1. Year Groups

Year 1/2

2. Aspect of D&T

Mechanisms

Focus

Wheels and axles

3. Key learning in design and technology

Prior learning

- Assembled vehicles with moving wheels using construction kits.
- Explore moving vehicles through play.
- Gained some experience of designing, making and evaluating products for a specified user and purpose.
- Developed some cutting, joining and finishing skills with card.

Designing

- Generate initial ideas and simple design criteria through talking and using own experiences.
- Develop and communicate ideas through drawings and mock-ups.

Making

- Select from and use a range of tools and equipment to perform practical tasks such as cutting and joining to allow movement and finishing.
- Select from and use a range of materials and components such as paper, card, plastic and wood according to their characteristics.

Evaluating

- Explore and evaluate a range of products with wheels and axles.
- Evaluate their ideas throughout and their products against original criteria.

Technical knowledge and understanding

- Explore and use wheels, axles and axle holders.
- Distinguish between fixed and freely moving axles.
- Know and use technical vocabulary relevant to the project.

4. What could children design, make and evaluate?

push/pull toys e.g. emergency service vehicle
carnival float farm vehicle clown's car
vehicle for imaginary/story character
shopping trolley other – specify

5. Intended users

themselves people who help us friends
story character farmers/farm animals
teddy class doll other – specify

6. Purpose of products

making work or everyday life easier
moving objects toy vehicle to play with
solving a problem for a story character
other – specify

7. Links to topics/themes

People Who Help Us Helping Others
Our Local Community Food and Farming
Traditional Stories Fairy Tales Transport
Nursery Rhymes Toys other – specify

8. Possible contexts

imaginary story-based home school
leisure culture local community
other – specify

9. Project title

Design, make and evaluate a _____ (product) for _____ (user) for _____ (purpose)
To be completed by the teacher. Use the project title to set the scene for children's learning prior to activities in 10, 12 and 14.

10. Investigative and Evaluative Activities (IEAs)

- Explore and evaluate a range of wheeled products such as toys and everyday objects. Through questioning, direct children's observations e.g. the number, size, position and methods of fixing wheels and axles. *How do you think the wheels move? How do you think the wheels are fixed on? Why do you think the product has this number of wheels? Why do you think the wheels are round?*
- Draw an example of a wheeled product, stating the user and purpose, and labelling the main parts e.g. body, chassis, wheels, axles and axle holders.
- Walk around the school building and grounds, recording how wheels and axles are used in daily life.
- Read a story or non-fiction book that includes a wheeled product. Use this to introduce relevant vocabulary and to emphasise user and purpose.

11. Related learning in other subjects

- **Science** – working scientifically: ask simple questions and observe closely. Explore use of everyday materials.
- **Mathematics** – number of wheels, more than, less than, equal.
- **Spoken Language** – use of technical vocabulary. Ask relevant questions to extend understanding and build vocabulary and knowledge.

12. Focused Tasks (FTs)

- Using construction kits with wheels and axles, ask children to make a product that moves.
- Demonstrate to children how wheels and axles may be assembled as either fixed axles or free axles.
- Show different ways of making axle holders and stress the importance of making sure the axles run freely within the holders.
- Ensure that children are taught how to mark out, hold, cut and join materials and components correctly.
- Using samples of materials and components they will use when designing and making, ask the children to assemble some examples of wheel, axle, axle holder combinations. Display the work completed as a reference for their DMEA.

13. Related learning in other subjects

- **Spoken language** – give well-structured descriptions and explanations. Develop speaking and listening skills. Learn relevant technical vocabulary.
- **Mathematics** – measuring length using non-standard and standard units.

14. Design, Make and Evaluate Assignment (DMEA)

- Discuss with the children what they will be designing, making and evaluating within an authentic context.
- With the children identify a user and purpose for the product and generate simple criteria.
- Ask children to generate, develop and communicate their ideas as appropriate e.g. through talk and drawing. Talk about, evaluate and share ideas with other children/adults.
- Make their wheel and axle product using their design ideas and criteria as an ongoing guide.
- Discuss how the children might add finishing techniques to their product with reference to their design ideas and criteria. Direct the children to information and communication technology opportunities such as clip art, word processing, paint or simple drawing programs.
- Ask children to evaluate their finished product, communicating how it works and how it matches their design criteria, including any changes they made.

