Science Teacher Booklet

E-mining

Sustainability | Resources | Technology

Step-Up 2018-2020

Castletroy College

Emining@shcools project goals

Dear colleagues,

Thank you for your enthusiasm and engagement with this SSE interdisciplinary project, entitled E-mining. As you are aware our 2nd year students are going to engage in a 4-week learning experiences on sustainability in the use of natural resources in technology.

They will study the environmental, social and economic consequences of current global as well as individual practices in terms of origin, manufacture, design, use and disposal of materials.

They will compare our current 'take-make-dispose' linear economy with a circular economy where products, their components and materials are used more efficiently and multiple times. They will be inspired to take action as European as well as Irish citizen and play a central role in the organising of a WEEE collection event in Castletroy College in early March.

Timeline

This project starts on **Monday 21st January 2019** in all Science, Business and CSPE classes and on **Monday 28th** in Geography and Metal work classes.

Purpose:

The purpose of planning these lessons in a cross curricular, interdisciplinary manner is to support our students in making *more meaningful and authentic connections between learning in different subject* and areas of the curriculum while also *developing our professional collaborative practice as teachers.*

Assessment

There is a variety of methods of assessment built into this unit of work and students can showcase their learning and understanding in various way such as by participation in small group and whole class discussion, successful completion of class and homework activity sheets, answering questions in class, presentation of research projects, written report on class investigations, planning and problem solving, organising and marketing and even through a table quiz!

Students will also be asked to keep a learning log for the duration of the project.

What is a learning log?

A learning log is a personalised record of one's own learning. It is like a diary where students can record their reflections on their learning experiences. The **Learning Log** is a technique to help students focus on what they are **learning** in class by writing their thoughts, reactions, and responses to class activities, videos, speakers, discussions. In a learning log, students are asked either to take what they have been learning in class and reflect on it or relate something out of class to what they have been learning in class. When a learner makes personal **connections** with the subject matter, it has been proven that more meaningful learning will occur for them.

Links to SSE.

We are currently working on four areas of improvement as part of SSE.

i. Teacher clarity through the sharing of learning intentions
ii. Active learning strategies that allows students to take more ownership of their learning and which facilitate the development of key skills.
iii. Reflection on learning
iv. Collaborative practice.

All lessons have elements i) ii) and iii) built into them. The lesson plans are simply a guide, you are welcome to deliver these lessons using methodologies and strategies of your own.

What can you do to ensure maximum benefit to our students?

- Encourage your students to use their **learning log and fill it in every week**. This will mean checking in on their knowledge/understanding of the learning intentions **both at the start and end of each week**. Please also **facilitate students to reflect** on one or more learning experiences in your classes each week
- Talk to your students about learning in other subject areas and **ask them to identify connections** between what they are learning in your subject area to other Emining classes.
- Please **be explicit about our SSE areas for improvement** during all Emining classes

  i) sharing learning intentions as identified in lesson plans.

  ii) activities where students are at the centre of their learning, and

  iii) opportunities for students to reflection on their learning, both the content and process.

- As this is year 1 of a two-year project we very much welcome all feedback that you can give us to improve this unit of work for next year.
- Ultimately, we want our students to **enjoy the learning experience**, to be engaged and to participate in the learning and maybe even be inspired to take action in educating the wider community on more sustainable practices in their use of technology.

Invited speakers:

Every week, learning in classrooms is complimented by a visit of a guest speaker.

Week 1: Irish centre for research in Applied Geoscience Topic: Mining in Navan v's Africa.

Week 2: Dell - Carbon footprint of a computer.

Week 3: European Recycling Platform - WEEE recycling and Marketing

Week 4: WEEE in Ghana - Peadar King- showing of a documentary plus Q&A session.

The schedule for this will be sent out a week in advance. Some of the speakers may clash with your 2nd year class but if not then you are very welcome to attend these talks if they may be of interest to you.

Week 1 talk(s) will take place in the Library on Wednesday 23rd January during P7 & then again during P8. Each talk is 40 mins.

Thank you again for your interest, enthusiasm and engagement in this project. We hope that you too may enjoy and benefit in some way from being part of this new teaching and learning experience.

The Emining team

Design Team: Sharon Delaney, Kevin Grant, Linda Hannon, John Keehan, Lisa Kiely, Anne Marie McMahon, Marian Roche.

Week 1: 21st of January to 25th of January

Science

Define the term elements, mixtures and compounds.

Identify from the periodic table metals and non-metals and list their properties.

Make generalizations about the properties that differentiate metals from non-metals.

Explain how the elements used in mobile phones has changed over the past decade

Work in a group to plan, design and carry out an investigation to determine if a material is a conductor of heat and electricity

I can use a multi-meter to measure resistance.

Define the term critical raw material and give 3 examples of critical raw materials

CSPE

Understand the term ecological footprint.

Calculate my ecological footprints.

Use images and texts to show my ecological footprint.

Investigate ways that I can lesson my ecological footprint

Create a definition of sustainable development

Become aware of the UN Sustainable Development Goals

BUSINESS

Explain the term “economic resources”

Identify and explain each of the factors of production

Distinguish between needs and wants

Explain the term scarcity.

Describe how a business uses each of the factors of production to create goods, services and wealth

Explain how scarcity, choice and opportunity cost impact on the production of goods and services

List the rewards associated with each of the factors of production

E-mining
Educating | Sustainable | Technologies

Science Lesson Plans

Week 1: Classification of materials based on their properties.

Week 2: CRMs and extraction

Week 3: Sustainability of student's ownership and use of technology (phone).

Week 4: Disposal and recycling

Week 1 : Lesson 1

Learning Outcomes

Chemical World

4. Students should be able to classify substances as elements, compounds, mixtures, metals, non-metals, solids, liquids, gases and solutions
6. Students should be able to investigate the properties of different materials

Resources

Element-compound-or-mixture-homework-activity-sheet. (worksheet 1).
Uncoloured B&W periodic table (Worksheet 2).
Elements - 7 sets of elements available.
Table on element properties for station model activity (worksheet 3)
Textbook

Learning Intention

Classify substances as elements, mixtures and compounds
Classify an element as a metal or a non-metal using the periodic table
Identify properties, by observation, of metals and non-metals (using samples provided by teacher)
Make generalizations about the properties that differentiate metals from non-metals (P182 Catalyst)

Suggested Classroom Activities

1. Starter activity to ensure students recall prior knowledge on elements, mixtures, compounds and particle diagrams from 1st year (see activity sheet 1).
2. Recall periodic table is divided into metals & non-metals – use blank periodic table to draw in division line.
3. Group work/pair work using stations: Identify, by observation, properties of metals and non-metals using samples provided by teacher. Students complete sheet 3.
4. In pairs, compare what metals and non-metals have in common & differences between them

Homework

Green box page 182 on Catalyst: research on metals and non-metals .

Assessment

Complete worksheets 1 and 2 above accurately plus complete h/w.

