Appendix – Annotated KS3 Programme of Study (PoS) (2014)

Notes in the right hand column are intended for teachers outlining how aspects of the PoS might be covered in cycling related projects.

These are not to be shared with students who should research the context themselves and come up with their own ideas for new products. Giving pupils too much guidance will reduce their ownership of the project and could lose them points in the judging.

KS3 POS – Subject Content	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Through a variety of creative and practical activities	**Creative and practical activities** Through these activities pupils are equipped with the knowledge, understanding and skills to engage successfully and independently in the process of designing and making. They include focused tasks where pupils are taught specific technical knowledge, designing skills and making skills, and investigative and evaluative activities where they learn about D&T in the wider	Research the wider context of cycling to develop greater awareness of opportunities and unfulfilled needs. Identify a specific need, then evaluate and test existing solutions. Learn more about the situation. This could be teacher/expert input on generic materials, ingredients, processes, and manufacturing techniques. Pupils should then apply the new found knowledge, skills and understanding to the cycling context. Generate ideas for new/improved products and carry out incremental development. The solution needs to be fully documented including mock-ups and/or real/virtual models and developed to a point where it could be made. Pupils do not have to manufacture their design to enter the competition, but may work to make models as part of their designing.
Pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making.	**Iterative process** When designing and making, pupils should engage in an iterative process. Through this process pupils' ideas are communicated and clarified through action. As opposed to a formulaic linear or cyclical process, during an iterative process thought leads to action, resulting in further thought and action as pupils resolve design problems and address design opportunities.	The challenge is focussed on pupils coming up with good ideas and developing them through several iterations or versions. This might be in the form of testing and analysis of real or virtual models and mock-ups, and how this helped inform improvements in each successive version.

They should work in a range of domestic and local contexts, such as the home, health, leisure and culture, and industrial contexts, such as engineering, manufacturing, construction, food, energy, agriculture (including horticulture) and fashion.	**Range of domestic, local and industrial contexts** Pupils should carry out projects within contexts that add meaning, relevance and create motivating opportunities for learning. Engaging with contexts may involve visiting locations and people outside school, inviting experts into school and using media to enable pupils to explore less familiar surroundings. The list of examples illustrates the breadth of contexts in each key stage. They do not prescribe content to be taught, but a range of authentic situations which provide starting points for designing and making. Schools may choose to work in contexts that are not listed. For example, in KS3 pupils may work in contexts such as the circular economy or sustainable development.	Talk to a range of people who regularly use bikes for leisure, sport, touring, commuting. This might include local cycling clubs, cycle shops, cycle manufacturers. Cycling is an inherently 'green' activity but pupils will need to show an understanding of this when choosing materials, ingredients, processes and components. End of life processing is also important as it can further reduce the overall environmental cost. Teachers must ensure when pupils are carrying out research, they follow all child protection procedures.
When designing and making, pupils should be taught to:	**When designing and making** Pupils' learning within Design, Make, Evaluate and Technical Knowledge should be developed as a connected, coherent whole when they are designing and making products.	Evidence pupils have a clear understanding of the context, and use this to focus their research in areas relevant to their ideas

Design

KS3 POS – Subject Content	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Use research and exploration, such as the study of different cultures	**Different cultures** pupils should study a range of cultures that are less familiar to them, providing opportunities to research and understand a variety of values, needs and wants.	Research how people use bikes in different parts of the world. How they are used, the materials they are made from, how they are made and repaired and what happens at the end of their useful life.
To identify and understand user needs	**User needs** Understanding needs is an essential part of designing for a client or user group. Pupils should be taught how to address the interests, problems and preferences of a wide range of people.	Show an understanding of the specific user group they are designing for, e.g. safely transporting young children, or designing meals for cycle touring where cooking facilities are limited to a single gas burner.

