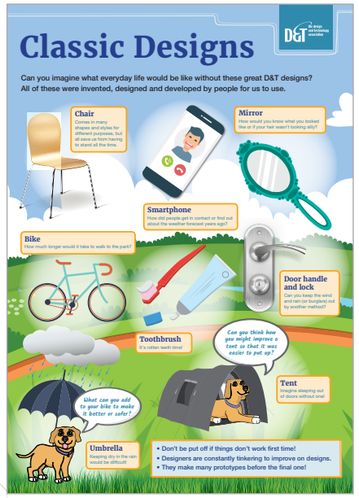
How to the use the classroom posters in this issue

Each term's D&T Primary includes two A2 posters to use as classroom resources and to help with your lesson planning. The posters are usually associated with downloadable resources available from the resource shop on the Association's website. This issue has two posters for Key Stage 2, looking at classic designs and innovations in wheel design.

The D&T Primary National Curriculum Programme of Study (Evaluate) includes children's understanding of "how key events and individuals in design and technology have helped shape the world" and that children "investigate and analyse a range of existing products". Both these posters address these and have prompts and questions to allow children to think about improving existing designs through the iterative process.

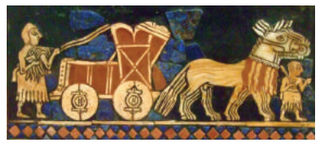
Classic Designs

This poster asks children to imagine what everyday life would be like without designs that they may take for granted. The products have been chosen for their familiarity and usefulness but may be items that children do not realise were invented, designed and developed by individuals or companies.



Innovations in wheel designs

Wheels are another product that children may take for granted, although their design has gone through several iterations, from solid discs to the inclusion of spokes and tracked vehicles. This gives an excellent opportunity to reinforce types of movement and consider design decisions when planning products that use wheels of different types.



Introducing Design Dog and Tech Tiger

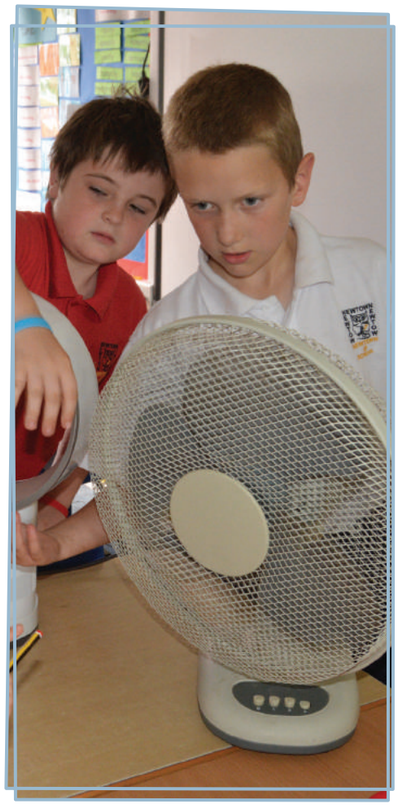
Two D&T characters are included in the posters and will be linked to future classroom display materials and resources. They are aimed to encourage children to identify with the subject and be prompted to ask and answer questions posed about design and technological aspects of their learning. The characters will also be made available in a range of poses for use in classroom displays. These images and many more image bank can be viewed at:

https://www.flickr.com/photos/151737991@N02/albums

D&T Primary

Issue 34 | 2017 The Practical Primary Poster Publication

Visit us at:
data.org.uk
for more news, resources and information



In this issue:

- Big posters:
  - Classic Designs
  - Innovations in wheel designs
- Iterative design in action
- Programming with the Crumble controller

