced within this 10-year span. "Teacher education programmes are going to be critical in giving teachers the skills and knowledge they need," she says.

On the one hand, some institutions are still not teaching computer use, although some schools are starting to say that they won't hire a teacher if they don't have these skills. On the other hand at least 17 states now won't certify a teacher if they don't have these skills. Roberts is optimistic: "Between new certification and learning IT skills, new teachers will be technology literate at the very least, and ready to teach in the 21st century."

Roberts is dedicated to making the technology accessible. In 1994, 35 per cent of schools had Internet access; in 1996 this figure had risen to 65 per cent. However, most of these connections are in resource areas and only 14 per cent of classrooms are connected. To be properly effective the computers must be connected to the Internet in classrooms.

Roberts gives the example of a history lesson where high school students who have never been to Washington DC, can track legislation through Congress on its Web site. "You hear people talking about wanting to be 'connected', but what does connection mean? I think it is that, all of a sudden, the classroom or the community of learners is different . . . What if you could go out and collect real scientific data that could be helpfully interpreted and useful to other scientists, and could be connected to other classrooms collecting similar data? We could start to see this little phenomenon — whether it was toxin or acid rain — is something we could all be concerned about because we're part of a global environment."

Roberts also describes a project called the Alphabet Highway, in which students' poems and compositions are put up on the Internet after meeting specific criteria for standards and quality in writing. "On the Web they are doing something the rest of the world might be interested in and that's a very powerful idea."

Roberts feels more research is needed, and evaluation to see what's working "because right now it's very ad hoc . . . do kids end up doing more writing and reading because they're on-line? I have a suspicion that they do — that certainly came out in Union City (see page 22).

"Our strength in America is our diversity. It's also our weakness. It means there's no assessment of educational efforts. We love experimenting; however, there are some very tried and tested things, and we should never give up on those fundamental skills. In the course of experimenting, we'd better be sure we're benefiting kids, not hurting them."

It is thought that, by next year, 28 per cent of classrooms will be connected and that, by the year 2000, 95 per cent of schools will have at least one general connection (Bill Clinton and Al Gore's stated objective is to wire up every classroom by 2000). Connection has been helped by the Telecommunications Act of 1996. The Act was seen as an opportunity for infrastructure provision, so that cost would not be the barrier for every school and library in the US to get on-line. There is already "Universal Service" on telephones so, broadly speaking, everyone in the US will have a phone, and this Act expanded the definition of a universal service to include schools and libraries joining the information age. It basically meant that, if not all, then 90 per cent of the cost of connection would be subsidised. But schools still faced some expense — computers, cabling and the laying of cables around the school buildings. That's where NetDays came in.

The idea behind a NetDay is . . . over the course of one Saturday, a school will get connected and teachers to use the Internet in the library or classroom. It means an army of volunteers from the community — parents, teachers, businesses, students — spending the day drilling holes and pulling wires, and making sure that the cables are all in place to have the final electrical connections made. Schools have to nominate at least five connection sites, including the library, and the cables are run along the ceiling, down walls, through walls and through doorways to these sites to be connected. To plan the project, people from industry met with the President and Vice President, who put their support behind it; additionally, first Sunday agreed to launch it and help pull the first wires.

"Where it worked," Roberts enthuses, "it was amazing, and by the end of the day the kids were on-line." In Massachusetts the education leaders and the business high-tech companies spent a year planning, identifying resources, encouraging businesses to donate cables and time, signing up volunteers, getting the list of schools and so forth. On one Saturday in April, 400 schools in the state had a NetDay. In a single day, the 400 schools were wired up. "It didn't work everywhere," says Roberts. "There wasn't necessarily this industry leadership in every community." However, NetDay across the US has seen 40,000 schools wired up, with 500,000 volunteers.