15. Related learning in other subjects

- **Spoken language** – use spoken language to develop understanding through imagining and exploring ideas.
- **Art and Design** – use a range of media and materials creatively to design and make products.
- **Computing** – use technology purposefully to create and manipulate digital content.
- **Mathematics** – measurement using non-standard and standard units.

16. Possible resources

selection of toy vehicles with differently fixed axles

card boxes, card, cotton reels, plastic tubing, dowel, clothes pegs, paper sticks/dowel, paper/plastic straws, card discs, MDF wheels

single hole punch, card drill, cutting mat, masking tape, PVA glue, paint, thin/thick paint brushes, felt tip pens, decorative paper, double sided sticky fixers, junior hacksaw, vice, left/right handed scissors

17. Key vocabulary

vehicle, wheel, axle, axle holder, chassis, body, cab

assembling, cutting, joining, shaping, finishing, fixed, free, moving, mechanism

names of tools, equipment and materials used

design, make, evaluate, purpose, user, criteria, functional

18. Key competencies

problem-solving teamwork negotiation
consumer awareness organisation motivation
persuasion leadership perseverance
other – specify

19. Health and safety

Pupils should be taught to work safely, using tools, equipment, materials, components and techniques appropriate to the task. Risk assessments should be carried out prior to undertaking this project.

20. Overall potential of project

Years 1/2 Mechanisms
Wheels and axles

Instant CPD

Tips for teachers

- ✓ Ensure a variety of different shaped boxes are available so children can select the one most appropriate for their design.
- ✓ Provide wheels with a range of diameters and thicknesses for children to explore and select the most suitable.
- ✓ A card disc glued onto a wooden/MDF wheel is easy to draw on to add details using felt tip pens.
- ✓ To add a trailer, use flat magnets glued onto the ends of boxes (opposite poles outwards) or short pieces of pipe cleaner bent to form a 'hook and eye'.
- ✓ Homework - ask children to complete a checklist of different types of vehicles and how many of each one they see in their local area.
- ✓ Homework - ask the children to record a range of wheeled toys. They could record in writing or with pictures such as drawings, cut outs or photographs.

Useful resources at www.data.org.uk

- **Working with wheels and axles** (9-11 years but contains useful information)
- **CPD Resources Primary INSET Guides**

Other useful web-based resources:

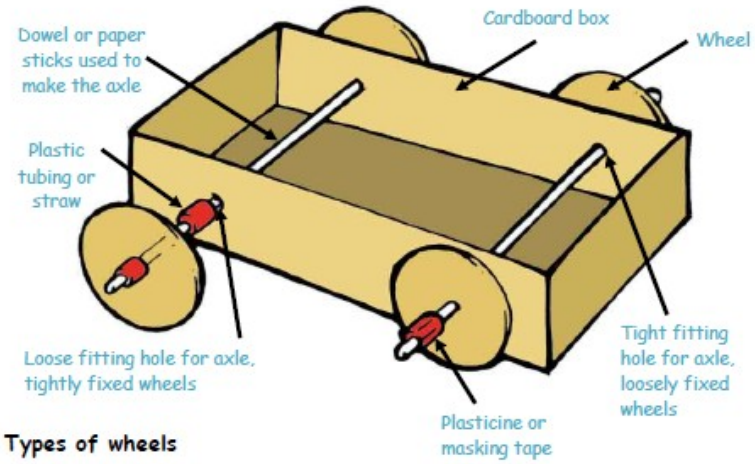
- **http://education.staffordshire.gov.uk/Curriculum/Subjectareas/DesignandTechnology/Primary/Support/Datafile/**

D&T Association publications

- **Primary Helpsheets – Unit 2A Vehicles**
- **Primary Lesson Plans – Unit 2A Vehicles**

Please note that these publications are based on previous National Curricula.

Example of two different ways to fix wheels



Types of wheels

Wood/card/MDF | Plastic | Cotton reels | Foam covered reels

Ways to hold free moving axles

Use pairs of clothes pegs glued with PVA to the underside of a box.
Check the peg holes are large enough to allow axles to move freely.
Make sure they are aligned carefully so the vehicle moves in a straight line when the wheel and axle mechanism is added.

Use card triangles with holes for the axle.
Check the holes are large enough to allow the axle to move freely.
Make sure opposite triangles are aligned carefully so the vehicle moves in a straight line when the wheel and axle mechanism is added.