Student Reflection

Reflection 'in' learning during group work as they work in groups to complete worksheet 1

Skills

Communicating
Seeing patterns (in non-metals)
Managing information - being curious
Expressing ideas clearly & accurately
Learning with others
Working with others – respecting others, co-operating

Week 1 : Lesson 2

Learning Outcomes

Chemical World

4. Students should be able to classify substances as elements, compounds, mixtures, metals, non-metals, solids, liquids, gases and solutions
6. Students should be able to investigate the properties of different materials

Physical world

2. Students should be able to: identify and measure/calculate length...resistance...

Resources

Circuit equipment – bulb, battery, wires, crocodile clips, multimeter

Lab report template - Investigation template – worksheet 3 from last lesson.

Success criteria for writing the lab report

Learning Intention

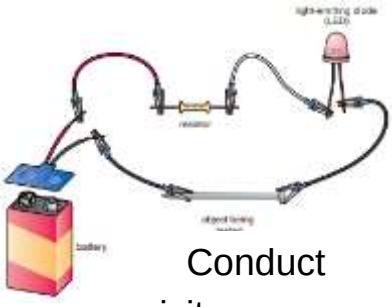
Carry out a test to determine if an element is a conductor or insulator.

Distinguish between metals and non-metals in terms of conduction of electricity and/or heat.

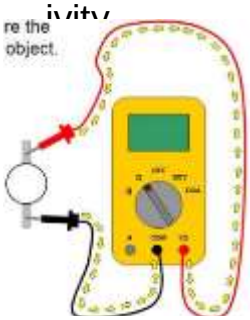
Use a multimeter to measure the resistance of materials

Suggested Classroom Activities

1. Review metals & non-metals keywords, position on periodic table & characteristics from previous lesson
2. Identify for students that metals are conductive (in house wires, radiators, etc.) using inquiring questions
3. Introduce simple circuit to test if electricity flows or not – station with samples of elements with circuit equipment. Students will test for (i) conductivity (ii) resistance
4. Introduce keywords: conductor, insulator, resistance.
5. Write up lab report for today's practical – complete for homework if not finished



Conduct



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Skills

Cooperating
Being curious
Communicating
Seeing patterns
Respecting others
Learning with others
Working with others
Managing information
Expressing ideas clearly & accurately
Reflecting on and evaluating my learning

Assessment

Carry out a test for conductivity in materials and write a detailed report using success criteria.
Finish for homework if necessary

Student Reflection

Reflection 'in' learning when planning and designing investigation

Week 1 : Lesson 3

Learning Outcomes

Chemical World

4. Students should be able to classify substances as elements, compounds, mixtures, metals, non-metals, solids, liquids, gases and solutions

Nature of Science

10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Resources

Elements in old mobile phones v's new (worksheet 5)

Coloured print of elements in smartphone (worksheet 6)

List of CRMs in smart phone – on PPT

Learning Intention

Identify metals and non-metals in a smartphone using the periodic table

Understand how the type of elements used in smart phone have evolved over the years

Identify properties of these metals that deem them useful for use in smartphone

Explain what is meant by a CRM

Suggested Classroom Activities

1. Use handout 5 to highlight elements in used in original phone.
2. Compare elements used – to see additional new elements used in smart phones & ones no longer in use (lead)
3. Identify characteristics of elements that make them useful in smart phones –worksheet 6.
4. Explain what is meant by a critical raw material – PPT – complete
5. Introduce & discuss homework: YouTube TED Talk on CRMs https://www.youtube.com/watch?v=_s1ZP-jG5D8 (Flipped classroom approach)

Skills

Co-operating
Being curious
Seeing patterns
Communicating
Respecting others
Working with others
Learning with others
Managing information
Expressing ideas clearly & accurately
Reflecting on and evaluating my learning

Assessment

CNQ on TED Talk at home.

Student Reflection

One-page weekly student log reflection

Week 1 : Lesson 4

Learning Outcomes

Chemical World

10 - Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials

Nature of Science

6. Students should be able to conduct research relevant to a scientific issue, evaluate different sources of information including secondary data, understanding that a source may lack detail or show bias

7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations

Resources

Video on CRM- students have watched this prior to class

Youtube video to watch

Article on CRMs with questions to complete for homework (worksheet 7)

Learning Intention

Through sharing and discussion, deepen their understanding the concept of critical raw materials

Suggested Classroom Activities

1. Reflection on CNQs from the ted talk video.
2. Class discussion on CNQs
3. Students in groups can read article, start questions and finish for homework.

Skills

Working with others
Respecting others
Cooperating
Communicating
Seeing patterns
Managing information
Being curious
Expressing ideas clearly & accurately
Learning with others

Assessment

Discussion from CNQ homework

Questions from article

Student Reflection

Learning log- overall weekly reflection

T-bar reflection tool

Week 1 : Recap & Reflection

What worked well this week?

Did your students make any connections with other subjects?

What areas could be improved?

Any other notes or comments?

Week 2 Overview: 4th of February to 8th of February

Science

Explain the social and environmental impact of mining.

Calculate the energy used while charging my mobile phone.

Identify what my phone needs to interact with in order to function.

Working in groups, analyse data from a survey and identify patterns and trends in current mobile phone use.

Present survey data in an appropriate format – table, chart, graph.

Explain the difference between a circular and a linear economy.

CSPE

Identify the consequences of electronic waste

Discover how electronic waste has an impact on the lives of people in Ghana and China.

Compare and analyse information

Identify possible solutions to the challenge of unsustainable consumption of CRM e.g. circular economy and recycling events

Geogrpahy

Identify three uses of cobalt in everyday life.

Compare how resources are extracted in developed v's 3rd world country.

Identify a country as developing or developed based on how they extract resources from the earth (primary economic activities)

Understand how poorer countries can be exploited by wealthier countries.

Business

Explain how an economy works

Identify the factors of production.

Understand the different types of Government Revenue and Expenditure

Demonstrate how companies are affected by Supply/Demand and different economic systems.

Know how price and other factors will affect demand and supply

Metal work

Evaluate the factors that influence their own design and that of others

Apply their knowledge of the property's materials associated with a range of engineering

Understand the properties associated with a range of engineered materials

Week 2 : Lesson 1

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials

Nature of Science

6. Students should be able to conduct research relevant to a scientific issue, evaluate different sources of information including secondary data, understanding that a source may lack detail or show bias
7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations
10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Resources

Paper to make posters, markers, etc.

Learning Intention

Deepen & develop understanding of CRMs through research

Research one smartphone CRM

Suggested Classroom Activities

1. Review questions from article from homework.
4. Class task to be discussed with students (in groups 3-4 to research as much information as possible about one smart phone CRM and present in a visual format that can be shared around the school). Think, pair, share to identify information that needs to be researched on each CRM (possible ideas to include - origin, extraction, applications in technology, characteristics, supply, reserves, consumption. Include research on what makes this element critical).
5. In groups of 3-4, students choose one CRM (used in a smartphone) that they will do a research project on. Then, in groups of 3-4, gather background information, divide up the task to include research on its origin, extraction, applications in technology, characteristics, supply, reserves, consumption. Include research on what makes this element a critical element. Use as least two sources of information for each subheading. Links to suggested websites and YouTube videos above. Students review webpage articles and commence background reading on an individual CRM.
6. Teacher to show one or two of the links above and discuss effective searching, the difference between searching and researching, plagiarizing, referencing their sources and also evaluating their sources. Effective researching on internet - AND OR NOT
7. Evaluating sources

Skills

Working with others
Respecting others
Cooperating
Communicating
Seeing patterns (in non-metals)
Managing information
Being curious
Learning with others
Expressing ideas clearly & accurately
Reflecting on and evaluating my learning

Assessment

Students must have researched and come to next class with information on their subheadings for their research on one smartphone element (CRM): its origin, extraction, applications in technology, characteristics, supply, reserves, consumption. What makes it a critical element? Use as least two different recorded sources of information.