It is important to see some of the success in this process, Roberts points out. companies: "Bell Atlantic telephone company has been so active in getting sch

In 1994, 35% of US schools had Internet access; two years lat it was 65%. Most connections were in resource areas; only 14% of classrooms a connected

connected . . . what's very encouragi me is the combination of NetDays investment at the state and local level."

And the future? "We could go in di ent directions," Roberts muses, "Con odesy, globalisation of education leads to everyone's standards being ered. I can't see that happening. Th interactive communication. The m it's interactive it means that you're a and a producer. I'm as much a part Web as I want to be. I want higher l of literacy and opportunities for peop be learners for the rest of their lives."

Hitched up to Wall Street

At Washington Irving High School in New York's financial district, they're taking advantage of the local fibre-optic jungle to build a futuristic communications system. **Vivi Lachs** reports

I entered the large brick building and was brusquely asked for my ID by the uniformed security guard behind a desk. To my right young people were filing in, putting their bags through a scanner and walking through a metal detector. My security guard, walkie-talkie strapped to her belt, took me to the fifth floor (of nine) as that was the area she patrolled each day.

You would be forgiven for thinking that this is a centre for juvenile offenders. This is Washington Irving High School in the centre of Manhattan's business district in New York and pretty standard for the area.

The school, which covers grades 9 to 12 (14 to 18-year-olds), has 2,700 pupils from 80 to 90 different countries speaking 40 or so languages. The majority at present are Dominicans, but the dominant immigrant group seems to change every five years or so because of population movement. The school had a new principal five years ago which brought more stability. He turned the school into "houses" or mini schools of 450 pupils in an attempt to make it more personal.

I was greeted by the warm and affable IT co-ordinator, Ed Sasse, who sat in his office surrounded by new computers on desks, obsolete computers in piles on the floor and a multitude of cardboard boxes.

He sighed as I entered, telling me that the distance-learning system I had come to see had been down for the last three days. "No one thinks twice," he said. "We may not be as critical as a bank, but we have to convince them that school systems are important."

The distance-learning system is a fully equipped room of video conferencing equipment. It was financed by a local telecommunications company that invested $500,000 (£311,000) in the school, creating this room and a cable infrastructure to provide Internet access. Washington Irving is a "title one" school, which means that 60-70 per cent of the students' families are below the poverty level. It was chosen because of its location, as Ed Sasse says, "because we were near the fibre, we became part of this fibre network".

The room consists of three video cameras and microphones. The students sit at two rows of desks with a teacher's lecture desk at the front. This desk controls the cameras that are filming the teacher and students and the views displayed on the large television screens both in front and behind the students. These screens show the link-up class. The system is connected to four other high schools, one junior college and the Lincoln Centre which is a centre for the arts in the Upper West side of Manhattan.

And what do they do with this pricey new system? A number of projects. One is a conversational Spanish class between three schools, using their cultural similarity as an impetus. They run another class in critical thinking, looking at cultural differences between the schools. These projects both seem to use the technology for making links across areas that may not have that connection otherwise. The other school may only be on the other side of New York, but for most inner-city kids that is a large distance for students who may have never left their own area.

HI-TECH USA

Their third project is a grade 12 calculus class which is run at Washington Irving. One of the other schools has too small a class to run, so they join in with the Washington Irving class over satellite. They have had the state controller of the area visiting over the wires. Their final project has been with a school in Mississippi making a newspaper.

All these projects are still in their early days, so Ed Sasse is enthusiastic — with qualifications. He feels that the projects are beginning but they need supplementing with electronic mail contact to flesh them out. "I don't know if I'm going to say it's the best thing in the world, but I'm working on it."

Ed can't talk about the distance-learning projects without integrating them with the Internet projects run at the school. The school has networked five or six rooms, which can be used by different curriculum areas. There are also some rooms with two or three computers linked up to the Internet.