D&T the design and technology association

Tinker, tinker little star

Iterative design in action

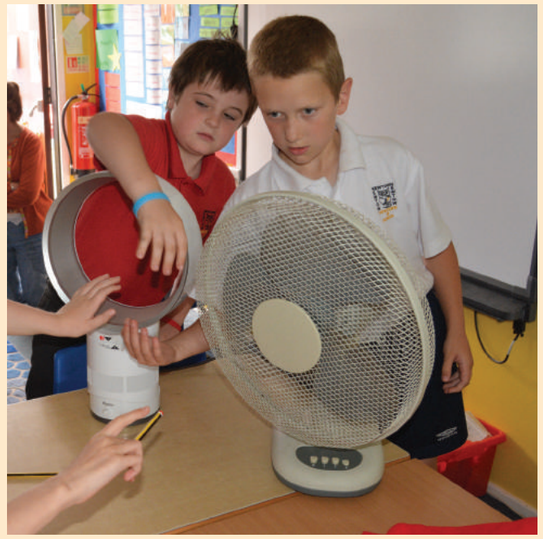
What is tinkering?

The term ‘Tinkering’ has traditionally been used disparagingly, as a way of dabbling, messing about and fiddling in an attempt to repair something that is probably beyond the skills of the ‘tinkerer’. More recently however, and with the rise of maker spaces, the term is being used as an investigative and hands-on way of both understanding and improving upon products.

Tinkering is closely allied to the iterative design process but is also about discovering how things work, how they are put together and the parts’ relationships to one another. We shouldn’t expect children (or adults) to come up with designs and models that are complete and fully operational at first go, and tinkering offers a way of both understanding the workings of products, and trying out, in small stages, how they might be improved upon.

The programme of study across Key Stages 1 and 2 is quite explicit on the use of iterative design, and how problem solving should involve risk taking and a multidiscipline approach, particularly with STEM subjects:

> *“Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making.”*
> *“Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others’ needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising and capable citizens.”*
>
> (Design and technology programmes of study: key stages 1 and 2)



How tinkering benefits learning

Tinkering is at the root of engineering and growing inquisitive and flexible engineers for the future should begin at an early stage. Many products seem to be taken for granted (see this term’s Classic Designs poster) and for a large number of people access to these products to adapt or repair them appears out of their reach.

Tinkering allows children to explore at their own pace, and through this to discover ways of applying their knowledge to their design and make activities. Tinkering can be combined with focused tasks that allow children to develop skills that might then be applied to design challenges, without them having to later acquire these skills as they focus on developing ideas. They can learn from trying out different approaches, what works, what doesn’t work; and accept that when things don’t, this is a part of the design development process.

When James Dyson invented his first Dual Cyclone vacuum cleaner he spent 15 years creating over 5,000 versions that were not quite right before he made one that worked as he wanted.

> *“You don’t have to bother to be creative if the first time you do something, it works. Creativity is creating something that no one could have devised; something that hasn’t existed before and solves problems that haven’t been solved before. Making something work is a very creative thing to do.”*
>
> (https://www.entrepreneur.com/article/224855)

There are dangers of describing these design stages as ‘failures’, ‘trial and error’ etc as this might be discouraging for children who may be driven to want a successful outcome at first attempt, and may be disappointed to realise the ‘final’ product may not be as they had envisaged.

How does tinkering appear in the classroom?

Learning through play is recognised as an effective way of encouraging curiosity and helping children to discover ideas and practical solutions, particularly when working together in groups to help one another. Children can learn by doing and at a pace that suits them. The teachers’ role can be supportive rather than directing the learning, asking questions and encouraging the children to do the same.

There are practical issues to consider however. However creative and exploratory this approach is, we cannot devote indefinite time to exploring and trying out ideas. The benefits of an approach that does not have a final outcome may need to be explained to the class and others. Lessons therefore need to be structured to allow tinkering to take place, but within a context and timescale that ensures quality learning takes place. Tinkering can prove costly in terms of the resources needed, and delivery needs to be managed effectively to prevent a waste of materials.

Disassembly of everyday products helps children learn about their construction and the materials used, but exercise caution with some that may have sharp edges or small components.

Using construction kits to explore structures’ strengths and stability is a great tinkering example, while programming microcontrollers such as the Crumble in stages, testing out the validity of each process before moving on to the next, and being prepared to take backwards steps if things are not working as envisaged.

