**Science Curriculum Project**

**Introduction to the project**

For this project students will investigate a UK engineering company called Tekmar. The project links the renewable energy sector in the UK to the GCSE Combined Science and GCSE Chemistry curriculum.

The project is built around the driving question “How can you build an offshore windfarm.”

Through this question students will explore the need for renewable energy resources, emerging careers within that sector and the relevance of their classroom learning to this context. The project will culminate in a final product showcase where students will present a “bid” to explain to explain why the offshore wind farm should be built and how engineering businesses such as Tekmar can help.

*Note: This project was developed following a teacher externship at Tekmar. There are many other engineering businesses involved in the renewable energy sector who could be used to give context for a project.*

**Cross Curriculum project opportunities**

There several opportunities to deliver this as a cross-curricular project linked to the driving question of “How can you build on an offshore windfarm” with a number of potential sub questions and student products to reflect this. For example linking to:

* Geography - climate change and resource management in geography curriculum
* English Language – producing a written text to a specified audience, oracy.
* Maths - geometry and measures, probability, statistics
* Science – Energy transfers; electricity; forces; reactivity of metals; rock cycle.

**Use the following rubric to do a self-check of your driving questions**

|  |  |
| --- | --- |
| **Challenging problem or question** | |
| **Includes features of effective Project Based Learning (PBL)** | * The project is focused on a central problem or question, at the appropriate level of challenge * The central problem or question is framed by a driving question for the project that is: * Open-ended; this will allow students to develop more than one reasonable answer * Understandable and inspiring to students * Aligned with learning goals; to answer it, students will need to gain the intended knowledge, understanding and skills |
| **Needs further development** | * The project is focused on a central problem or question, but the level of challenge might be inappropriate for the intended students * The driving question relates to the project but does not capture its central problem or question; it may be more like a theme * The driving question meets some of the criteria in focusing on the driving question but missed others |
| **Lacks features of effective PBL** | * The project is not focused on a central problem or question (it may be more like a unit with several tasks), or the problem or question is too easily solved or answered to justify a project * The central problem is not framed by a driving question for the project, or it is seriously flawed; for example: * It has a single simple answer * It is not engaging to students (it sounds too complex or “academic” like it came from a textbook, or appeals only to a teacher) |

**What part of the curriculum is covered by the project? What are the learning goals?**

The project covers key elements of the AQA GCSE Combined Science specification (8464) and AQA GCSE Chemistry specification (8462).

By the end of the project, students will have a greater understanding and a deeper knowledge of the following subject content:

* **Chemistry of the atmosphere**

The Earth’s atmosphere is dynamic and forever changing. The causes of these changes are sometimes man-made and sometimes part of many natural cycles. Scientists use very complex software to predict weather and climate change as there are many variables that can influence this. The problems caused by increased levels of air pollutants require scientists and engineers to develop solutions that help to reduce the impact of human activity

* **Using Resources**

Industries use the Earth’s natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists study how human activity has affected the Earth’s natural cycles, and how damaging effects can be minimised.

* **Working Scientifically**
  + Appreciate the power and limitations of science and consider any ethical issues which may arise.
  + Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.
  + Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences.
  + Recognise the importance of peer review of results and of communicating results to a range of audiences.

*Note: there are some aspects of the GCSE specification for above subject content, which did not authentically fit within the scope of this project. This content can be taught as stand-alone lessons either before or after the student project or within the project lessons as appropriate. Please see scheme of work for further details.*

**Possible entry activities**

To lead students into the project, and as a pre-curser to the driving question, an **entry event** will take place to kick-start the project and put it in context. Examples of possible entry events could include:

1. Show a video to introduce project. For example:

Our Future- Morgan Freeman

<https://www.youtube.com/watch?v=8YQIaOldDU8>

or

Why green energy

<https://www.youtube.com/watch?v=56MhjXTcSCg>

1. Annotate anchor text – reading age 12.5

<https://www.theguardian.com/environment/2019/mar/07/government-throws-its-weight-behind-offshore-wind-power-expansion>

1. Arrange a visit to Blyth STEM hub

<https://www.blythstemhub.org.uk/>

1. Arrange an in-school visit by a STEM ambassador from renewable energy or engineering employer

<https://www.stem.org.uk/stem-ambassadors>

**What will the end product or public exhibition be?**

One of the key elements of PBL is that what students produce is made public. This can take many forms, but in essence, students make their project work public by explaining, displaying or presenting it to people beyond the classroom.

