Curriculum Map of Primary Engineer – Engineer Level 1 and 2 (Control Car)

Please Note: Minimum requirement for Celebration Event – Pupils have completed the Pupils Workbook AND their control car

- The Primary Engineer Mark Scheme is included at the end of this document for reference
- Engineer Level 1 and 2 are both from P4/5/6 pupils
- Level 1 = Standard Primary School resources/equipment, Level 2 = Non Standard Primary resources/equipment (pupils have been able to access secondary type resources or facilities)
- Engineering as a context for learning encourages pupils to develop key transferable skills through development of the Engineering habits of Mind - systems-thinking, adapting, problem finding, creative problem-solving, visualising, and improving. See Learning to be an Engineer - Implications for the education system By Royal Academy of Engineering (Summary Report published March 2017)

EHoM	Sub-habit 1	Sub-habit 2
CREATIVE PROBLEM-SOLVING is … Generating ideas and solutions by applying techniques from different traditions, critiquing, giving and receiving feedback, seeing engineering as a 'team sport'.	**Generating ideas:** comes up with suggestions in a range of situations.	**Working in team:** has good people skills to enable idea and activity sharing; good at giving and receiving critique/feedback.
IMPROVING is … Making things better by experimenting, designing, sketching, guessing, conjecturing, thought-experimenting, prototyping.	**Experimenting:** makes small tests or changes; sketching, drafting, guessing, prototyping.	**Evaluating:** making honest and accurate judgments about 'how it's going'; comfortable with words and numbers as descriptors of progress.
PROBLEM-FINDING is … Deciding what the actual question is, finding out if solutions already exist by clarifying needs, checking existing solutions, investigating contexts, verifying, thinking strategically.	**Checking and clarifying:** questions apparent solutions methodically and reflectively.	**Investigating:** has a questioning, curious and, where appropriate, sceptical attitude.
ADAPTING is … Making something designed for one purpose suitable for another purpose, by converting, modifying, transforming, adjusting, changing, reshaping, re-designing, testing, analysing, reflecting, rethinking.	**Critical thinking:** analyses ideas, activities and products; able to defends their own thoughts and ideas in discussion and also to change their mind in light of evidence.	**Deliberate practising:** disciplined; able to work at the hard parts.
VISUALISING is … Seeing the end product, being able to move from abstract ideas to concrete, manipulating materials, and mentally rehearing practical design solutions.	**Thinking out loud:** puts 3D ideas into words as they become pictures or rehearses possible lines of thought or action.	**Model-making:** moves between abstract and concrete, making models to capture ideas.
SYSTEMS-THINKING is … Seeing connections between things, seeking out patterns, seeing whole systems and their parts and how they connect, recognising interdependencies, synthesising.	**Connecting:** looks for links, connections, relationships; working across boundaries.	**Pattern-making:** uses metaphors, formulae, images etc. to find patterns to illustrate new meaning.

Engineer Level 1 and 2

Moray Skills Pathway - See Activity Overview Guidesheet for more details on Activities Pre/Post Engineer Visit

	Experiences & Outcomes/ Career Education Standards	Suggested Activities
What is an Engineer?	CES - I can describe different jobs in my community and some of the skills needed for these. Horizons 1 I can learn about the world of work from visits, projects and my experiences. Horizons 4 I can discuss the relevance of skills to the wider world and make connections between skills and the world of work. Strengths – 1 / 3 I can identify people in my network who can help me broaden my horizons. Networks - 3 E&O - I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a I am investigating different careers/occupations, ways of working, and learning and training paths. I am gaining experience that helps me recognise the relevance of my learning, skills and interests to my future life. HWB 2-20a	1. Complete the Pre-activity survey on STEM & Engineering. 2. Draw an Engineer Activity – pupils draw an engineer and name their character (interesting to note proportion of males/female characters drawn and any safety clothing they might be wearing. This can be used to tease out misconceptions about this job and help you come up with ideas for questions for their engineer. 3. Identify the skills/attributes of an engineer – use labels to annotate their drawing: • Creativity – good at problem solving, imagination • Employability – good at making decisions, taking responsibility • Self-Management – confident and don't give up • Teamwork – good at working with others • Communication – listening and talking • Thinking – creating and applying knowledge • Interpersonal – respect others, resolve group issues • Leadership – encourage others, enthusiastic, contributes ideas 4. Engineering as a process – introduce the idea of Making 'things' that work and making 'things ' work better (Core Engineering Mind). Examine examples of engineered products like bridges, towers, buildings, household objects (phones/TV etc) before moving on to cars as an engineered product. 5. Access My WOW using link below. There are 36 examples of engineering jobs. Pupils can individually or in pairs research one job title and write a brief summary of the job along with noting down the top skills. Share this with peers and see if there are common skills. https://www.myworldofwork.co.uk/my-career-options/engineering 6. Create interview questions for the engineer (include questions related to the skills identified in Activity 2, 3 or 4) – send to the engineer along with pictures of their drawings to prompt discussion.