Setting up a tinkering area with appropriate tools, objects and safety equipment, as well as books and digital resources such as Dorling Kindersley’s The Way Things Work Now, encourages children to develop their making skills and feel comfortable about exploring objects’ construction.

Designing, making and evaluating a greetings card with moving parts for family or friends

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
What sort of greetings card shall I make and who will it be for? What part will move? How will it appeal to the user?	Discussing ideas, drawing annotated sketches, generating design criteria
How will it move?	Discussing ideas, modelling possible lever and linkage mechanisms
Which lever and linkage mechanism will work best for my greetings card?	Discussing and evaluating mock-ups and prototypes against design criteria
What media and materials will I use?	Discussing, exploring and trialling media and materials
Who will I work with? How long will it take? What order will I work in? What tools and techniques will I use?	Negotiating, developing and agreeing a plan of action
More thoughts … appraising, reflecting, refining	More actions … building, testing, modifying
Will the greetings card meet the needs of the user and achieve its purpose?	Evaluating the greetings card with the intended user and against design criteria

The iterative design process

The D&T Association’s Projects on a Page provides examples of how children might engage in the iterative designing and making process. During the process children’s ideas are communicated and clarified through their actions, in contrast to a rigid design-make-evaluate process, thought leads to action, resulting in further thought and action as children create their products.

The example shown top right is from Levers and Linkages for Years 3/4:

Tinker yourself!

You might like to plunge into the tinkering process, especially when learning a new technology such as programming and control before preparing to teach this, as it helps take away any apprehension you may have.

Tinkering can make a good staff activity too: encourage other staff to play, take risks and problem solve and they’ll likely see the benefits to other subject areas.

Let us know your experiences – it would be good to hear how tinkering has impacted on your school.

Resources from the Association

- Primary Crumble Controller Starter Kit
- Iterative Designing in Action – a DVD including video, activities and presentations.
- Projects on a page primary scheme of work.

Goose Fair Crumble Rides

Bringing computer programming and control to life in D&T with the Crumble controller.

Suzanne Gomersall, Nottingham Trent University

Year 5 pupils at Nottingham's Milford Academy recently brought their fairground ride project to life with the help of some primary D&T specialist trainee teachers from Nottingham Trent University (NTU), during a visit to the Clifton Campus.

As a primary D&T senior lecturer at NTU, I was keen to make links between my subject and local Clifton schools as part of the 'Raising Aspirations' project, designed to encourage more children from deprived backgrounds to aspire to attend university and obtain graduate jobs. I decided to use this opportunity for the third year D&T primary undergraduate trainees to support a class of children in tackling the Design, Make and Evaluate Assignment (DMEA): *"To design and make a new children's fairground for Nottingham Goose Fair"*. At the same time, this would enable them to develop their own knowledge and understanding of working with a Crumble controller, a programmable board suitable for primary children (see Fig 1) as well as work within the six design principles: **user, purpose, function, design decisions, authenticity** and **innovation**.

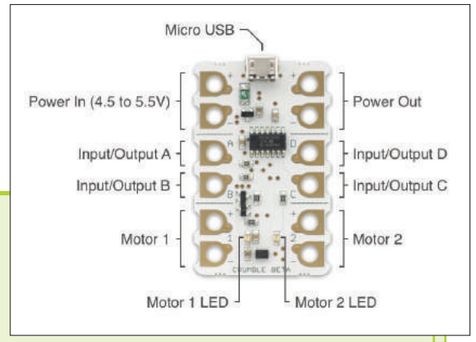


Figure 1 – Crumble controller

Figure 2 – the DMEA shared with the children

Figure 3 – Children carrying out an IEA on the trainees' fairground rides

Innovation part 1– Mechanisms and Computer programming

Before the children came into NTU to design and make their rides, the trainees designed and made their own rides in pairs, initially powered with motorised pulley wheels and reversible switches that allowed the ride to change direction. The trainees were then introduced to Crumble through a Focused Task (FT). After learning the basics of programming the Crumble controller, they were then able to programme it to control the ride, which this time involved more options: change of speed, change of direction, sequences of flashing LEDs that changed colour ('sparkles'), as well as using sensors to trigger the ride to start. The trainees planned for the visit to include the three key D&T activities: Investigate and Evaluate (IEA), FT and DMEA activities, as well as experience many aspects of university life as part of the 'Raising Aspirations' project.