Use large paper/plastic straws fixed with masking tape to the underside of a box.
Check straws are positioned carefully so the vehicle will move in a straight line when the wheel and axle mechanisms are added.
Make sure the straw hole is large enough to allow the axle to move freely. The wheels must be fixed tightly to the axle.

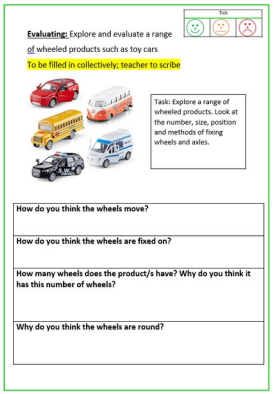
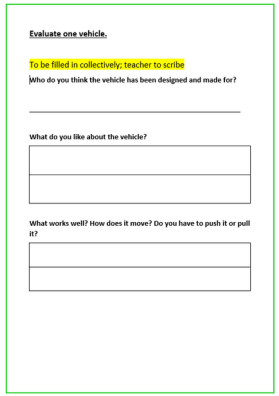
Designing, making and evaluating a small scale wheeled trolley that will carry tools to use in the school garden or for a character in a story

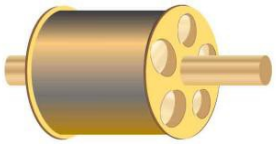
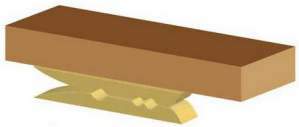
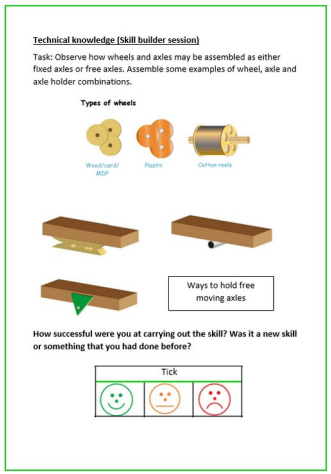
An iterative process is the relationship between a pupil's ideas and how they are communicated and clarified through activity. This is an example of how the iterative design and make process *might* be experienced by an individual pupil during this project:

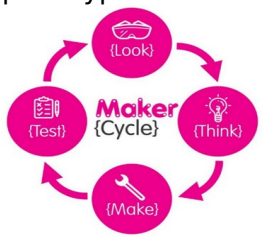
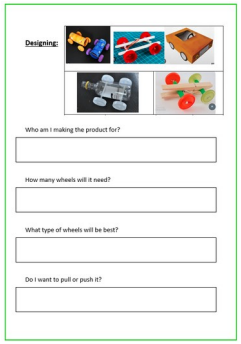
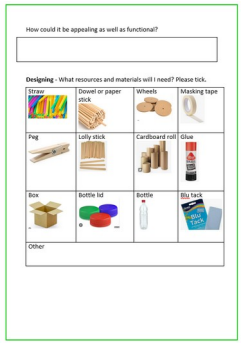
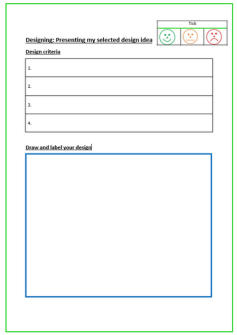
THOUGHT	ACTION
Who am I making the trolley for?	Talk about and explore a range of existing wheeled products
How many wheels will it need? What type of wheels will be best?	Discuss and consider the best size and material from the wheels available Talk about the surfaces the trolley might have to travel over
What does it need to carry?	Discuss and list the things that need to be carried
Should there be sections for different items? How big does each section need to be?	Use drawings and collect different sized and shaped boxes Clarify and model ideas using the boxes
Do we want to pull or push it? Which way moves best?	Try out existing trolleys and test out ideas including different types of handles
How could it be appealing as well as functional?	Talk about and combine ideas to create designs
What tools, resources and materials will we need?	Think about and collect resources Select appropriate tools
What will I do if something does not work as planned?	Reflect on and refine ideas and designs as the process develops
How will I check the trolley is fit for the user and for its purpose as I make it?	Frequently test the movement and design of the trolley with and without contents
What do I think about my final product?	Reflect and evaluate against the original design criteria