Links for research

https://wiki.kidzsearch.com/wiki/Neodymium
http://www.softschools.com/facts/periodic_table/neodymium_facts/363/
http://www.softschools.com/facts/periodic_table/gallium_facts/207/
https://www.livescience.com/38292-dysprosium.html

Week 2 : Lesson 2

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials

Nature of Science

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7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations
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Resources

Poster paper, scissors, markers, ruler, Pritt stick, etc.

Learning Intention Deepen and develop understanding of CRMs through research

Identify success criteria

Suggested Classroom Activities

1. In groups of 4 prepare poster presentation on their CRM.
2. Class discussion: decide on success criteria for their presentation
3. Reflect on their learning through this jigsaw method approach.

Skills

Working with others
Respecting others
Cooperating
Communicating
Seeing patterns
Managing information

Being curious Expressing ideas clearly & accurately Learning together

Assessment

Work in their groups to produce a summary google slide on their CRM. There must be one slide per heading as listed for previous lesson. Each slide must be clear, not text heavy and include graphics/images. Student Reflection

Reflect on the learning that occurred while completing the group task.

Week 2 : Lesson 3 & 4

Learning Outcomes

Chemical World

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Nature of Science

7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations
10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Learning Intention

Student's project to be uploaded to google classroom prior to the classroom.

Success criteria (as formulated in previous lesson) Each group will present their research one smartphone element (metal) and produce a factsheet to include its origin, applications in technology, characteristics, supply, reserves, consumption.

Suggested Classroom Activities

1. Groups of students present their posters and google slide in their groups to class
2. Formal written peer feedback using identified success criteria.
3. Formal time for reflection on learning for each group

Skills

Working with others
Respecting others
Cooperating
Communicating

Managing information
Being curious
Learning together
Listening and expressing myself

Developing my spoken word
Expressing ideas clearly & accurately

Assessment

Presentation skills and content knowledge.

Homework:

View clips looking at the impact of mining on the environment and complete one CNQ after watching both clips.

Environmental impact of mining

Social and health impact of mining

Week 2 : Recap & Reflection

What worked well this week?

Did your students make any connections with other subjects?

What areas could be improved?

Any other notes or comments?

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Science

Explain the social and environmental impact of mining.

Calculate the energy used while charging my mobile phone.

Identify what my phone needs to interact with in order to function.

Working in groups, analyse data from a survey and identify patterns and trends in current mobile phone use.

Present survey data in an appropriate format – table, chart, graph.

Explain the difference between a circular and a linear economy.

CSPE

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Discover how electronic waste has an impact on the lives of people in Ghana and China.

Compare and analyse information

Identify possible solutions to the challenge of unsustainable consumption of CRM e.g. circular economy and recycling events

Geogrpahy

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Compare how resources are extracted in developed v's 3rd world country.

Identify a country as developing or developed based on how they extract resources from the earth (primary economic activities)

Understand how poorer countries can be exploited by wealthier countries.

Business

Explain how an economy works

Identify the factors of production.

Understand the different types of Government Revenue and Expenditure

Demonstrate how companies are affected by Supply/Demand and different economic systems.

Know how price and other factors will affect demand and supply

Metal work

Evaluate the factors that influence their own design and that of others

Apply their knowledge of the property's materials associated with a range of engineering

Understand the properties associated with a range of engineered materials

Week 3 : Lesson 1

Learning Outcomes

Nature of Science

10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Resources

Post-its

PowerPoint - energy during extraction phase

Learning Intention

Using the flipped classroom approach, students will have watched videos prior to this lesson. In groups discuss their learning under the headings
(I) environmental impact of mining
(ii) social and health impact of mining.
Realise the social and environmental impact of mining.

Outline the benefits of a circular economy over the current linear economy.

Suggested Classroom Activities

1. Working in pairs, students discuss their learning from completing the CNQ. Link this to what they know about mining from geography, cspe, our week 1 guest speaker and from reading the article above.
2. Groups discussion on what could be done to make this process more sustainable – each group come up with 3-4 suggestions and log ideas on a post-it. Post-its gathered and ideas shared with the class.
3. PowerPoint to outline the benefits of a circular economy over a linear economy.

Week 3 : Lesson 2 & 3

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

Nature of Science

4. Students should be able to: produce and select data (qualitatively/quantitatively), critically analyse data to identify patterns and relationships, identify anomalous observations, draw and justify conclusions

Resources

Survey data

Paper for posters, graph paper, markers, etc.

Article for homework:

Learning Intention

Identify and share connections/links between learning in science and learning in other subject areas.
Using data from survey, present data on current use of mobile phone.
Analyze data to identify patterns or trends in our current phone use.

Suggested Classroom Activities

Working in small groups, take one question from the survey data and present in a useful format.

Skills

Working with others

Respecting others

Cooperating

Communicating

Managing information

Being curious

Learning together

Listening and expressing myself

Developing my spoken word

Seeing patterns, trends and relationships

Gathering, interpreting and representing data

Expressing ideas clearly & accurately

Assessment

Present their poster to class or school community.

Student Reflection

Week 3 : Lesson 4

Learning Outcomes

Physical World

2. Students should be able to identify and measure/calculate ….electrical power

6. Students should be able to explain energy conservation and analyse processes in terms of energy changes and dissipation

Chemical world

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

Resources

Information needed re. power rates of phones – Table / PowerPoint

Clip explaining how to calculate electrical power https://youtu.be/zWIdYdHNBq0

Worksheet on power calculations.

Learning Intention

Students should be able to calculate the energy used while charging/using their phone per day/week/month/year by carrying our various power calculations.

Research and compare details about power rates of phone

Suggested Classroom Activities

1. Calculate energy used in running a mobile phone for an average Castletroy College student user.
2. Calculate this cost of running the phone using power and unit cost data.

Skills

Managing information - being curious
Expressing ideas mathematically
Seeing patterns, trends and relationships
Gathering, interpreting and representing data

Assessment

Ability to the cost of running a mobile for a day/week/month/year using simple electrical energy calculations and based on the 'use' data gathered in the student survey.

Homework:

Finish work on calculating the cost of running various electronic equipment.

Week 3 : Recap & Reflection

What worked well this week?

Did your students make any connections with other subjects?

What areas could be improved?

Any other notes or comments?

Week 4: 11th to 15th of February

Science
Appreciate the scale and impact of electronic waste and the danger of human toxicity.
Analyse survey data and identify trends and patterns in our recycling rates.
Identify and list of advantages and disadvantages of our current system for dealing end of life products.
Distinguish between a linear and circular economy.
Analyse sources of information for credibility and bias.