On the day: Setting the scene – Authenticity, User and Purpose

Initially I introduced the DMEA to the children, which clearly identified the user and the purpose (see Fig 2) within a real-life authentic context – Nottingham Goose Fair. Once the children knew what the design problem was, the trainee teachers shared their rides with the children, which the children then investigated, evaluated and analysed (IEA) to help create their own design criteria.

Function and Design Decisions

Through small-group discussions with their trainee teachers, the children decided on possible **Design Criteria**. Ideas were shared as a whole class, and together they decided the ride needed to: appeal to children, rotate (either vertically or horizontally), to be attractive and fun. Pairs of trainees worked with small groups of children to think through the DMEA, and generate different ideas for names and types of rides. This gave them a chance to think about how their ride was going to work (function), and start to make some design decisions.

Once the final design was chosen, the children used a shoe-box as the base for the ride and, with guidance from the trainees, measured, cut and constructed the ride mechanism, developing their making skills, technical vocabulary and safe use of tools (see Figure 4).

Innovation – part 2

The trainees then led a Focused Task in which the children learned how to make their Crumble control traffic lights so they lit up in the right sequence and so they responded to a 'button press' input (see Fig 5). **Innovation** in a primary setting can be described as

Figure 4 – Children developing their making skills on various aspects of the ride

Figure 5 – Children programming the Crumble

'a new idea for you or your peers', and using the Crumble was new for all of the children, as well as for their teacher!

After these basics had been learnt, the children were able to make further design decisions, such as deciding what they would like their rides to do and the Crumble controllers were duly programmed. A range of high quality decorating resources were available to help the children finish making their rides, which meant that the children were very proud of the finish.

Finally, the children **tested** and **evaluated** their rides against the **design criteria**. All rides successfully met the criteria and the wide range of themes, from Spongebob Squarepants to Spooky Spiders was wonderful (see Figure 6)!

Project Summary

Children's surveys completed after the experience gave very positive responses, particularly on the aspect of 'working in teams' and 'exploring the rides'. Many children felt they have developed their skills in using D&T tools, teamwork and computer programming and that they had '*learned a lot*' and '*had lots of fun*'. They also commented on how this project had helped with other curriculum subjects, such as maths, art and science.

Class teacher Mr. Goff agreed that the children had enjoyed the project, and that it had '*utilised and enhanced existing D&T skills, particularly focusing on the crucial initial design phase. It also gave them opportunity to be innovative with more complex components such as Crumble. All the children were delighted with the outcome of a working fairground ride and talked enthusiastically about their experience for a long time afterwards*'.

Finally, the opportunity to work with children on this project was met with real positivity from the trainee teachers, with comments such as '*a great opportunity to gain experience in our subject specialism whilst having the opportunity to put into practise our pedagogical skills and planning*', '*the link to computing helped us make cross-curricular links between subjects and also helped improve computing knowledge*' and '*absolutely loved it! It brought everything together*'.

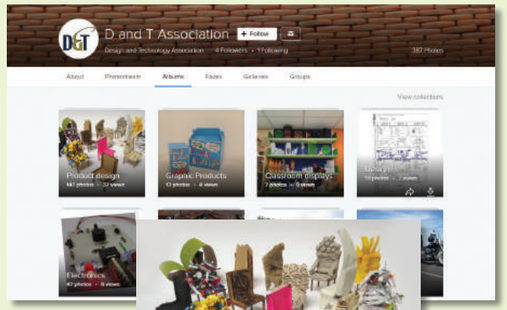
Using Crumble controllers enabled the children to 'apply their understanding of computing to program, monitor and control their products' in an effective, engaging and primary-appropriate way. The low cost of the Crumble controller kits and the ease of use of the software (which closely matches the Scratch programming language many children will be familiar with) means this approach has real potential for bringing D&T projects to life in many schools.

