Draft - 2013

Taking an Environmental Sustainability Approach to Science Investigations

- Concepts, Ideas, and Links for teachers

As teachers we want the investigations that our students engage in to capture their interest, motivate them to find out more and at the same time provide meaningful information.

Whether students carry out their investigations at home or at school they need access to good ideas that relate to something they know and have a purpose.

At Enviroschools Wellington we have begun a project to build up a series of ideas for investigations based on the Enviroschools Theme Areas of

- Living Landscapes
- Water of Life
- Zero Waste
- Energy! and Ecobuilding

Over time we want to gather together great examples of projects based on these themes and publish them in a booklet and on our website.

Phase one 2013:

This initial booklet of draft ideas

Gathering feedback from teachers

- Did you use this?
- How helpful was it?
- How could it be more helpful?
- What other ideas do you have to share?

Gathering more detailed information

- please let your facilitator know of any sustainability focused projects that your students are doing for science fairs or as part of your classroom programme so that they can come and take photographs and interview students about their project
- we are interested in any projects that investigate issues impacting on our environment. These can be an experiments, studies or innovations
- small prizes will be available to all projects published

What does environmental sustainability mean?

"*Meeting the needs of the present without compromising the ability of future generations to meet their needs."*

United Nations in 2005

'Enough for all for Ever'

Ko te whenua te wai u mo nga whakatipu – The land provides the substance for the coming generations.

Big ideas:

- The earth is a habitat alive with organisms of various shapes and sizes, all dependent on each other.

- We rely on the earth and the life she supports for everything we use for our survival and our comfort

- Every year people generate harmful substances and waste which can damage the environment we rely on.

- If we are careful about what we use and how we behave, we can live in ways that are good for people and for nature.

Investigations into **Living Landscapes**

The Earth provides habitats for an incredible array of microscopic life, insects, plants and animals which make up our biodiversity – the variety of life. Variety is important to the health of an ecosystem.

Soil is a vital natural resource to support living landscapes or ecosystems. It supports most of our food production, filters ground water and provides us with building materials, so we need to look after it.

Soil may look like a bunch of dirt, but good quality soil is actually a complex and living mixture of dirt, nutrients, microorganisms, insects and worms.

Question to investigate	Description	Link	What's the point?
How does soil change with depth?	This project will help you to understand how soil properties change with depth and how they change from different sites.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p011.shtml	Soil is often overlooked because it only covers less than 10% of the Earth's surface. But soil is a vital natural resource for terrestrial life, and supports most of our food production. Learning about soils will teach us how to look after this precious resource.
How can we find the best place to plant in an area?	Make an instrument to test the soil to find out how compacted it is, before you dig! Test the level of compaction of soil at different locations and choose the best planting locations.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Geo_p010.shtml	Digging in really compacted soil is hard work – Imagine what it would be like for plant roots or soil animals! Compacted soil can limit the growth of plants and prevent water from draining away. It is important to know about soil compaction if you want to start a garden or plant trees.

Question to investigate	Description	Link	What's the point?
How can we prevent soil erosion?	Use homemade sampling containers to estimate rates of soil erosion due to rainfall at different sites.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p012.shtml http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvEng_p035.shtml	Soil is a natural resource and in short supply. In New Zealand we loose soil quicker than we create it. Erosion is dangerous because it creates landslides, reduces the land available to reduce food.
What conditions are important to support micro-organism life in the soil?	Learn how our planet recycles and reuses everything we need to support life by making a mini biosphere (ecosystem) to test the response of soil microorganisms to environmental changes in a closed system.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Geo_p038.shtml	Everything on our planet is linked by a giant recycling system called the biogeochemical cycle. We need to look after the living things that make up that system. A lot the life that makes up this system we can't even see with the naked eye; micro-organisms.
Are Soil Microorganisms Important for Plant Health?	Test whether plants grown in sterile soil do better than plants grown in unsterilized soil.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/PlantBio_p031.shtml	Microorganisms are important to the health of soil and things growing in it.
How does contact with different types of soil changes the pH of water?	Measure the pH of the soil in your garden. Explore what this means for growing plants in it.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p013.shtml	Most plants grow best in soil near neutral pH. Fertilisers can make our soils more acidic so too much of them may not always help plants grow better.
Does having worms in soil help plants grow faster?	Set up small earthworm colonies to compost different types of food waste. Test the soils in each type to see how diet affects both the earthworm population and the nutrients they put back into the soil.	http://www.youtube.com/watch?v=vFaO6HM9Prk http://tlc.howstuffworks.com/family/worm-activities.htm	Earthworms are important for recycling dead plant and animal material into plant food.
Which soil type do Earthworms like best?	Collect different soil types and some earthworms. Observe earthworm behaviour over time.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p061.shtml	Earthworms are important for recycling dead plant and animal material into plant food.