Identify and solve their own design problems	**Solve their own design problems** Pupils are required to identify problems themselves in addition to responding to those they are set.	Pupils need to identify opportunities, such as cycle commuters carrying and protecting electrical devices on journeys that combine bike use with public transport.
And understand how to reformulate problems given to them	**Reformulate problems** This is when, following research and investigation, pupils determine that the original problem or brief requires redefining.	Evidence that the design specification has been altered and refined in the light of research, analysis, testing.
Develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations	**Innovative, functioning and appealing products** Projects set should always provide opportunities for originality, resulting in products that work in some way in order to be successful. Products should provide an elegant solution that is engaging and aesthetically pleasing for the intended user.	Specifications should have a balance of subjective and objective performance criteria. Objective criteria should be measurable with performance quantified. Avoid copying existing products or making minor changes to them. Innovation doesn't have to be an entire product idea. It can be an aspect of a design, e.g. a clamping system borrowed from stage lighting adapted to attach a smart phone to the handlebars.
Use a variety of approaches	**Variety of approaches** Pupils should be taught to use a range of designing strategies. These strategies guard against otherwise stereotypical responses that can emanate from briefs, tasks and challenges that are set. Two examples are provided in the subject content for KS3 but others should also be used.	Module 4 of the KS3 Strategy materials on designing has a lot of ideas for helping pupils work creatively. https://www.data.org.uk/resource-shop/secondary/ks3-dt-national-strategy-module-4-teaching-the-subskills-of-designing/
User-centred design, to generate creative ideas and avoid stereotypical responses	**User-centred design** Involves optimising the design of a product around the needs, wants, and values of its intended user. It requires the ability to be able to foresee how specific users are likely to use a product, by involving them at an early stage and in live testing and evaluation.	Bikes to carry specific equipment; e.g. fast food deliveries, camera equipment for photographers, bike taxis. High energy foods for specific events like sprints, endurance or groups of people such as vegetarian, or those with allergies or gluten intolerance.

And biomimicry	**Biomimicry** Involves the techniques of looking at how the natural world solves problems and using this inspiration to develop new ideas for the made world. Pupils should be taught how to investigate nature, for example materials, structures and systems and use this to suggest new product ideas and possible solutions to problems. **	For example helmet designs with low friction/loose covers or fluid between the inner and outer shells mimicking the fluid that surrounds the brain. Designed to reduce rotational neck injuries when a rider's head contacts the ground. http://rideapart.com/2010/10/could-disconnecting-the-shell-improve-helmet-safety/ Under no circumstances should pupils test safety equipment they have designed on themselves or others. Testing should use sensors/data capture devices to quantify performance or fragile objects like eggs or soft fruit for empirical testing.
Develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations	**Mathematical modelling** involves pupils modelling functional aspects of their designs using mathematics, to indicate the likely performance before they are realised or constructed. For instance when using a simple motor and gearing system with known ratios, they can predict change in speed of the output relative to the input.	Spread sheets to calculate nutritional content and RDA for meals/snacks/energy drinks, etc. Apps for athletes to help with dietary planning which calculate and display energy intake compared with energy used. Analysis tools to calculate surface area of fabrics, volume/cost of parts for moulding/3D printing, Simulation tools to check strength of cases or brackets for fixing things to bikes.
And computer-based tools	**Computer-based tools** Pupils should use a variety of computer-based tools including computer-aided design (CAD).	3D model camera mounts, accessories, cases for alarms, etc. Reverse engineer a camera or smart phone on which their design for case/bracket for attaching to a bike is based.

Make

Pupils do not have to manufacture their design to enter the competition.

KS3 POS - Subject Content	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Select from and use specialist tools, techniques, processes, equipment and machinery precisely, including computer-aided manufacture	Computer-aided manufacturing (CAM), for example reverse engineering, creating textiles products, modelling and testing electronic circuits, structural analysis and nutritional analysis.	Direct manufacture of bracket, clips, cases using CNC machining/3D printing. Secondary manufacture such as vacuum forming/injection moulding from formers and moulds produced on CNC/3D print. Circuit design/programmable systems for electronic alarms, exercise monitoring, etc.
Select from and use a wider, more complex range of materials, components and ingredients, taking into account their properties	**Range of materials components and ingredients** Pupils should use a broad range of both traditional and modern materials, including smart materials, and through learning about their properties, make informed choices about which to use in the products they design and make. 'Ingredients' refers to food ingredients.	When designing energy foods for cyclists. Choice of electronic components to customise inputs/outputs for exercise monitoring system Informed choice of material, balancing strength with cost and ease of manufacture.

Evaluate

KS3 POS – Subject Content	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Analyse the work of past and present professionals and others to develop and broaden their understanding	**Past and present professionals and others** As part of their designing and making, pupils should investigate the work of others, including design movements and designers, to develop their appreciation of design and to inform their own design thinking.	Historical development of bicycles. Alex Moulton – pioneer of the small wheeled bike and suspension. Folding bikes e.g. Strider, Brompton.
Investigate new and emerging technologies	**New and emerging technologies** New materials, processes and technologies are constantly being developed, for example conductive threads in textiles, some of which are transforming the designed and made world. Pupils should be taught to investigate these and, where applicable, make connections with their own designing and making.	Lotus racing bike which pioneered the use of carbon fibre. Ergonomic fit of helmets for individuals allowing closer fit and better streamlining.
Test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups	**Views of intended users** Pupils should continuously evaluate their products and ideas, putting at the centre of their thinking the views of those who will use their products.	Dialogue with end users, e.g. testing different recipes for competitors for cost/ nutrition/taste. Evidence of testing against both subjective and objective performance criteria, and where possible quantifying improvements in later versions of a design.
Understand developments in design and technology, its impact on individuals, society and the environment	**Impact** Pupils should be taught about both the positive and negative impact of design and technology in the wider world. This could include the responsible use of resources, considering sustainability issues and becoming familiar with a circular economy approach to product lifecycles.	Evidence resources have been chosen based on an understanding of their environmental and/or social impact. Show the choice of materials, ingredients and processes has been informed by an understanding of sustainability and the circular economy.