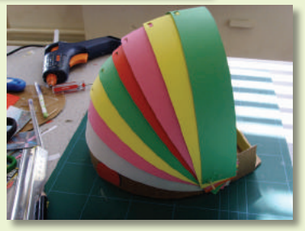
Primary Crumble Controller Starter Kits and Components packs are available from the D&T Association website. The 'Primary Crumble Controller Starter Kit Bundle' includes pdfs of two Projects on a Page Primary Crumble Planners: Years 3/4 Simple Programming and Control and Years 5/6 Monitoring and Control and the 'Programming and Control at KS2' article from D&T Primary #32.

Figure 6 – The children with their final products

D&T Image Bank

A free resource to help teachers and pupils





The D&T Association has put together a bank of free-to-use images for teachers and pupils to use in their D&T work. There are albums for Product Design, Structures, Mechanisms, Textiles, Electronics etc as well as Materials, Textures and moods, Landscapes, Transport, and Animals, insects and birds. We are adding to the bank all the time and would welcome your pictures to help show exemplar work, teaching aids or just pictures of what takes place in your classroom.

If you have images of pupils' work, or other pictures that might be useful for mood boards, presentations, sketching, inspiration for design development, etc that you are happy to freely share with others, please let us know.

Please make sure you are the owner of the images or have permission from anyone featured before you share. **willy.adam@data.org.uk**

The image bank can be viewed at: **www.flickr.com/photos/151737991@N02/albums** or going to Flickr.com and searching for 'Design and Technology Association' under the 'people' tab.

Primary Editorial – September 2017

The last few months have certainly been eventful! Following a snap election, the country has a new political landscape where the power dynamics have shifted considerably. Much of what we expected from the current government has been ditched, with the Queen's Speech raising more questions than answers.

For education, the big news was that plans for more grammar schools appear to have been dropped; free school lunches stay; and there is a continued commitment to Apprenticeships and the further reform of technical education. Plans for more funding to schools have been announced, although the details still need confirming. The consultation on the EBacc has finally completed with a disappointing commitment to continue – despite the views of the sector – albeit with a longer timescale.

We have written to the Secretary of State for Education, Justine Greening, urging her to recognise the importance of design and technology in contributing to the government's strategies for both social mobility and economic growth. Our letter was backed by key supporters from education, industry and the cultural sector – including: Sir James Dyson, Siemens, Tristram Hunt, Director of the V&A, The Design Museum, Carolyn Robson, Chair of the Expert Panel on Design and Technology and Vice-Chair of the Teaching Schools Council as well as employer bodies like the Institute of Engineering and Technology, the Manufacturing Technologies Association, the EEF and SEMTA.

We have urged the Secretary of State to invest more in the professional development of design and technology teachers, ensuring they can keep pupils up to date with the latest technological developments. We also set out the need for more support to enable inspirational partnerships between education, industry, and cultural institutions, as well as better careers information to help inform young people.

We are encouraged by recent pronouncements from the new Chief Inspector and our own conversations with Ofsted. Amanda Spielman has already won some support from the sector through her insistence that all children should study a broad and rich curriculum – one which includes design and technology and other creative and technical subjects. We know from many of our members – at primary and secondary level – that this is not currently the case. Unfortunately, we hear too many stories of design and technology being squeezed or even dropped from the timetable, regardless of pupil choice or aspiration. Hopefully, this review will ensure that all children are able to access a broad and balanced curriculum across both primary and secondary education. We would welcome your views on this – do get in touch if you would like to find out more.