For now, it only covers about half the school as the funding ran out, but Ed is completely sold on the usefulness of the Internet. "When a kid's given a research topic by a teacher, the Internet's the first place they go. Encyclopedias are a dead-end because the subjects are current issues like AIDS or drugs." The Internet, he argues, gives up-to-date information. He refers again to the critical thinking classes, saying that what the students need to learn is the ability to distinguish what information is true and what is important. He also says that he has seen a difference in use vis a vis girls. "It's the first computer application that doesn't have a sexual bias. The girls are as interested as the boys."

And where to from here? Ed is keen to get pupils publishing on the Internet on subjects that concern them, such as a home page on teens and violence ... He suggests that this would be very motivating for them to get it right. "I'd say to them, 'Hey, if you make a spelling mistake, a million people will see it.' "

The second area for movement is professional development. Teachers need convincing that they don't need to be experts to use the Internet; they can let the students be the experts. The attitude has already changed with the excitement of the new technology. "I don't have to beg them like I used to," Ed laughs. "When I came, teachers were teaching keyboarding. I convinced them to teach keyboarding within word-processing and now I'm convincing them to use word-processing and the Internet within the curriculum." Communication has moved on, he maintains. "It isn't so much about writing anymore, but about putting together a whole presentation."

Ed Sasse is a science teacher who feels he became computer co-ordinator by accident. "I was the first guy who walked in and asked where the computer room was, so they made me the computer co-ordinator."

And he has effected changes. Most teachers still teach traditionally with desks in rows. "I think architecture affects education," he says. He rearranged rooms so that computers were facing the walls or other computers rather than the teacher. He is carpeting some rooms to make them places where pupils really want to go. "Come back in six months," he tells me as we shake hands. "You won't recognise it."

Modern way to do time

Once upon a time prisoners were sentenced to sewing mailbags or breaking rocks. But in modern California, the state has found a new task for the inmates of its penal institutions — they are repairing and refurbishing computers donated by business and industry for use in schools.

Californian schools average 39 students to every computer with a hard drive — a worse ratio than the UK's. Now California aims to rise from fiftieth to first place in the national pupil-to-computer ranking under a scheme that uses hardware recycled from business and the aid of prisoners.

The Computers for Schools scheme is the first to address both lack of funds in education and wider social issues that would otherwise require hundreds of millions of dollars in government cash. Run by a private, non-profit organisation, the Detwiler Foundation, the scheme was started in 1991 and aims to flood Californian schools with a million computers by the year 2000.

Each participating school has an action plan to get working computers and peripheral goods from businesses with fewer than 100 employees. The foundation matches each donation with a refurbished IBM-compatible 386 or faster from one of the growing number of big companies in the scheme. Each machine comes with licensed software, and includes a word-processor, banner-maker, and other classroom applications. The cost to solicit, process, and place each computer is just $20 (£12). The reason it is so cheap is because jail inmates refurbish the machines.

As well as helping schools, the scheme trains prisoners for a long-term career after their sentence is completed. Aware of official projections that say equipment repair will be the fastest-growing employment field in the next 20 years, the California Youth Authority and the California Department of Corrections have implemented computer-repair training schemes to provide offenders with an opportunity to learn a worthwhile trade by having them recondition computers for schools; it is operating successfully in at least one women's prison. A further 27 community colleges, high schools and adult vocational classes also act as repair centres.

Despite California's strong economy — and the fact that more students than in any other state will eventually enter hi-tech companies — most computers in the state's primary schools are older than the students and less than half the computers in use in schools have hard drives. Most high schools still teach keyboard skills on typewriters.

But the scheme appears to be giving schools realistic hope that limited funds don't preclude technology. More than 27,000 computers have been placed and many observers think the scheme could become the model for the rest of the country.

Mark Sealey

In a suburb of Washington, DC, there's a school. Well, three schools actually. And one of them isn't really there. Vivi Ladas explains

Magnetic Maryland

Montgomery Blair High School in Maryland, a suburb of Washington, DC, is really three schools in one. It is a "magnet" school for maths, science and technology; it is part of the Maryland Virtual High School; and it is a mixed public (state) secondary school.