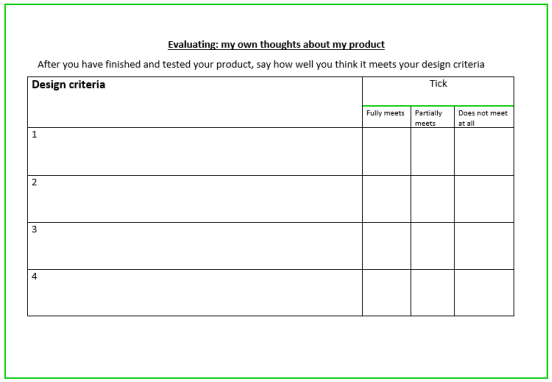
Glossary

Axle – a rod that enables a wheel to rotate. The wheel can rotate freely on the axle or be fixed to, and turn with, the axle.
Axle holder – the component through which an axle fits and rotates.
Chassis – the frame or base on which a vehicle is built.
Friction – resistance which is encountered when two things rub together.
Dowel – wooden rods used for making axles to hold wheels.

Session	Learning objective	Activity/outcome	Assessment	Vocabulary
1 Look LI: Give an opinion on a pre-existing product  		<u>Task: Research and explore existing products</u> Introduce the project: Making a toy car **Investigative and Evaluative Activities (IEAs)** • Explore and evaluate a range of wheeled products such as toys and everyday objects. Through questioning, direct children's observations e.g. the number, size, position and methods of fixing wheels and axles. *How do you think the wheels move? How do you think the wheels are fixed on? Why do you think the product has this number of wheels? Why do you think the wheels are round?* • Draw an example of a wheeled product, stating the user and purpose, and labelling the main parts e.g. body, chassis, wheels, axles and axle holders. • Walk around the school building and grounds, recording how wheels and axles are used in daily life. • Read a story or non-fiction book that includes a wheeled product. Use this to introduce relevant vocabulary and to emphasise user and purpose.	• Who do you think the product has been designed and made for? • What do you like about the product? • What works well? **Complete pages from booklet**   	vehicle, wheel, axle, axle holder, chassis, body, cab evaluate, purpose, user, criteria, functional
2 Test LI: Test out ideas  		**<u>Tinkering session</u>** **<u>The teacher should:</u>** • Explain to the children that they are going to make a toy car • Provide the children with a wide range of resources to explore making a toy car, including wheels, card boxes, split pines etc. • Act as a facilitator – observe the children and provide support if necessary. • Encourage children to think about the **Makers Cycle – Look, think, make, test** • Observe misconceptions (e.g. the use of split pins/wheels not turning/gluing wheels to side of a box.)	• What ideas do you have? • How could you join those things together? • How is it going to work? • How could you make it better? • How can you make sure the wheels turn? **Complete pages from booklet**	assembling, cutting, joining, shaping, finishing, fixed, free, moving, mechanism names of tools, equipment and materials used