And the responsibilities of designers, engineers and technologists	**Designers, engineers and technologists** Pupils should reflect upon the impact of past and contemporary designers, engineers and technologists on the wider world, considering their own responsibilities when developing products.	Worldbike - http://worldbike.org/why-bikes http://en.wikipedia.org/wiki/Bicycle_poverty_reduction

Technical Knowledge

KS3 POS - Subject Content	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions	**Properties of materials** pupils should learn about and make use of the properties of materials such as mechanical, thermal, electrical, magnetic, optical, chemical, nutritional and sensory when making an informed choice about the products they are designing. They should develop an understanding of how structures perform and use this to inform decisions related to the shape and size of structural elements.	Evidence design has been informed by an understanding of materials, structure etc. E.g thickness of materials , shape and use of ribs, thickening for cases, brackets, etc
Understand how more advanced mechanical systems used in their products enable changes in movement and force	**Mechanical systems** Pupils should understand and use more sophisticated mechanical systems including gears, gear trains, pulleys, levers and linkages using either kits or components they manufacture themselves.	Mechanisms to clamp, fold, adjust, and position parts of a bike or attachments.
Understand how more advanced electrical and electronic systems can be powered and used in their products, such as circuits with heat, light, sound and movement as inputs and outputs	**Electrical and electronic systems** Pupils should learn how to plan, manufacture and populate their own electronic circuits and build these into products they design. Some of these products should incorporate the use of sensing and control components which receive input signals, process them, resulting in outputs such as sound, movement and light.	E.g. applied to products such as alarms, monitoring and lighting systems.

Apply computing and use electronics to embed intelligence in products that respond to inputs such as sensors, and control outputs such as actuators, using programmable components such as	**Programmable components** The operation of these can be programmed, modelled and tested using either icon based software or programming code.	Exercise monitoring e.g., velocity, average speed, energy used, etc. Control of sports cameras while on the move

Cooking and Nutrition

As part of their work with food, pupils should be taught how to cook and apply the principles of nutrition and healthy eating. Instilling a love of cooking in pupils will also open a door to one of the great expressions of human creativity. Learning how to cook is a crucial life skill that enables pupils to feed themselves and others affordably and well, now and in later life.

Pupils should be taught to	Description	How typical GBMO projects might cover aspects of PoS and help pupils be creative and innovative.
Understand and apply the principles of nutrition and health	**Principles of nutrition and health** Pupils in KS3 should be taught about energy, nutrients, water and fibre, diet and health and nutritional needs throughout life.	Taught in the context of cyclists taking part in different cycling events.
Cook a repertoire of predominantly savoury dishes so that	**Repertoire of predominately savoury dishes** In KS3 the range of dishes should be in line with the principles of The eatwell plate.	Show how closely the foods devised for cyclists match these recommendations.
They are able to feed themselves and others	**Feed themselves** KS3 pupils should take into account personal preference, socio-economic aspects, nutritional and health needs.	Show how closely the foods devised for cyclists match these recommendations.
A healthy and varied diet	**Healthy and varied diet** As depicted in The eatwell plate and Eight tips for healthy eating.	Show how closely the foods devised for cyclists match these recommendations.

Become competent in a range of cooking techniques [for example, selecting and preparing ingredients; using utensils and electrical equipment; applying heat in different ways; using awareness of taste, texture and smell to decide how to season dishes and combine ingredients; adapting and using their own recipes		Describe the process of taking ingredients and turning them into food products for cyclists.
Understand the source	**Source** KS3 pupils should explore the origin and production of food products and ingredients.	Know where the ingredients used come from, the food miles and costs/impact of using them.
Seasonality	**Seasonality** KS3 pupils should consider how seasons may affect the food available.	Avoiding unnecessary transportation. Using local produce.
And characteristics of	**Characteristics** KS3 pupils should consider the function, nutrient profile and sensory attributes of ingredients.	Show how the chosen ingredients match the needs of the target group of cyclists.
A broad range of ingredients.	**Broad range** KS3 pupils should study and use a range of food commodities, e.g. cereals, fruit, vegetables, meat, fish, eggs, fats/oils, milk/dairy food products.	Matching these to the dietary needs of people who exercise.