The magnet programme involves 400 of the school's 2,400 pupils taking specialised courses in maths, science and technology. The other 2,000 pupils come to the school because it's in their catchment area, but the magnet pupils come from all over Montgomery county. They are chosen on teacher recommendation and school grades. As one of their magnet teachers says, "They range from bright to very bright."

These teachers teach only the magnet programme, not in the main school. This causes some bad feeling among many of the high-school teachers who feel other pupils are being denied access to equipment and expertise. The "regular" pupils are mixed culturally, including African Americans, Hispanics and Asian Americans. This mix is not reflected in the magnet classes. One teacher explains apologetically that the magnet programme was set up at Blair to stop middle-class families from moving out of the area.

The magnet technology classrooms are packed with computers. I observed a programming class for 16-year-olds and, when bold enough to ask a pupil what he was doing, the reply was incomprehensible, as was the jumble of words on the screen, but he seemed to speak fluently and knowledgeably about why he preferred the Rs programming language (named after Perl – and how he was looking forward to using Java. "Is it hard to understand?" I asked to bemused negative response.

Other pupils had been designing a computer game, which they saw as having vocational relevance. One demonstrated his game, which involved plotting the trajectory of a rocket that "blows" their pupil couldn't demonstrate his because it used a special piece of video software on his home computer. About 80 per cent of these students have PCs at home.

Class division: many teachers in the US feel their pupils are being denied access to equipment and expertise

In the science part of the programme, computers are used as a tool to develop scientific ideas. After coming up with an idea for a new product, they search through the University of Maryland's (or the Internet's) vast patents for the Internet to find anything similar. They then show their idea to the group using *PowerPoint* presentation software.

Teacher Sarah Clement says she doesn't use IT much in Earth sciences, and then shows me satellite images of the Gulf Stream downloaded from the World Wide Web. The pupils use these to compare and contrast wavelength. Sarah Clement's emails the producers of the images – who has agreed to visit the school to talk to the pupils – to verify their point size.

On special days the magnet and regular teachers work together. When the magnet school was being wired for the Internet, none of the regular school labs, offices and classrooms were hooked up at the same time. It was seen as more important that teachers used it before the students, so the offices were first priority.

The Maryland Virtual High School, partly funded by the government-sponsored National Science Foundation, was started three years ago with the aim of getting schools on-line. As well as Montgomery Blair, nine other schools are involved.

The director of the project is a Blair teacher, Mary Ellen Verona, who runs an array of projects on subjects such as testing the boiling point of water, measuring the length of shadows during the spring equinox, testing stream data from a lake equipped with sensors, and monitoring pollution in a stream. Teachers put forward their own projects and then collaborate on them.

One anatomy teacher uses a digital camera to take pictures of cells for it dissecting and puts the images on the Web. He is working with the Virtual High School systems manager to construct a space below the images where pupils can discuss their work on-line, and even draw over the image to illustrate their points.

At the moment the main activity at Virtual High involves teachers setting up Web pages and communicating. Verona is disappointed that pupils are not yet using the facilities effectively.

At the regular high school, I asked the media specialist how much IT was being integrated into the school curriculum. She replied, "I don't see it a lot of that yet. We try to incorporate the Internet, but we don't really know what's there yet."

Dave Birkes, head of science, argues that nothing will change until computers are installed in classrooms. "Most teachers don't go out with their pupils to labs to a computer room." The Earth science room does in fact have five computers, all wired up, but they have trouble getting on-line. The school is going to be moving to a new building in two years, and the idea is that there will be a whole infrastructure of wires, and a changeover from 45-minute lessons to 90-minute lessons.

So, these schools in one on the same site. The Internet is bringing schools down

Vivi Ladas is a consultant in multimedia who is touring North America on a Churchill scholarship to look at technology in schools. Her other travels across the US can be followed in the Computers Update

Living in the past, present and future

"No place affords a more striking conviction of the vanity of human hopes than a public library," Hail IT supplier BMI's Internet for Learning service shared Samuel Johnson's despondency. In Living Library would have been visitors. As it is, the beauty is that is alive, kicking and now on offer to schools, writes Hugh Jolly.