Question to investigate	Description	Link	What's the point?
What is the effect of earthworm density on decomposition of surface materials in soil?	Observe over time how quickly grass clippings are transferred into the soil with different numbers of worms	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p049.shtml#summary	Earthworms are important for recycling dead plant and animal material into plant food.
How biodiverse is my back yard?	Use a homemade bug vacuum to collect insects from your backyard to determine whether it is a biologically diverse habitat.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p045.shtml http://www.raftbayarea.org/readpdf?isid=12	The more different kinds of insects in a particular place the more biodiverse it is and the healthier the ecosystem.
Are There Bugs Under Your Feet?	make a Berlese funnel to investigate micro-invertebrates in soil	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p042.shtml	The more different kinds of insects in a particular place the more biodiverse it is and the healthier the ecosystem.
Do natural or chemical fertilizers work best?	Compare the effects of fertilisers with added nitrogen fertilizer vs. non added nitrogen on the germination and growth of seeds.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/PlantBio_p010.shtml#summary http://www.selah.k12.wa.us/soar/sciproj2004/jacobr.html	Plants need nitrogen as well as soil, water and sunshine.

Investigations into **Water of Life**

Water is essential for life and the abundance or scarcity of water is a major influence on which life forms can exist in a place. Water is also a good environmental indicator, and from the colour and state of our waterways we can tell a lot about our relationship with nature and the health of our community.

Fresh water is in short supply; less than 1% of the water supply on earth can be used as drinking water and getting to our taps is an expensive and energy intensive process. So reducing the amount of water we use can have a positive impact on our environment.

Question to investigate	Description	Link	What's the point?
How much water do you save on average by having a shower rather than a bath?	Measure the amounts of water used by taking a bath vs. having a shower.	**http://ga.water.usgs.gov/edu/sq3.html** **http://www.need.org/needpdf/PriSavingHotWater.pdf**	We can conserve water by using less or to finding safe ways to use it more than once
Can Mulch Reduce Garden Water Requirements?	Compare how well soil holds moisture when it is covered in muclch to when it is not.	http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=EnvEng&p=3	We can conserve water by using less or to finding safe ways to use it more than once
How is plant growth affected by using greywater rather than rain or tap water?	Observe the effects of watering plants with greywater vs tap water.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p040.shtml	We can conserve water by using less or to finding safe ways to use it more than once
What are the effects of fertilisers on algal growth?	Grow algae in several concentrations of fertilizer and observe its effect on algal growth.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p054.shtml	Many waterways have fertiliser seeping into them from farming practices which enhances algal growth. Too much algae can deplete the oxygen in the water, killing off other species in the water.

Question to investigate	Description	Link	What's the point?
How much fertiliser is collected in run-off?	Apply different concentrations of fertilizer in water to sod in a plastic tray. After allowing the sod to soak in the solution, test for the concentration of nitrogen in the run-off .	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p025.shtml	Many people routinely use fertilizer for crops, gardens, and lawns. Each time they apply fertilizer, the fertilizer seeps through the soil into the water table. There are many different chemicals present in fertilizers. This can eventually lead to the contamination of a local water source, like a stream, pond, lake, bay, or ocean.
How much water can be saved by using drought resistant seed?	Grow different types of drought resistant grass seed in a container and then starve for water after they are established.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p022.shtml	Drought-tolerant grasses are good for water conservation because they require less water to grow and stay green.
How well will duckweed grow in different types of water?	Compare growth of duckweed in different types of water eg mineral water, tap water etc.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/PlantBio_p030.shtml	Some plants grow only in water-logged environments. These plants are usually native to wetlands and are important for the sustainability of aquatic ecosystems. Wetland ecosystems are very fragile and susceptible to the toxic dumping of sewage and fertilizer run-off from neighbouring farm land.