Propose two questions on digital dumping for a Q& A session with our guest speaker.

CSPE

Evaluate how I can contribute to reducing the unsustainable consumption and production of critical raw materials
Help organise a WEEE collection event.
Identify waste materials in my environment that I can contribute to the waste recycling event.
Work as part of a team to organise a waste collection event
Employ our organisational and creativity skills to achieve our tasks.
Work efficiently and utilise our time management skills.
Begin to identify possible topics for CSPE CBA

Business

Identify factors that affect demand and supply.
Value, apply and cost a business plan.
Identify what are the main source of materials in Ireland and other countries
Explain the different type of production that occurs in certain countries and why?
Justify the importance of sustainability when creating business plans.
Identify three current environmental issues and regulations.
Discuss Ethical business behaviours – choices that are ethically correct (CSR)
Identify Safety regulations in the workplace
Understand the word marketing and construct a marketing plan.
Communicate with necessary stakeholders to inform on an upcoming event
Understand the importance of internal and external stakeholders in an organisation
Explain the effect that marketing has on an event

Metal work

Evaluate the factors that influence their own design and that of others
Apply their knowledge of the properties associated with a range of engineering materials
Understand the properties associated with a range of engineered materials
Understand the properties associated with a range of engineered materials

Week 4 : Lesson 1

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

Nature of Science

7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations

Resources

Link to video
Copies of scientific paper
Template to evaluate the scientific paper
Article on human toxicity of ewaste. - to read for homework & do CNQ -NB SEE NOTE BELOW.

Learning Intention

Appreciate the impact of waste, human toxicity, scale of electronic waste, etc.

Evaluate sources of information.

Suggested Classroom Activities

Video to watch Ghana - worlds largest e waste dump 25 mins plus 15 mins reflection and discussion. This will be complimented by our guest speaker of the week which is Peadar King, who will speak directly about digital dumping in Ghana.

Skills

Reflecting on and evaluating my learning

Thinking creatively and critically

Assessment

Formative during group discussion.

Student Reflection

T-chart reflection tool

Homework

Read and evaluate a scientific paper on human toxicity and e-waste (see resources above)

E waste and human toxicity **Worksheet no 10. NB: it would be envisages that students would be asked to just read 1-2 pages of this doc and use it soley as an article to 'evaluate'. Look at the source, identify themselves through some research that this is a world renowned publication, peer reviewed and hugely credible.**

Week 4 : Lesson 2

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials

Nature of Science

10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Resources

Data on what happens to our mobile phones – handout/PowerPoint

Graph paper/paper for a poster

Learning Intention

Examine current recycling rate of critical raw materials using periodic table.

Examine data on what happens our mobile phone, how many at home from student survey

Suggested Classroom Activities

1. Examine current recycling rate of critical raw materials using periodic table.
2. Interpret the data from the survey to identify what happens to our mobile phones when we are finished with them
3. Represent this data in an appropriate format
4. Homework: Watch the link..... prior to lesson 2 this week (flipped classroom approach) and record key points

Skills

Reflecting on and evaluating my learning

Thinking creatively and critically

Expressing ideas mathematically

Seeing patterns, trends and relationships

Gathering, interpreting and representing data

Assessment

Class discussion on the data that has been studied

Student Reflection

Reflect and connect to learning in other areas

Homework

Taking one piece of data, represent graphically using success criteria discussed in class. This poster will be displayed within the school community.

Week 4 : Lesson 3

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

Nature of Science

10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Learning Intention

Identify and critique current system of recycling end of life products – advantage and disadvantages.

Distinguish between a linear economy and circular economy.

Suggested Classroom Activities

1. Video from google classroom – flipped classroom approach.
2. Think, pair share.
3. Venn diagram - to compare current systems.
4. LISA TO SOURCE INFO RE: THIS

Skills

Reflecting on and evaluating my learning

Thinking creatively and critically

Assessment

Participation in pair work and class discussion

Week 4 : Lesson 4

Learning Outcomes

Chemical World

10. Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

Resources

Questions from across all subject departments involved

Answer Sheets

Learning Intention

Review of material covered on CRMs across all the subjects involved (in a fun way!!)

Suggested Classroom Activities

Table Quiz

Skills

Reflecting on and evaluating my learning

Thinking creatively and critically

Week 2 : Recap & Reflection

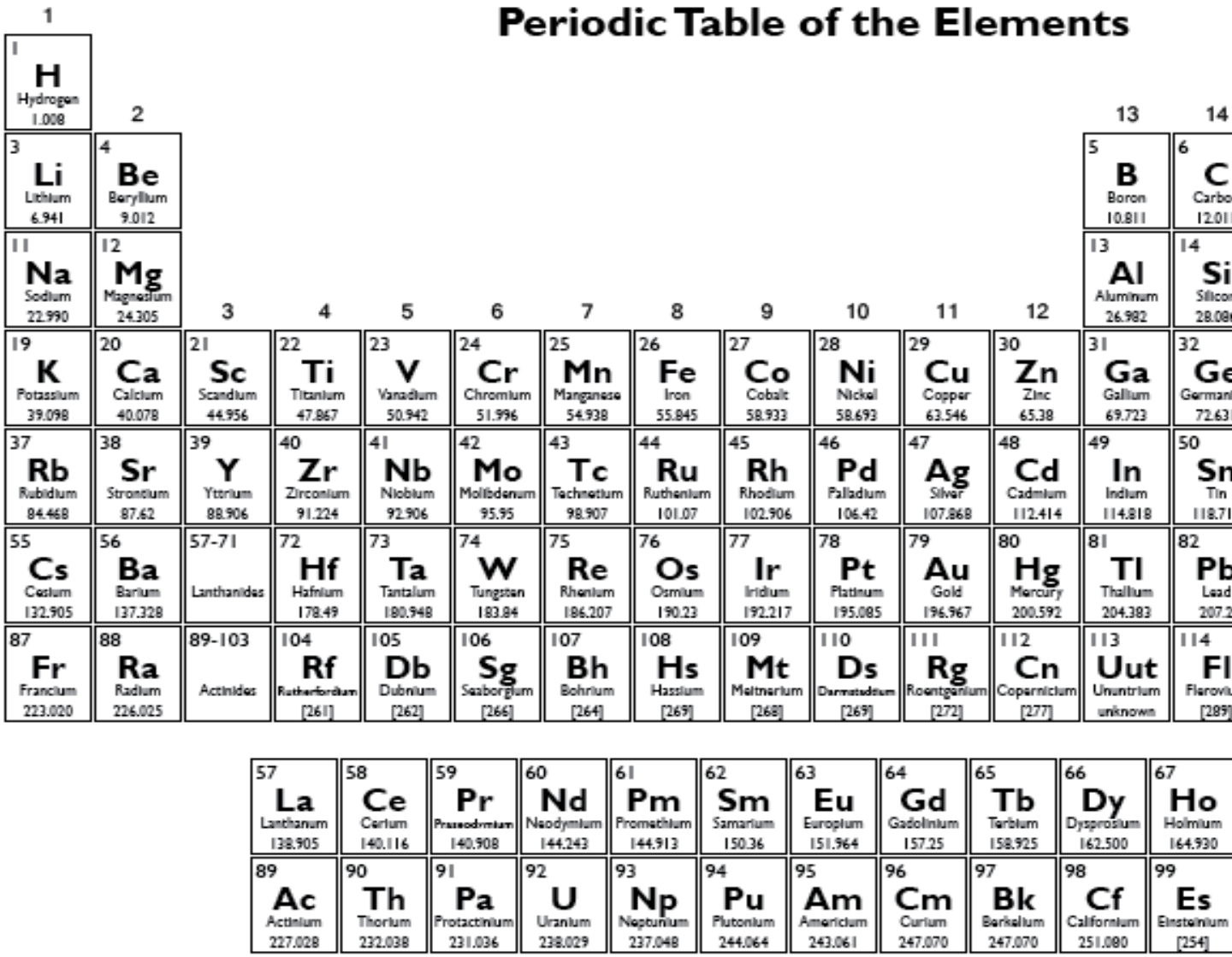
What worked well this week?