Living Library is an on-line reference archive drawing material from educational publishers, newspapers and selected Web sites to provide a wide range of resources.

Publications from the Oxford University Press include its *School Dictionary*, *Dictionary of Famous People*, *Children's Thesaurus* and *Children's Book of Famous People*. The principal general reference source is World Book's *Multimedia Encyclopedia*. (At the moment only the US edition is available, but BMI hopes to have the excellent international English version on-line later in the year.) Dorling Kindersley has supplied *The Kingfisher Children's Encyclopedia*; there are 1,500 digital images from Microsoft's *Cookie Picture Library*, and Hodder has contributed *The Hutchinson Dictionary of Science* and *The Hutchinson Dictionary of History*.

The limited capacity of telephone lines means that video, animation and audio material are not supplied, but these will be incorporated as soon as possible.

More than 5,000 links to the World Wide Web, indexed and categorised according to age group, are included. BMI may also offer schools an Intranet model.

Users can search the entire *Living Library* database or its four constituent parts: Words and Meanings, People and Quotes, Recent News, and Reference. Power Search is a more advanced option.

Secondary schools with networked Internet access and a CD-Rom jukebox may feel it is cheaper to buy multimedia CDs and put them on the network. This, however, ignores the attraction of unlimited, curriculum-relevant information. Neither does it take into account the cost of individual subscriptions.

The vast amount of on-line information now available presents its own difficulties, and many teachers will surely welcome a focused source of information, accessed via *Living Library*'s single search engine.

Living Library is available on a free three-month trial. It is available to schools/colleges by the following annual subscriptions: primary single user (non-IT), subscribe) £320; primary single user (non-IT), subscribe) £160; secondary single user (including IT), subscribe) £300; secondary single user (non-IT), subscribe) £360; networked access (including IT), subscribe) £1,395; networked access (non-IT), subscribe) £2,495.
BMI (0735 826000)

Caught in the net

It's almost two years since Tony Blair announced his deal with BT to give every school and college in the country access to the Internet via a "broadband superhighway".

That pledge, so appealing in its simplicity hard to politically effective in the time, went into Labour's manifesto with only slight modifications, and is now considered government policy. But as with most clear, simple, popular pre-election promises, making it real is going to be far from clear and simple.

The "National Grid for Learning" is a long-term project that will require heavy investment to take broadband fibre-optics to every school, college, library and hospital in the country. Exactly what form this grid will take is not clear. The notion of a dedicated network provided solely by BT is less plausible than a "virtual network" existing alongside many others, with the load shared by various telecoms providers, including the cable companies.

How much has to be spent, by whom, and what they will get in return, all remains to be thrashed out. Much of the thrashing is going on right now in a select committee at the Department of Trade and Industry, where telecoms, educational and IT heads are being hauled together with the aim of producing a White Paper by the autumn. But what are schools supposed to do in the meantime? Wait and see is not an option for teachers and students eager to explore the educational wonderland that is the Internet. According to the telecommunications watchdog OFTEL, most schools using the Internet (about 80 per cent of secondary schools, but only 5 per cent of primaries) still rely on basic, dial-up connection, typically to just one PC.

Many early adopters became disillusioned by slow, unreliable connections and unpredictable, often frighteningly high, phone bills – as much as £5,000 for primary schools, and £20,000 have been reported. Late last year, OFTEL's education task force urged BT and other operators to offer schools Internet packages deals with an emphasis on ensuring predictability of charges, and free choice of Internet service providers. Big telecoms companies have resisted BT from charging schools less than other customers (as laws would be relaxed).

At around the same time, the cable industry launched a deal which appeared to satisfy most of the OFTEL requirements, offering so-called flat-rate charges working out at roughly £6 per pupil per year for unlimited Internet access, regardless of the size of the school.