Investigating Circuits Investigating Forces Investigating Pulleys	E&O - I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. MTH 2-21a / MTH 3-21a By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects. SCN 2-07a I have used a range of electrical components to help to make a variety of circuits for differing purposes. I can represent my circuit using symbols and describe the transfer of energy around the circuit. SCN 2-09a	1. Investigating Circuits • Modelling a Circuit – Component Hats (bulb, battery, electrons) plus energy cards: Pupils are given energy cards by the battery and pass them from electron to electron to represent the energy flow in a wire. The bulb then throws them away to represent heat/light. Breaking the circuit stops the flow of energy. • Making circuits with basic kits of bulbs, wires, batteries. 2. Investigating Pulleys • Investigating use of pulleys in real life: cranes, lifting loads (old well etc) • Use some of the pulleys in the car making kit to lift masses. If you have spring (Newton) balances you could investigate how much easier it is to lift a mass using a pulley. • How will the pulley be used in the control car? 3. Investigating Forces - Friction & Air Resistance • Timeline of cars through the ages – look at cars as an engineered product. How have they changed? (Key word – streamlined) • Examine different types of wheels – sort them into ones that help you go faster and ones that help you stick to the road. Look at wheels on F1 cars compared to an everyday car – how are they different? • What materials are the wheels made of and why? • Testing cars on a ramp – which ones go faster and why? Investigate: Try changing the materials on the ramp (carpet V tinfoil/smooth surface), adding a mass to the car, type/size of wheels, angle of slope, releasing car V pushing car. • Remember for your car, you want wheels that will provide MORE grip. Once you have completed your experiment look at the materials that created MORE friction.

Making the Basic Car	E&O - I can use my knowledge of the sizes of familiar objects or places to assist me when making an estimate of measure. MNU 2-11a I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems. MNU 2-11b I can extend and enhance my design skills to solve problems and can construct models. TCH 2-09a I can recognise basic properties and uses for a variety of materials and can discuss which ones are most suitable for a given task. TCH 2-10a I can use a range of graphic techniques, manually and digitally, to communicate ideas, concepts or products, experimenting with the use of shape, colour and texture to enhance my work. TCH 2-11a	See Risk Assessment for task Making the car involves • designing the vehicle – THEME could link to current IDL • VERY IMPORTANT: measuring the axles – can use non-standard measurements but key to car running straight is even axles. How many wheels do you want? I have seen some cars with 6 instead of 4 (extra grip?) • Making the vehicle – they come with wooden wheels; how well will these grip the ramp to allow it to climb the ramp? When you have made the basic chassis they will all be pretty similar – how will you create a streamlined shape? What materials will you use – should it be light or heavy? • The Electronic circuit – please take care to ensure that the wires are not going to short circuit the battery AND keep battery out when not using car. Marks available for making car: Quality of chassis – 10, Quality of mechanisms - 10 Quality of electrics – 10 , Quality of switch - 10 Quality of finished model - 20
Testing the Car 1 – On a flat surface and Up a ramp Evaluation	E&O - I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. MTH 2-21a / MTH 3-21a I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a	Testing the car involves • Seeing if the circuit works! • Investigating how well the car goes UP a ramp. Keep the surface of the ramp smooth but change the angle of the ramp and measure how far it goes up the ramp (distance in cm). By collecting this information you could create a graph of results and write this experiment up using the headings Aim, Hypothesis, Method, Results, Conclusion, Evaluation • A key part of testing the car is evaluating your work – pupils should make sure to note this down as part of their project. Marks available when testing car: Straight line performance - 30 Ramp performance - 20
Refining Testing the Car 2	E&O - I can use a range of graphic techniques, manually and digitally, to communicate ideas, concepts or products, experimenting with the use of shape, colour and texture to enhance my work. TCH 2-11a I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a	Refining the car involves • Using the evaluation to decide on changes that need to be made to your design • Draw out your design highlighting your changes (this gains marks for the project) • Make changes and finish the bodywork of the car • Retest the car as above!