Did your students make any connections with other subjects?

What areas could be improved?

Any other notes or comments?

Week 1: Worksheets 1



Science worksheets 2

Periodic Table of the Elements

1	2											13	14	15	16	17	18
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305	3	4	5	6	7	8	9	10	11	12	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.798
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molibdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.905	54 Xe Xenon 131.293
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [292]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]	103 Lr Lawrencium [262]

Worksheet 3 : To observe and test properties of materials, Metals and Non-metals

Lesson 1 and 2.

Questions to make your think?

Why are frying pans made of metal and baking dishes often made of glass or ceramic?

Could a baking dish be made from a metal? Could a frying pan be made from glass?

Learning intentions:

- In this activity you will classify materials a metals or non-metals.
- Make generalizations about properties that differentiate metals from non-metals.
- Carry out a test to investigate the conductivity of each material

a) You teacher will provide you with samples of a number of different metals.

Material	Colour	State	Flexibility	Lustre (shiny/dull)	Ductile	Reactive

Make observations about each material

Note: Ductile refers to how easily the substance can be pulled out into a wire. Try bending each piece to determine how ductile it is/

Reactivity: try sanding a small part of each sample, is the surface different underneath in appearance? If the surface is different then it means the sample as reacted with the air.

End of lesson 1:

Lesson 2:

b) Carry out a test to investigate if it is a conductor or insulator.

Experimental set-up – labelled diagram

Material	Electrical Conductor Y/N

To measure the resistance of the material.

Experimental set-up – labelled diagram

Resistance

Material	Resistance (ohms).

Classify the materials into two groups after general observations and testing.

Metals – have a shiny and lustrous surface. They conduct electricity. They are malleable and ductile and are often relatively reactive.	**Non-metals –are often dull, nonconductive, brittle and non-ductile.**

Have you any samples that do not fit clearly as either a metal or non-metal?

Questions:

a) List the names of three metals you are familiar with in your daily life.

For each metal you listed above, describe two different uses for each.

b) List the names of three non-metals you are familiar with in your daily life.

For each non-metal you listed above, describe two different uses for each.

c) List two properties of metals and non-metals that you can observe with your senses.

d) List two properties of materials that require tests to observe. T

The way materials are used can change with time. Milk was originally delivered in glass bottles. Now cartons made from wax-coated paper and plastic jugs are used for milk.

Snow skis used to be made from wood, now they are made from fibreglass or graphite.

What factors go into decisions about changing what materials should be used when building a product?

Science Worksheet 4 : Science Investigation report: Feedback sheet

Topic: _____ Date:_____

What were you investigating? _____

I have or he/she has	
Included a hypothesis using our 'if' and 'then' model.	
Justified my hypothesis with relevant referenced research.	
Written a clear, easy to follow method.	

Drawn a neat, labelled diagram.	
Presented my results in a table and included the units.	
Drawn a graph from my data and labelled the axis.	
Identified a pattern/trend in my graph.	
Explained my findings and stated a conclusion	
Linked my conclusion with my research findings	

Self- assessment with feedback Peer ass nent with feedback Tick √

Reflection on learning.

WWW (What Went Well)- mention two things.

I really enjoyed……

EBI (Even Better If)

Because….

What were you investigating? _____

I have or he/she has	
Included a hypothesis using our 'if' and 'then' model.	
Justified my hypothesis with relevant referenced research.	
Written a clear, easy to follow method.	

Drawn a neat, labelled diagram.	
Presented my results in a table and included the units.	
Drawn a graph from my data and labelled the axis.	
Identified a pattern/trend in my graph.	
Explained my findings and stated a conclusion	
Linked my conclusion with my research findings	

Self- assessment with feedback Peer assessment with feedback Tick √

Reflection on learning.

WWW (What Went Well)- mention two things.

EBI (Even Better If)

I really enjoyed……

Because….