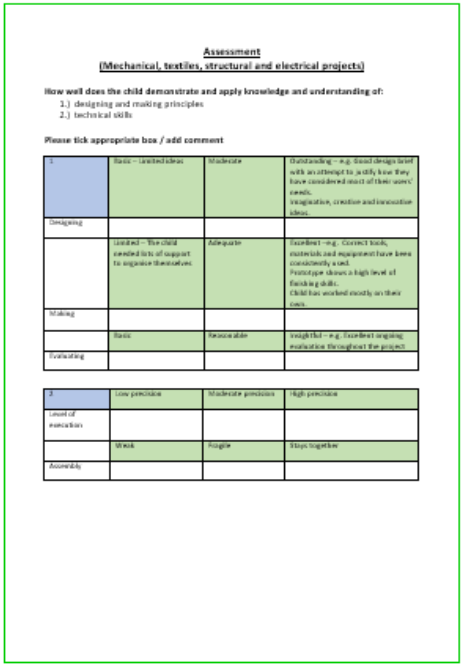
			
3 Think/Test LI: Learn a new skill 	**<u>Skill builder session</u>** Teacher should lead a skill builder session where they teach their class a new skill. **Focused Tasks (FTs)** • Using construction kits with wheels and axles, ask children to make a product that moves. • Demonstrate to children how wheels and axles maybe assembled as either fixed axles or free axles. • Show different ways of making axle holders and stress the importance of making sure the axles run freely within the holders. • Ensure that children are taught how to mark out, hold, cut and join materials and components correctly. • Using samples of materials and components they will use when designing and making, ask the children to assemble some examples of wheel, axle, axle holder combinations. Display the work completed as a reference for their DMEA.   <u>Children should</u> • follow procedures for safety and hygiene • use a range of materials and components • measure, mark out, cut and shape materials and components • assemble, join and combine materials and components	<u>Technical knowledge:</u> <u>Pupils should:</u> • know about the movement of simple mechanisms such as levers, sliders, wheels and axles • use the correct technical vocabulary for the projects they are undertaking • Can you work safely? • Can you work accurately? **Complete pages from booklet** 	vehicle, wheel, axle, axle holder, chassis, body, cab assembling, cutting, joining, shaping, finishing, fixed, free, moving, mechanism names of tools, equipment

	What have you found out? e.g. How would you strengthen/stiffen/ reinforce/attach the wheels?		
4 Make LI: Design a prototype  	<u>Task: Design the prototype (e.g. draw a diagram, write a list of equipment)</u> **<u>Design, Make and Evaluate Assignment (DMEA)</u>** • Discuss with the children what they will be designing, making and evaluating within an authentic context. • With the children identify a user and purpose for the product and generate simple criteria. • Ask children to generate, develop and communicate their ideas as appropriate e.g. through talk and drawing. Talk about, evaluate and share ideas with other children/adults. Share your product. Why have you designed it that way?	• Can you think of ideas and plan what you want to do? • Can you choose the best tools and materials? • Can you give a reason why these are best? • Can you describe their design by using pictures, diagrams, models and words? **Complete pages from booklet**    	vehicle, wheel, axle, axle holder, chassis, body, cab names of tools, equipment and materials used design, purpose, user, criteria, functional
5 Make LI: Make a prototype	<u>Task: Make a prototype</u> **<u>Design, Make and Evaluate Assignment (DMEA)</u>** • Make their wheel and axle product using their design ideas and criteria as an ongoing guide. • Discuss how the children might add finishing techniques to their product with reference to their design ideas and criteria. Direct the children to information and communication technology	**Complete pages from booklet**	vehicle, wheel, axle, axle holder, chassis, body, cab assembling, cutting, joining, shaping,

	opportunities such as clip art, word processing, paint or simple drawing programs. <u>Children should:</u> • select from a range of tools and equipment, explaining their choices • select from a range of materials and components according to their characteristics • as above <u>Mini plenary</u>: What have you found out? e.g. how would you strengthen/stiffen/ reinforce…?   		finishing, fixed, free, moving, mechanism names of tools, equipment and materials used design, make, evaluate, purpose, user, criteria, functional
5 Look/Think LI: Evaluate the prototype 	<u>Task: Evaluate your prototype</u> • Ask children to evaluate their finished product, communicating how it works and how it matches their design criteria, including any changes they made. <u>Children should:</u> • talk about their prototype • make simple judgements about their product against design criteria • suggest how their products could be improved	• Was your product successful? • What went well with your work? • How could you make it better? • If you did it again, what would you want to improve?  **Evaluating: my own thoughts about my product** After you have finished and tested your product, say how well you think it meets your design criteria **Design criteria** | Tick: Fully meets | Partially meets | Does not meet at all 1 2 3 4	evaluate

Assessment

Teachers should use the following document to assess pupils against.
Please complete one for HAP, AAP and LAP pupil/attach to their booklets before handing to Nadia.



Assessment
(Mechanical, textiles, structural and electrical projects)

How well does the child demonstrate and apply knowledge and understanding of:
1.) designing and making principles
2.) technical skills

Please tick appropriate box / add comment

1	Basic – Limited ideas	Moderate	Outstanding – e.g. Good design brief with an attempt to justify how they have considered most of their users' needs. Imaginative, creative and innovative ideas.
Designing			
	Limited – The child needed lots of support to organise themselves.	Adequate	Excellent – e.g. Correct tools, materials and equipment have been consistently used. Prototype shows a high level of finishing skills. Child has worked mostly on their own.
Making			
	Basic	Reasonable	Insightful – e.g. Excellent ongoing evaluation throughout the project
Evaluating			

2	Low precision	Moderate precision	High precision
Level of execution			
	Weak	Fragile	Stays together
Assembly			