In theory this was great news for schools in cabled areas, but unfortunately more than half of UK schools are not in cabled areas. The Cable Communications Association says take-up of the offer has been good, but is unable to release precise figures.

Cable's "£6 per pupil" figure has become a benchmark. Late in May, BT submitted limiting proposals for a similarly priced scheme. This was rejected by OFTEL last week on the grounds that its choice of Internet service providers (ISPs) was anti-competitive. The affair was passed off as a minor hitch, with BT, OFTEL and others eager to co-operate on a substantive scheme, which OFTEL will open up for public consultation in July. But, as consultation takes at least six weeks, hopes of schools getting a new deal out of BT by September have all but vanished.

Free choice of ISP is clearly a good thing, but on what basis should teachers make their choice? As many have already discovered, getting it wrong can be expensive and frustrating, while changing ISP in mid-stream is not always as easy as it should be. All of which makes a new survey of service providers, to be conducted by the National Council for Educational Technology, extremely welcome news. This, according to the NCET's Malcolm Herbert, will produce the UK's first independent evaluation of Internet access, whether with dial-up services, which will be monitored for reliability, speed of connections, and data transmission speed. The aim is to produce Which?-style reports, published regularly by the NCET (on paper as well as on its Web site) starting later this year.

And if you can't wait for that, another NCET project, the Education Department Superhighways Initiative, is about to publish a 48-page technical guidance document on low-bandwidth Internet access. As Malcolm Herbert points out, the ISP business is highly volatile, with smaller firms being swapped up by the larger operators. His final piece of advice for schools looking for an Internet connection now is that "added value" educational content "doesn't have to be bought with the service provider", and that all-in-one "bundled" solutions are not likely to be as cost-effective as approaching individual suppliers.

BILL HOUSE

"Many early Net adopters became disillusioned by unreliable connections and frighteningly high telephone bills"

INTERNET

Tomorrow's world: St Andrew's School, Kirkcaldy, Scotland, where Apple has installed one of its classrooms of the future, a world-wide project based in Cupertino, in California's Silicon Valley

No more surfing. Now we're mining the Net

The Web is changing the way we teach, says **Vivi Lachs** after a tour of the US

Doug Player, superintendent and chief education officer of the West Vancouver School District is talking about the change he sees the Internet making to schools. "It's going to change the way teachers teach and that's what important about it".

His assurance that change is needed in the wake of the technology is something I heard repeated across cities I visited earlier this year in the United States and Canada. In some places the Internet has been a catalyst for thinking about change in classroom design, teaching style and curriculum. In other places, changes already under way have been reinforced by technology.

In Union City, New Jersey, classrooms were being converted from lecture style to groups of tables. In River-Oaks Elementary School, Toronto, Montgomery Blair High School, Maryland, and Davidson Middle School, California, pupils were accessing information from the Web as a regular part of their lessons. In Claremont High school, British Columbia, the principal, John Pringle, maintained "You can't talk about education without technology." Doug Player stressed that those schools in West Vancouver using a chalk-and-talk style of teaching may have to think again. "Rather than teachers lecturing," he argues, "children will be producing. Teachers are going to have to learn to be on the side."

The Apple Classroom of Tomorrow project (ACOT), based in Cupertino in northern California, is attempting to help teachers through this change. It is working in a number of schools in the US, and indeed in Europe (there is an ACOT school in Scotland, pictured above). Cupertino's Portal Elementary School is a showcase school. Each classroom has between four and six computers with Internet in an attempt to integrate the Net into regular teaching. The teachers are committed to using the technology to reinforce their co-operative approach to learning. Caroline Embrey at Portal talked about how children can get large chunks of dense information from the World Wide Web — her job as teacher is to help them decide what is important and what is not. "My paradigm has shifted a lot in teaching them how to approach questions with a structure for learning or the information doesn't mean anything.