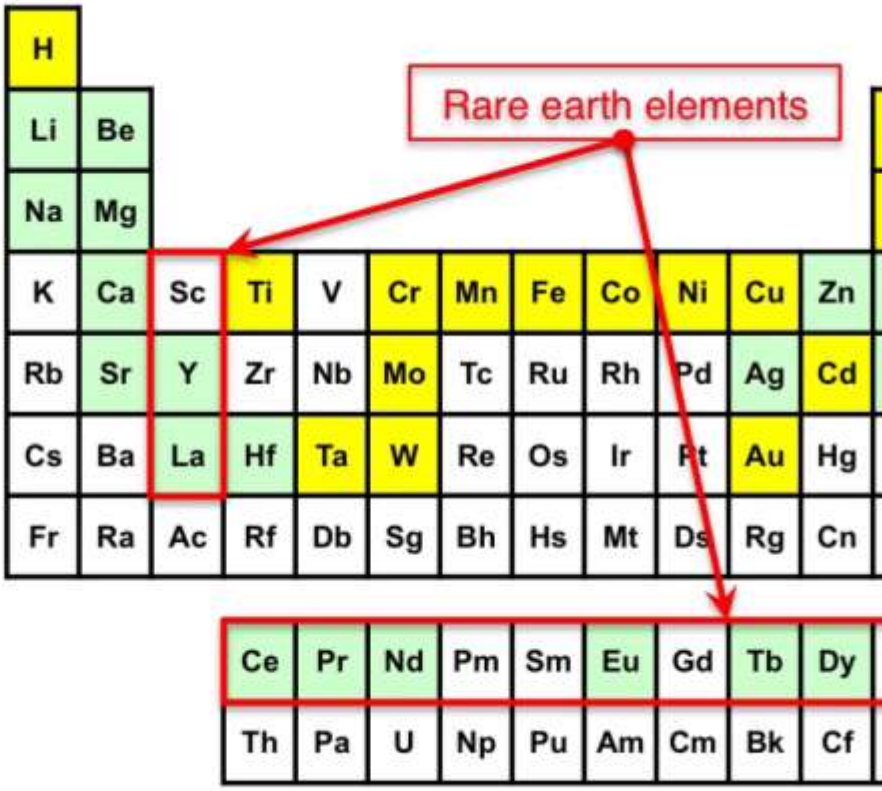
Science Worksheet 5

The ingredients of an early cell phone

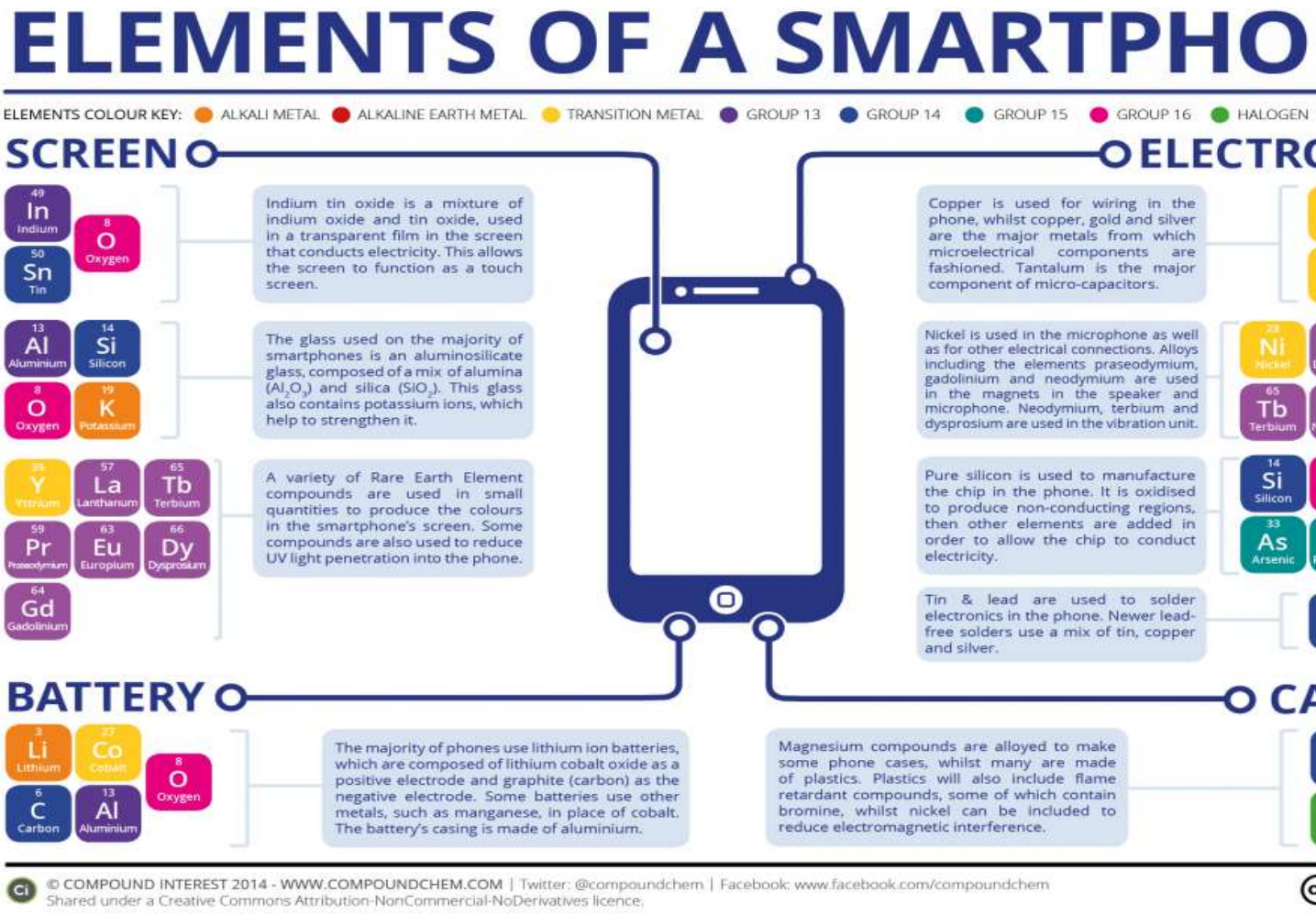
H												
Li	Be											
Na	Mg											
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	G
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	I
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	T
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	U

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	H
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	E

The ingredients in a smart phone



Science Worksheet 6


ELEMENTS OF A SMARTPHO
ELEMENTS COLOUR KEY: ALKALI METAL ALKALINE EARTH METAL TRANSITION METAL GROUP 13 GROUP 14 GROUP 15 GROUP 16 HALOGEN
SCREEN
49 In Indium
50 Sn Tin
8 O Oxygen
Indium tin oxide is a mixture of indium oxide and tin oxide, used in a transparent film in the screen that conducts electricity. This allows the screen to function as a touch screen.
13 Al Aluminium
14 Si Silicon
8 O Oxygen
19 K Potassium
The glass used on the majority of smartphones is an aluminosilicate glass, composed of a mix of alumina (Al_2O_3) and silica (SiO_2). This glass also contains potassium ions, which help to strengthen it.
39 Y Yttrium
57 La Lanthanum
65 Tb Terbium
59 Pr Praseodymium
63 Eu Europium
66 Dy Dysprosium
64 Gd Gadolinium
A variety of Rare Earth Element compounds are used in small quantities to produce the colours in the smartphone's screen. Some compounds are also used to reduce UV light penetration into the phone.
ELECTRO
Copper is used for wiring in the phone, whilst copper, gold and silver are the major metals from which microelectrical components are fashioned. Tantalum is the major component of micro-capacitors.
28 Ni Nickel
65 Tb Terbium
Nickel is used in the microphone as well as for other electrical connections. Alloys including the elements praseodymium, gadolinium and neodymium are used in the magnets in the speaker and microphone. Neodymium, terbium and dysprosium are used in the vibration unit.
14 Si Silicon
33 As Arsenic
Pure silicon is used to manufacture the chip in the phone. It is oxidised to produce non-conducting regions, then other elements are added in order to allow the chip to conduct electricity.
Tin & lead are used to solder electronics in the phone. Newer lead-free solders use a mix of tin, copper and silver.
BATTERY
3 Li Lithium
27 Co Cobalt
8 O Oxygen
6 C Carbon
13 Al Aluminium
The majority of phones use lithium ion batteries, which are composed of lithium cobalt oxide as a positive electrode and graphite (carbon) as the negative electrode. Some batteries use other metals, such as manganese, in place of cobalt. The battery's casing is made of aluminium.
CA
Magnesium compounds are alloyed to make some phone cases, whilst many are made of plastics. Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.
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Science Worksheet 7: Critical Raw Materials

Raw materials are crucial to Europe's economy. They form a strong industrial base, producing a broad range of goods and applications used in everyday life and modern technologies. Reliable and unhindered access to certain raw materials is a growing concern within the EU and across the globe. To address this challenge, the European Commission has created a list of critical raw materials (CRMs) for the EU, which is subject to a regular review and update. CRMs combine raw materials of high importance to the EU economy and of high risk associated with their supply.