Investigations into Zero Waste

Products that decompose rapidly are called "biodegradable materials". These products are good for the environment because when we have finished with them they will break down and contribute back into the soil. There is no waste in nature and there was very little waste in early societies.

Every year each household contributes waste products by using and consuming disposable products and materials. Sometimes these things are recycled, other times the items are re-used and sometimes things can be composted.

Many of the products that we produce nowadays do not break down and end up in a landfill. Landfills are huge piles of trash that are often buried. These products can leach harmful chemicals into the soil.

Question to investigate	Description	Link	What's the point?
How Fast Do Different Biodegradable & Compostable Materials Decompose?	Make an indoor composter and determine how readily different materials decompose.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p058.shtml http://wwf.panda.org/about_our_earth/teacher_resources/webfieldtrips/bio_nonbio_materials/	Waste products that cannot breakdown naturally by air, moisture, climate, or soil are not biodegradable and will litter the earth indefinitely. However natural waste and products made from nature break down easily when they are disposed of.
Can plastic shopping bags be biodegradable?	Find out what sunlight does to different types of plastic bags and varying the amounts of sunlight. What happens if you burry plastic bags in the ground for the same period?	http://www.youtube.com/watch?v=YDBtCb61Sd4 http://loveyourearth.org/Plastic_Bag_Facts.html	Plastic shopping bags need sunlight to disintegrate, but it will take 1000 years to disappear completely. Plastics will not break down buried in the soil away from sunlight as some other products will.

Question to investigate	Description	Link	What's the point?
Which types of packaging are better for the environment than others?	Conduct your own survey of selected materials to investigate if they are biodegradable or not in the soil. How does this affect your choice as a consumer?	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p010.shtml#summary http://www.need.org/needpdf/IntNaturalPlastic.pdf	Waste products that cannot breakdown naturally by air, moisture, climate, or soil are not biodegradable and will litter the earth indefinitely. However natural waste and products made from nature break down easily when they are disposed of.
How can we use wood products in a sustainable manner? Which method is least intrusive and displaces the least wildlife?	Compare the percentages of recycled material in paper products. Invent ways to minimize paper packaging materials.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p038.shtml http://wwf.panda.org/about_our_earth/about_forests/importance/forestsairclimate/	Just as our lungs absorb carbon dioxide from the blood and infuse it with oxygen, green plants absorb carbon dioxide during photosynthesis and release oxygen into the atmosphere in return. Our forests are therefore important for sustaining life so we need to be careful about what we choose to use wood for.
How much e-waste do we generate?	Survey households about how much electronic equipment they use.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p056.shtml	Electronic devices contain materials that can cause pollution and health hazards but they often end up in landfills, and we are running out of space to put landfills.
What foods do worms prefer in a compost bin?	Discover how the diet of earthworms affects their growth, reproduction, and the quality of the soil they process.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p041.shtml#summary	Food leftovers are a type of organic waste. Although organic waste is biodegradable, it is a big problem for the environment if it ends up in a landfill. In landfills, it decomposes anaerobically to produce a gas called biogas, which is mostly methane, a significant greenhouse gas. One way to help organic waste decompose is in a worm farm.

Question to investigate	Description	Link	What's the point?
How Much Organic Waste Can Composting Worms Eat?	Use your worm farm to test how much organic waste your worms can process, and how fast they can do it. Collecting data for several weeks, measure out and record a sample of organic waste, add it to the worm farm, and then record how many days it takes for the sample to disappear.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p055.shtml	Food leftovers are a type of organic waste. Although organic waste is biodegradable, it is a big problem for the environment if it ends up in a landfill. In landfills, it decomposes anaerobically to produce a gas called biogas, which is mostly methane, a significant greenhouse gas. One way to help organic waste decompose is in a worm farm.
What's the Ideal Proportion of earthworm castings in soil for young garden plants?	Compare growth in garden plants in soils with differing concentrations of worm castings.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/PlantBio_p002.shtml#summary	When processed properly, organic waste in the right concentrations can greatly enrich soils.