Link Engineer Visit	CES - I can describe different jobs in my community and some of the skills needed for these. Horizons 1 I can learn about the world of work from visits, projects and my experiences. Horizons 4 I can discuss the relevance of skills to the wider world and make connections between skills and the world of work. Strengths – 1 / 3 I can identify people in my network who can help me broaden my horizons. Networks - 3 E&O - I am investigating different careers/occupations, ways of working, and learning and training paths. I am gaining experience that helps me recognise the relevance of my learning, skills and interests to my future life. HWB 2-20a I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a	1. Interview the engineer about their job – what do they do? How did they get into this job? What skills does it need? What school subjects did they do that help them in their job? What do they like best about their job? 2. Some schools scheduled their engineer visit at the start of the process and the engineer helped pupils make the control car. Others asked the engineer to come in for the testing days to help them test, evaluate and refine their models. Post visit: 3. Pupils create a news report from the interview – this could be written formally or as a blog or a news round style video. 4. Look at the job profiles of some of our Local Engineers – what pathways did they take into their current role? 5. Peer review your drawings of engineers – what would you add/change and why (discussion) 6. If you did not have time to do this beforehand: Access My WOW using link below. There are 36 examples of engineering jobs. Pupils can individually or in pairs research one job title and write a brief summary of the job along with noting down the top skills. Share this with peers and see if there are common skills. https://www.myworldofwork.co.uk/my-career-options/engineering

Project – Completion of Booklet/Paperwork	E&O - I can make notes, organise them under suitable headings and use them to understand information, develop my thinking, explore problems and create new texts, using my own words as appropriate. LIT 2-15a I can spell most of the words I need to communicate, using spelling rules, specialist vocabulary, self-correction techniques and a range of resources. LIT 2-21a In both short and extended texts, I can use appropriate punctuation, vary my sentence structures and divide my work into paragraphs in a way that makes sense to my reader. LIT 2-22a Throughout the writing process, I can check that my writing makes sense and meets its purpose. LIT 2-23a I can consider the impact that layout and presentation will have and can combine lettering, graphics and other features to engage my reader. LIT 2-24a I can use my notes and other types of writing to help me understand information and ideas, explore problems, make decisions, generate and develop ideas or create new text. I recognise the need to acknowledge my sources and can do this appropriately. LIT 2-25a By considering the type of text I am creating, I can select ideas and relevant information, organise these in an appropriate way for my purpose and use suitable vocabulary for my audience. LIT 2-26a I can use a range of graphic techniques, manually and digitally, to communicate ideas, concepts or products, experimenting with the use of shape, colour and texture to enhance my work. TCH 2-11a I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a	Some schools got pupils to write up a "How to make a control car" as an example of functional writing By including a circuit drawing for your car using the correct symbols, you complete another aspect of SCN 2-09a. Looking at the Celebration Mark Sheet, pupils should be able to show evidence of their research on vehicles, on mechanisms (like pulleys) and electrics and on materials, their design ideas, working drawings, evaluation and record of changes to design. Examples of Good Practice for gathering evidence: • Some pupils created a poster of their learning covering these key aspects to bring to the celebration event along with photographs, models and evidence of their experiments to create a showcase around their model. Others went for a Project Booklet approach or a PowerPoint of their work which they displayed on a laptop. • Some schools created a video detailing their work – this linked digital literacy into the project as well. • Some schools have used a specific class project book for the Engineering Project to gather pupils ideas/thoughts and pictures from the various activities. This was also brought to the Celebration Event and really helped the judges when talking to the pupils to pick up on various aspects of what they had been doing.