Why critical raw materials are important

- **Link to industry** - non-energy raw materials are linked to all industries across all supply chain stages
- **Modern technology** - technological progress and quality of life rely on access to a growing number of raw materials. For example, a smartphone might contain up to 50 different kinds of metals, all of which contribute to its small size, light weight and functionality.
- **Environment** – raw materials are closely linked to clean technologies. They are irreplaceable in solar panels, wind turbines, electric vehicles, and energy-efficient lighting.

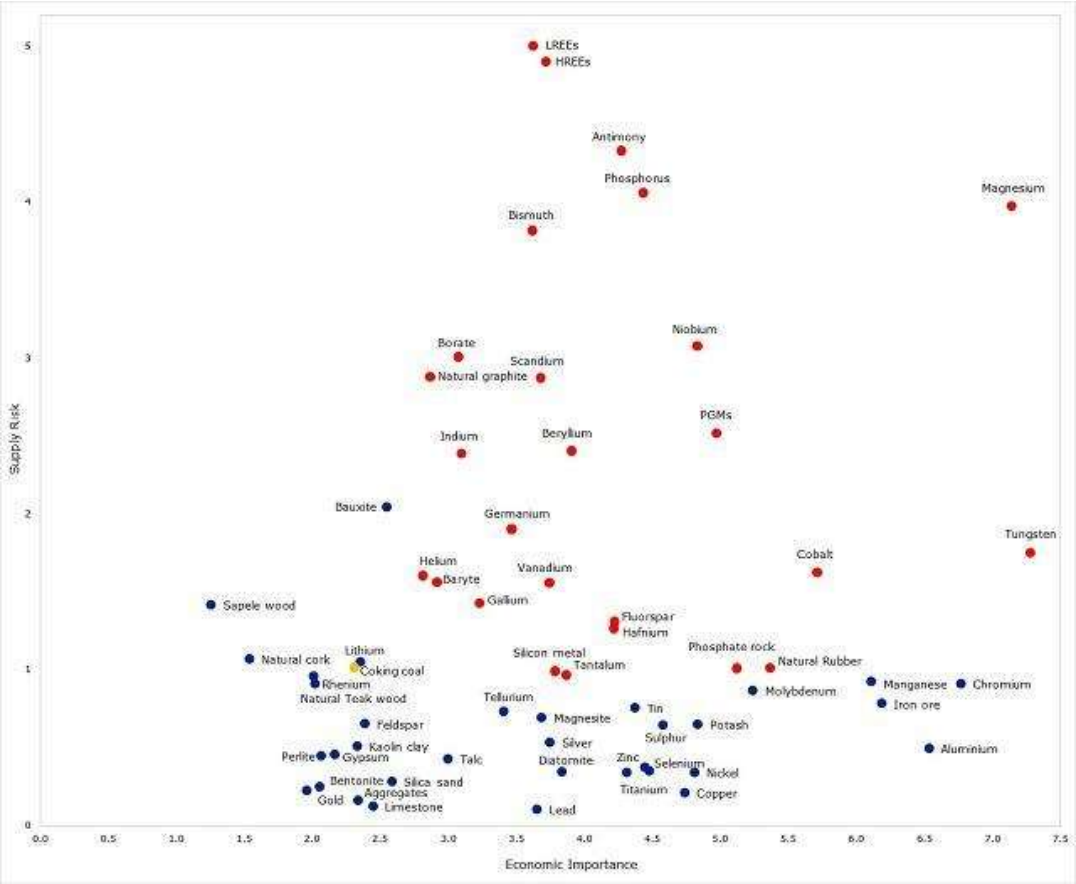
The methodology to identify CRMs

The Commission carries out a criticality assessment at EU level on a wide range of non-energy and non-agricultural raw materials. The 2017 criticality assessment was carried out for 61 candidate materials (58 individual materials and 3 material groups: heavy rare earth elements, light rare earth elements, platinum group metals, amounting to 78 materials in total). In 2011, 41 materials were assessed, while 54 materials were assessed in 2014.

The main parameters used to determine the criticality of the material for the EU are:

- **Economic importance -** aims at providing insight into the importance of a material for the EU economy in terms of end-use applications and the value added (VA) of corresponding EU manufacturing sectors at the NACE Rev.2 (2-digit level). The economic importance is corrected by the substitution index (SIEI) related to technical and cost performance of the substitutes for individual applications.
- **Supply risk -** reflects the risk of a disruption in the EU supply of the material. It is based on the concentration of primary supply from raw materials producing countries, considering their governance performance and trade aspects. Depending on the EU import reliance (IR), proportionally the 2 sets of the producing countries are taken into account — the global suppliers and the countries from which the EU is sourcing the raw materials. SR is measured at the 'bottleneck' stage of the material

(extraction or processing), which presents the highest supply risk for the EU. Substitution and recycling are considered risk-reducing measures.



2017 CRMs (27)			
Antimony	Fluorspar	LREEs	Phosphorus
Baryte	Gallium	Magnesium	Scandium
Beryllium	Germanium	Natural graphite	Silicon metal
Bismuth	Hafnium	Natural rubber	Tantalum
Borate	Helium	Niobium	Tungsten
Cobalt	HREEs	PGMs	Vanadium
Coking coal	Indium	Phosphate rock	

Third list of critical raw materials for the EU of 2017

The new list includes 9 more new materials than the 2014 list: baryte, bismuth, hafnium, helium, natural rubber, phosphorus, scandium, tantalum, vanadium. This brings the number up to 27 raw materials which are now considered critical by the Commission. 3 of these are entirely new to the list: bismuth, helium, phosphorus. The other 17 critical raw materials are included in the CRM table below. For the first time, individual assessment results are available for the 3 grouped metals: HREEs (heavy rare earth elements), LREEs (light rare earth elements), and PGMs (platinum group metals).

All raw materials, even when not classed as critical, are important for the EU economy.

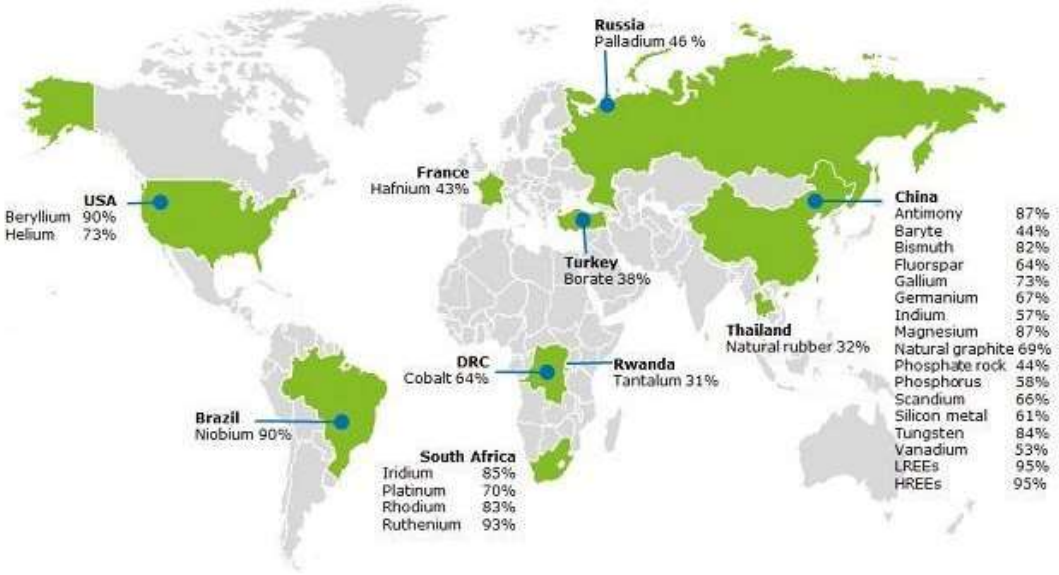
*HREEs=heavy rare earth elements, LREEs=light rare earth elements, PGMs=platinum group metals