Dr Julie Nugent, Chief Executive

Visit www.data.org.uk for events, resources and membership

Primary Design and Technology Summer School

De Montfort University, Leicester

Cross curricular learning

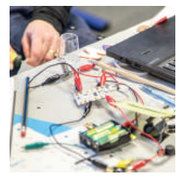
The all-day session at the Design and Technology Association's Summer School focused on using design and technology to help raise standards in English, maths and science in KS1 and KS2. Research indicates that design and technology is one of primary-aged children's favourite subjects so offers a great opportunity to boost children's attainment in other subjects. The session guided teachers through strategies for using our subject to help raise standards in English, maths and science in KS1 and KS2 by looking at:

- English – how D&T can provide a motivating context for spoken language and teaching non-fiction writing
- Mathematics – how D&T can provide opportunities for children to apply their understanding of measures, shape, ratio and statistics
- Science – how science understanding can be applied in D&T and how D&T can set exciting contexts for working scientifically

The course also covered long term planning for effective cross-curricular teaching using the popular Projects on a Page scheme of work.

The afternoon session had small teams of teachers designing and making night light prototypes based on classic designs that incorporated English maths and science, to help illustrate how effective cross curricular teaching using design and technology can be.

Teacher CPD for Autumn Term 2017



Teaching National Curriculum with Creativity & Confidence 2017
Bristol – 14 September, London 24th November, Lancashire 30th November

How to be a brilliant Primary D&T Subject Leader 2017
Lancashire – 21 September and London 28th September

Using Children's Enthusiasm for D&T to improve English, Maths & Science 2017
London on 12 October

Primary D&T in Action 2017 - Curriculum in KS1 & KS2
Birmingham on 20 October and in Huddersfield on 31 October

Let's learn how to teach practical skills & techniques now! 2017
Coventry on 14th November and Bristol on 7th December

Classic Designs

Can you imagine what everyday life would be like without these great D&T designs? All of these were invented, designed and developed by people for us to use.

Chair

Comes in many shapes and styles for different purposes, but all save us from having to stand all the time.

Mirror

How would you know what you looked like or if your hair wasn't looking silly?

Smartphone

How did people get in contact or find out about the weather forecast years ago?

Bike

How much longer would it take to walk to the park?

Door handle and lock

Can you keep the wind and rain (or burglars) out by another method?

Toothbrush

It's rotten teeth time!

Can you think how you might improve a tent so that it was easier to put up?

Tent

Imagine sleeping out of doors without one!

What can you add to your bike to make it better or safer?

Umbrella

Keeping dry in the rain would be difficult!

- Don't be put off if things don't work first time!
- Designers are constantly tinkering to improve on designs.
- They make many prototypes before the final one!

Innovations in wheel designs

What kind of wheel design would you use for a toy tractor, roller skates or to pull a suitcase?

3500 BC

Solid wheels – these were invented in Mesopotamia thousands of years ago. This was a flat piece of wood shaped into a circle with a hole in the middle for an axle to make carrying loads easier. Before the axle people had probably used log rollers to move things.

2000 – 1000 BC

Spoked wheels and iron rims were developed in Egypt and Europe. Used on chariots first, these were lighter, needed less material and were better at absorbing shocks from uneven ground. Putting a thin band of iron round the outside of the wheel made them last longer.

1770s

Continuous tracks – wheels running on their own surface – were developed for use on uneven ground. They are used for tanks, caterpillar tractors and bulldozers.

1802

Wire spokes and pneumatic tyres for bicycles and cars were invented in the 1800s. These absorbed shocks even better than solid spoked wheels. They were first used on bicycles.

20th Century

Modern car wheels made from metal alloys and with steel rims are pressed into shape using strong mechanical presses. Wheels can be spheres too, used on some wheelbarrows.

Wheels in wheels

The iBot is a wheelchair that could 'walk' up steps and used wheels to raise the sitter up to 2 metres high. Michelin's 'tweels' have their spokes arranged to act as shock absorbers. Some shopping trolleys and baby buggies have three-wheels that rotate around another axle which allows them to mount kerbs.

There are two types of rotary movement: spinning, like a wheel, and oscillating like a swing. What else uses rotary movement?*

*[Ferris Wheel, drill, fan, windmill, tap, swing, hamster ball]

D&T the design and technology association