How Safe is your Playground?
Analysing Soil in Scottish Schools

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Outline of Talk

• Introduction
• Outline of activities
• Sampling and analysis
• Results
• Grand Environment Day
• Funding
• Conclusions
• Acknowledgements
Introduction - Why is soil important?

- Provides the chemical elements needed by plants to produce our food, clothing and fuel
- Home to a huge range of creatures including microbes
- Foundation for our cities and homes
Introduction

• Provide students with an understanding of current environmental issues
• National project to involve the whole of Scotland and Strathclyde students
• Explore Chemistry outside of (but linked to) the curriculum and in a local context
• Develop employability skills
• Provide information on career opportunities
The Soils in Scotland’s Schools Project

• National Research Project for BGE pupils
• Funded by the Royal Society of Chemistry
• 397 schools invited to take part
• 99 responded and received monthly project newsletters
• 43 submitted soil samples from their school grounds for analysis
Outline of Activities

• Lesson plan developed and sent to schools in September 2017
• A protocol and sampling materials sent in October 2017
• Samples analysed for levels of copper, lead and zinc from October 2017-February 2018
• Newsletter sent each month to update on progress
• Details of Poster Competition sent to schools in February 2018
Outline of Activities

• Reports outlining the specific results for each school were prepared and sent to schools in June 2018
• Questionnaires sent to students and staff for feedback on resources
• Winning teams from each school were invited to the Grand Environment Day in September 2018
• Guest speakers judged posters and presented prizes to the top 3 teams
• Final report on results shared with schools
Metals of interest

- Copper (Cu) lead (Pb) and zinc (Zn)
- Many modern uses
- Sometimes called “the urban metals”
Soil analysis

Air dried samples

- Samples
- Reference
- Blank

20 mL Aqua Regia
(HCl:HNO₃, 3:1, v/v)

Microwave digestion system
(Mars Xpress, CEM, UK)

DF = 5

Diluted sample (2% Aqua Regia)

ICP-MS
(7700 ICP-MS, Agilent technologies, UK)

- Power: 800W
- Power (%): 100
- Ramp time: 20 min
- Temperature control: 160°C
- Hold time: 30 min

DF (total) = 50

Multi-element standards
0, 10, 100, 500, 1000 µg/L

Iron standards
0, 500, 5000, 25000, 50000 µg/L

Standards

DF = 10

Pseudo-total analysis

1 mL

10 mL

100 mL

Triplicate
Schools submitting samples
What we found – overall

Soil metal concentrations

Concentrations (mg/kg)

Copper (Cu) 
Pb 
Zinc (Zn)

Metals
What we found – per school
The effect of location

• Glasgow was historically the industrial heart of Scotland

• Schools divided into
  A: <10 miles from city centre
  B: 10-30 miles from city centre
  C: >30 miles from city centre
For all three elements: \( \text{A} > \text{B} > \text{C} \)
Is our soil safe?
Urban Background Concentrations
as measured by e.g. the British Geological Survey
http://www.bgs.ac.uk/gbase/NBCDefraProject.html
Soil Guideline Values
Published by Governments to help protect soil e.g.
http://esdat.net/Environmental%20Standards/Dutch/ENGELSE%20versie%20circulaire%20Bodemsanering%202009.pdf
Conclusions (scientific)

- Wide range of Cu, Pb and Zn concentrations found in the soils from Scottish schools
- Almost all fell within typical soil guideline values
- A difference between soils close to Glasgow urban area and more rural locations
- No indication of any serious risk to human health
Conclusions
(preparing students for success)

• Stimulated interest in environmental issues
• Platform to interact nationally
• Explore Chemistry interactively at a local level utilising data and technology
• Demonstrate career opportunities
• Develop employability skills
• Provide opportunities not normally accessible to some students
Feedback

“The class enjoyed the experiments – something a little different for them. Getting results from uni dept was good too. All round, a good experience.”

“They were interested and it gave them an insight into research ideas and the importance of research.”

“Overall this is a great package to develop data handling skills.”
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Ideas???

- Pollution
- Diet
- Locale
- Local industry

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