Investigations into **Energy!**

Energy is the vital force, it is needed for plants, animals, and people to grow and to be active. We also use energy to power things we use like home applicances, cars and to create products.

Some energy comes from renewable sources like the sun and wind. Other energy comes from non-renewable sources like coal, oil and gas. Our everyday use of these things is depleting their supply.

We are also creating an environment that is polluted, noisy and expensive to maintain. We can look at how to cut down on our use of electricity and fuel and generate our own from renewable local sources.

Question to investigate	Description	Link	What's the point?
How big is our Ecological Footprint?	Figure out how big your footprint is using footprinting tools.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p039.shtml#summary	The sustainability of our planet's resources ultimately depends upon our actions as citizens. How much we drive, what we eat, whether we have pets, and whether we recycle are all individual actions that affect the sustainability of the Earth's resources. Our Ecological Footprint shows the impact our actions are having on the earth.
Will ice melting at the north or south poles cause sea levels to rise? What would happen in your area of the world if the polar ice caps were to melt?	Use your own ice cubes at home to find out what happens to sea levels if the ice at the North Pole melts, or if the ice at the South Pole melts.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/OceanSci_p015.shtml	A rising sea-level could mean extensive flooding for people in all countries whose home and cities are built by the coast.

Question to investigate	Description	Link	What's the point?
What's going on with the Greenhouse Effect?	Build a simple and small greenhouse and investigate how trapped infrared radiation affects the temperature within.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p047.shtml	The greenhouse effect states that gases in the atmosphere, such as CO2, might increase the surface temperature of Earth. The ecosystems here on earth have adapted for life within a particular range of temperatures, so rising temperatures could dramatically alter life on earth.
What are the most energy efficient heating methods?	Find out what the most efficient way is to heat our homes.	http://www.nrel.gov/education/pdfs/educational_resources/middle_school/solar_projects_ms.pdf http://www.energyquest.ca.gov/projects/ http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvEng_p028.shtml	Most of our energy that we use to produce electricity or for driving cars is made from non-renewable sources, which are in short supply We depend on fossil fuels to supply gas and electricity to our heaters. But burning fossil fuels to create energy is harmful to the environment. The less energy we can use to heat our homes the better.
How much energy do TV's use when on standby?	Investigate the different uses of electricity in your home and determine if there are simple changes that you can make to save energy and money.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Energy_p020.shtml#summary	
Do energy saving bulbs produce the same kind of light as regular bulbs? Do they produce the same amount of heat?	Use your observation skills and a thermometer to test the amount of light and heat given out by different kinds of bulbs.	http://www.need.org/needpdf/PriComparingLightBulbs.pdf	We often have a choice of products. If they can achieve the same thing then we can choose to use the one that is least harmful to our environment.
Can a renewable fuel produce the same level of energy as a non-renewable fuel?	Heat water using different fuels and measure the change in temperature you can achieve with each one.	http://www.sciencebuddies.org/science-fair-projects/project_ideas/Energy_p030.shtml	We are gradually depleting our non-renewable fuels like oil, coal and gas. If we can find renewable fuels that do the same thing, we will be better off.

Useful links

http://www.sciencebob.com/sciencefair/ideas.php

http://www.sciencebuddies.org/science-fair-projects/project_ideas.shtml

http://www.all-science-fair-projects.com/

http://www.sciencefairadventure.com/

http://chemistry.about.com/od/sciencefairprojects/Science_Fair_Projects.htm

http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/idea-finder.html#Matter

http://sciencekids.co.nz/projects.html

http://www.southlandsciencefair.co.nz/

http://www.ipl.org/div/projectguide/

http://www.eia.gov/kids/energy.cfm?page=sf_experiments