You can check out these two websites and schools to give you some ideas and examples:

* X-P School Doncaster <http://www.xpschool.org/our-expeditions/>
* School 21 – London curriculum <https://www.school21.org.uk/sec-beautiful-work>

Key things to consider when planning the end product are:

* What support or help might you need with this?
* Are there any specific resources needed?
* Do you foresee any opportunities? Any challenges?

The end product is for you to decide. An example end product of a student presentation has been planned into the accompanying resources, however this can be adapted depending on the interests of your students. The audience could be other students, school staff, parents, or the local community. Students need to be clear at the start of the project what the anticipated end product will be. They should understand the end goal they are working towards, and what the expectations and timescales are.

**How long will the project run?**

The scheme of work is planned around a suggested 10 hours teaching time for Trilogy Combined Science and 12 hours teaching time for the Chemistry cohort. However this can be adapted depending on the needs of your students and the resources you have available. The planned resources can be used and extended as needed.

**What resources are available to inform and guide the inquiry?**

The following resources have been produced to support the delivery of this project. They can be adapted to differentiate the work depending on the needs of the students:

* Scheme of work identifying links to GCSE specification and connection to careers information.
* PowerPoint presentations to support delivery of lessons.
* Suggested research links to guide student learning
* Anchor text - Guardian article on wind power
* Articles on climate change with a range of reading age.
* Templates for activities eg exit ticket, consensus placemat, card sort of advanced manufacturing careers.
* Student and teacher information sheets for rusting practical.

**What are the checkpoints?**

* You should decide this based on the time and resources you have, and also what you want students to achieve. It is important to have some checkpoints built into the project timeline so that you can ensure students’ learning is focused, on track, and directly related to the learning outcomes and the end product you have decided on. Students should be made aware of the checkpoints from the outset, and what they need to achieve in order to pass the checkpoint.

**How will you be assessed?**

* You should design assessments in line with the end product, and with how the project fits into your cycle of assessment and targeted outcomes.
* It is good practice to share the rubric for assessment with students at the start of the project so they are clear of expectations and what is required of them and when.

**Teacher checklist and top tips to ensure a successful project**

Items to get ready and things to have at hand at the start of the project:

* **Project documents** – these are really important: what are students being asked to do? What guidance are they being given?
* **Feedback and assessment are ongoing** – teach students as you go along, do not leave everything until the end. Make sure students are given opportunities to practise with formative assessment points prior to the summative assessment and end product.
* **Work time** needs to be built in for students so they have time to **do** the work, research and background to complete the project to a high standard.
* **Scaffold the resources** – don’t give them to the students all at once.
* **Have a project wall** – What is the driving question? What do we need to know? What resources and guidance are available? Post these on the wall.
* **Share a calendar** with students that gives clear and authentic deadlines.
* **Create a rubric** so that students are clear from the outset how they will be assessed.
* **Make checklists and deliverables** available for students.
* **Be clear what the end product is.**
* **Celebrate** with a special event at the end of the project – this motivates students towards completion, and rewards them for their hard work.

**Resources to support PBL**

* Expeditionary learning classroom protocols. <https://curriculum.eleducation.org/sites/default/files/curriculumtools_classroomprotocols_053017.pdf>
* X-P School Doncaster <http://www.xpschool.org/our-expeditions/>
* School 21 – London curriculum <https://www.school21.org.uk/sec-curriculum> beautiful work <https://www.school21.org.uk/sec-beautiful-work>
* Buck Institute for Education [www.bie.org/project\_search](http://www.bie.org/project_search)
* PBLU <http://pblu.org/>
* EL Education Models of Excellence <http://models> of excellence.education.org/projects
* Envision Schools Project Exchange [www.envisionprojects.org/](http://www.envisionprojects.org/)
* High Tech High [www.hightechhigh.org/student-work/student-projects/](http://www.hightechhigh.org/student-work/student-projects/)
* EduCurious <http://educurious.org/solutions/project-based-courses/>
* West Viriginia Dept. of Education <http://wveis.k12.wv.us/teach21/public/project/>
* iEARN (International Education and Research Network) <https://iearn.org/cc/search/groups>
* Google - 24 assessments that don’t suck
* Boot camp Bootleg – D School Stanford – walks students through design process how too?
* Storyboard that
* 60 tools for formative assessment