"It's about inquiry and resourcefulness," she continued. "People who are resourceful do well. It's not about who has the most or who is the brightest."

Near the school is a teachers' development centre where staff from all over the US are trained by observing lessons, talking to pupils and teachers, getting some hands-on experience and thinking about how they can move technology forward in their own schools.

MaiYee DeSandies, from Alvarado elementary school in Union City, California, has made a Web site for her school with links to areas of curriculum use. "It is so important," she claims, "because it puts a parameter. It's a good kind of limitation so that the Net doesn't overwhelm you. The next step is mining, not surfing the Internet. Mining has a purpose, otherwise it's just eye-candy."

Electronic mail was also used in the schools I visited. Caroline Embrey, at Portal, was adamant that this raises questions about why we want to contact others: "Technology as a tool for communic[ation] is very powerful, so what do [we] want to communicate?"

MaiYee DeSandies was w[ork]ing on a project about Am[elia] Earhart, the first woman to [fly] across the Atlantic. P[upils] researched and read stories, [looked at] aeroplanes, a time-line and [...] tures. They followed the m[ove]ments of Linda Finch, who [was] doing a similar trip and was [in e-]mail contact with schools, gi[ving] details of her flight. Tarion, [aged] eight e-mailed Linda: "My [...] said she might bring me to the [...] off. I'm the little girl in braid[s,] look out for me okay".

Kenny, aged eight, wrote a [letter] of encouragement: "Dear L[inda,] Good luck. I hope you don't d[isap]pear like Amelia Earhart."

A number of schools use [their] school Web site as a daily mea[ns of] communication to a wider [audi]ence. The site might be up[dated] with projects, even home[work] details. Ecole Pauline Johnson [in West] Vancouver is a French immers[ion] school. The principal had tak[en a] group on a school trip to Que[bec.] He took pictures of what the p[upils] were doing each day using his [digi]tal camera and each evening p[ut] them on the school Web site. [Par]ents could go to their comp[uters] each evening and see their chil[dren] at work. "It's like they hav[en't] really gone anywhere — you [can] see them every night on the [Web]," said one delighted parent.

MaiYee DeSandies' pupils publish stories on the Web w[hich] give users the option of respon[ding.] One day Kate, eight, got an e-[mail] from Irian Jaya, Indonesia. It [said:] "Dear Kate, I read your story t[o my] second grade class and here [are] their responses." No one in [the] class knew where Irian Jaya w[as so] they set about researching it. O[ne e-]mail came back saying that p[eople] on her island did not eat hambu[rgers] but "the closest MacDonald[s is] 3,000 miles away in Bali".

Many British schools are [con]nected to Web sites, most of [which] include pupils' work. Wellfie[ld] Wickham primary school in [...]shire has pupils' home pages [which] include self-portraits, biogra[phies,] poems about Hallowe'en and [...] pieces about their school inspe[ction.]

Castle Community Scho[ol in] Kent has its Year 8 science p[...] on-line for open access. How[ard of] Effingham school, Surrey, h[as] pupils describing their first [day at] school. Not only have these [pupils] "published", but they may al[so get] a response. This is the beginn[ing of] interactive school Web sites. I [look] forward to more in the futu[re as] we become used to using the [Inter]net and appreciate its capabili[ties for] communication and informat[ion. It] will, as Doug Player said, c[hange] the way we teach.

CONTACTS

ACOT: http://www.research.app[...] com/research/proj/ acot
Alvarado Cyber Explorers
http://www.[...]
Castle Community School
http://www.rmplc.co.uk/eduwe[b] s/[...]/index.html
[...] School
http://www.rmplc.co.uk/eduwe[b] s/[...]/index.html
Howard of Effingham School
http://www.rmplc.co.uk/eduwe[b] s/howard/index.html

CLICK INTO PLACE

Vivi Lachs visits a pre-school in Canada that has two-year-olds using the Internet

> **"They're miles ahead of other kids when they start school"**

IN BRIEF