Main global and domestic producers of CRMs

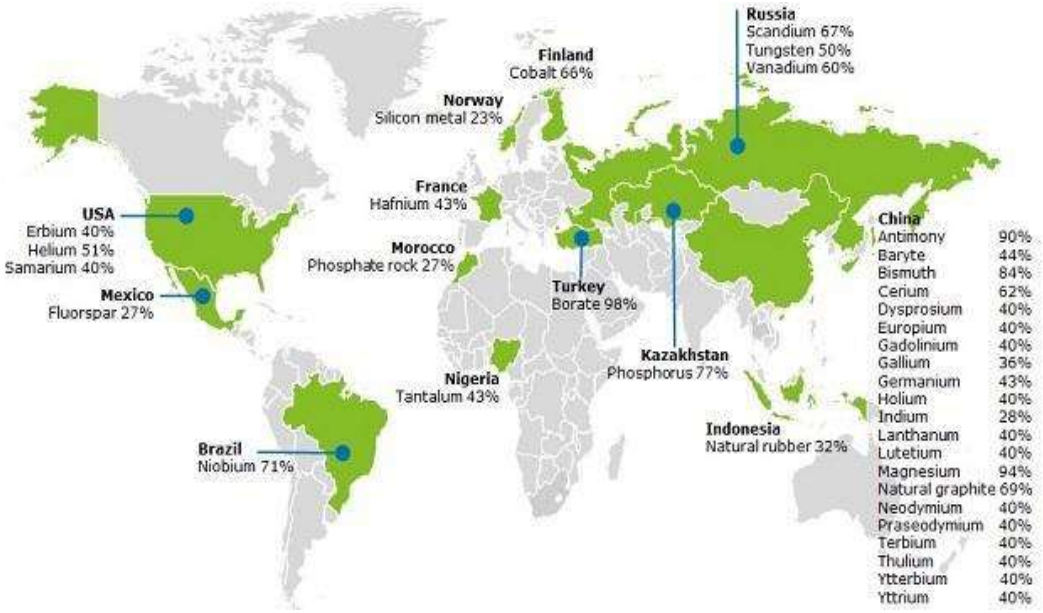
The EU's industry and economy are reliant on international markets to provide access to many important raw materials since they are produced and supplied by third countries. Although the domestic production of certain critical raw materials exists in the EU, notably hafnium, in most cases the EU is dependent on imports from non-EU countries.

China is the major supplier of critical raw materials, accounting for 70% of their global supply and 62% of their supply to the EU (e.g. rare earth elements, magnesium, antimony, natural graphite, etc.). Brazil (niobium), USA (beryllium and helium), Russia (palladium) and South Africa (iridium, platinum, rhodium and ruthenium) are also important producers of critical raw materials. The risks associated with the concentration of production are in many cases compounded by low substitution and low recycling rates.

Countries accounting for largest share of global supply of CRMs



Countries accounting for largest share of EU supply of CRMs



Questions

1. Explain in your own words why is it important to the EU that there is "reliable and unhindered access to certain raw materials?

2. State the numbers of materials tested for criticality at EU level in:
   (i) 2011
   (ii) 2014
   (iii) 2017
   What is the trend? Can you think of a reason why this is the case?

3. The main parameters to determine the criticality of a material are <u>economic importance</u> and <u>supply risk.</u>

Explain either of the underlined terms.

4. From the graph on page 2 of this article, identify:
   (i) 3 materials that score highly for criticality
   (ii) 3 materials that have low scores for criticality.

5. Using the maps on page 3,

(i) name 1 raw material produced in the EU and state where it is produced

(ii) name 5 countries that are major suppliers of CRMs to the EU.

6. Besides supply risk, name 2 other factors that increase the risk of materials.

Science Worksheet 8: Calculating Power

Success criteria

I will be able to:

- understand the term power
- calculate the power for different devices
- calculate the cost of running different devices
- explain and understand why different devices have different efficiencies

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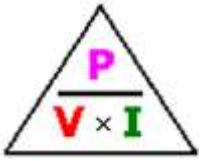
Electric power is the rate at which electrical energy is transferred by an electric circuit.

It is the rate of doing work.

Formula

P = V x I

Power (W) = Voltage (V) x Current (I)



Unit

watt or joules per second

1W = 1J/s

Example

A heater has 240 V running through it and uses 8.3 A. How many watts is this heater?

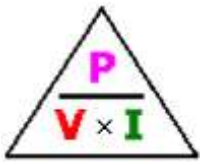
P = V x I

We have 240 V and 8.3 (amps) = I

So…..

240 x 8.3 = 1992

Answer = 1992 W



Show your Working!

Now try these:

1. What wattage is an appliance if is uses 120 V and 0.4 A?

2. What voltage is an appliance getting if it uses 2 A and is 500 W?

3. How many amps is an appliance using that has 300 V and is 1000 W?

4. How many watts would a mobile phone charger be rated for if it was supplying 0.5 A at 5 V?

- Energy companies use units of electrical energy called kilowatt-hours (kWh) or simply units.
- Units used = power x time

  (kWh) (W) (h)

  The cost per unit depends on the company, between 15-20c.

https://www.joe.ie/tech/this-is-what-it-costs-to-charge-your-smartphone-or-iphone-for-a-year-528010

This is what it costs to charge your smartphone or iPhone for a year

 ALAN LOUGHNANE

This is a lot less than we expected...

There's often a train of thought that charging your phone is quite expensive and over time, can bore a fairly hefty hole in your pocket.

But luckily, according to Forbes, it's actually not very expensive to charge your smartphone for the year.

An iPhone/average smartphone hold around 1,440mAh of charge, or about 5.45 watt hours. This means that if you were to drain and charge your phone everyday, it would require 2,000 watt hours (or 2 kWh) of energy a year.

This equates to less than €0.40c to charge your phone for a year according to Forbes.

Your laptop may cost slightly more by using 72 kWh, which means it would mean a charge of around €12 to charge your laptop for 12 months.

We have to say, we definitely expected the cost of charging our phones to be far more, but at the same time, it has to be taken into account that you have to charge your iPhone battery at least eight times a day, therefore the cost listed above may go up for some people...

https://www.forbes.com/pictures/ekhf45ffjkj/mobile-phone-25-cents-p/#32c65a4697d9


9:25 AM
9:25
Mobile phone: 25 cents per year
Your iPhone battery holds a charge of 1,440 mAh, or about 5.45 watt hours. If you fully drain and recharge your phone everyday, then over a year you would have to feed it about 2,000 watt