

Learning for Life and Work through Technology and Design Key Stage 3

Pneu and Improved Overview

Pupils discover the relevance of systems and controls within industry, specifically the practical application of pneumatics within an agri-food company. They complete a scenario-based challenge related to a labelling and stamping mechanism used in the context of packaging animal feed products.

Curriculum Links

Mapping to the Statutory Minimum Requirements	These activities allow pupils to:	
	<p>Develop skills in creative thinking and problem-solving through:</p> <ul style="list-style-type: none">Control – incorporating mechanical control systems in products and understanding how these can be employed to achieve the desired effects.	<p>In the context of the following Key Element:</p> <ul style="list-style-type: none">Explore issues related to Economic Awareness (Economic Awareness).



Health and Safety Warning

CCEA has assessed the health and safety risks associated with these activities. However, we strongly recommend that all teachers leading these activities carry out their own health and safety assessment, taking into account the ability of the students, the school's resources and its quality of equipment, etc.

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Key Questions

- What do we know about pneumatics?
- In what ways are automation/mechanical devices advantageous in an industry setting?
- How important is branding?

Prior Learning

- Basic pneumatic components
- Logic and control

Learning Intentions	Success Criteria
<p>Pupils are learning:</p> <ul style="list-style-type: none"> • that compressed air affects mechanical motion; • about basic pneumatic components, such as a three port valve, unidirectional flow control and a single acting cylinder; • about the advantages and disadvantages of using pneumatic devices; and • about the practical application of pneumatic devices in an industry context. 	<p>Pupils will:</p> <ul style="list-style-type: none"> • design and develop a simple pneumatic system based on a design brief; • design a new label for a pig feed, taking account of aesthetics; and • use practical skills to manufacture the solution, demonstrating quality and accuracy and following safety instructions.

Skills Development	Thinking Skills and Personal Capabilities	Cross-Curricular Skills
	<p>Thinking, Problem-Solving and Decision-Making:</p> <ul style="list-style-type: none"> • show that the pathway to the final solution is informed by experimentation with modelling. <p>Working with Others:</p> <ul style="list-style-type: none"> • make an active contribution when working as part of a group. 	<p>Communication:</p> <ul style="list-style-type: none"> • articulate and explain information, ideas and opinions clearly; • ask questions to explore and develop ideas; and • use precise vocabulary.

Assessment Opportunities	Cross Curricular Skills Assessment Tasks available
	<p>Using ICT: Pneu and Improved (Online Collaboration)</p>

Activity 1

Coming Unstuck

Share with the class the Agri-food sector profile which is available in the Sector Profiles section of the STEM Futures folder and online at: www.nicurriculum.org.uk/stem

Ask each group to discuss the sector and record the following:

- one thing they already knew about the sector;
- two things they have learned; and
- one thing that has surprised them about the sector.

Present the scenario in **Resource 1** to your class, using your whiteboard. Next, divide the class into small groups of four or five pupils, allocate roles and responsibilities and ask the groups to summarise the following on a sheet of A3 paper:

- the issues facing the feed company; and
- any questions they have about the scenario.

Provide them with time to discuss their thoughts with each other, and make sure that they understand the two main problems in the scenario:

- The label for pig feed needs to be modernised to promote the brand positively.
- A new system needs to be developed to provide a reliable stamping/labelling system for the animal feed.

Activity 2

Building a Brand

Discuss the terms *product* and *brand* and ensure that your pupils understand the differences between the two. Explain that a graphic designer would be responsible for the label design task.

Provide a link to www.JED.c2k.ni.net for information on what a graphic designer does.

Next, explain that the groups will be working as graphic designers to redesign and rebrand the pig feed label. As a class, discuss the following:

- How can branding influence customers?
- What if a company had no brand?
- What should the label look like?
- How important is the name of the product?
- Why is colour and creativity important?
- What information should be presented on the label?
- What material should the label be made from?

Use the discussion to agree success criteria for the new pig feed labels, including a brand.

Next, allow the groups to carry out research on the internet to gather ideas and information for their new pig feed label. Ask them to come up with three ideas as a group and to then evaluate the pros and cons of each before agreeing on their final design idea. Remind them to listen to and respect the opinions of others as they discuss and negotiate.

When the groups have chosen their final design, give them appropriate resources to complete their label. Afterwards, allow each group's spokesperson to present their design to the rest of the class and encourage other groups to offer constructive feedback based on agreed success criteria. Display the finished labels in the classroom.

Activity 3

Pneu and Improved

Recap with your class the other problem consultants raised in the scenario: the unreliable stamping system. Discuss as a class the types of motion that would be involved in a stamping system. This should lead to questions and answers about what would make a suitable control system, such as pneumatics. Introduce the term *pneumatics* and explain that air is used to move things.

Ask the class if they can think of where pneumatics are used in the outside world, for example in air brakes, on buses, or nail guns. Allow them to use the internet to research further examples of where *pneumatics* are used.

Organise the class into pairs. Provide each pair with lengths of 5 mm tubing, balloons, syringes and a clean, empty squeeze bottle. Allow them to explore pneumatics using the tubing and syringes and/or balloons. Encourage them to pose their own questions, for example 'what will happen if...?'

ACTIVITY 4

The Stamping Machine

Explain that in this activity, the groups are going to act as mechanical engineers and design a system for stamping. Start by allowing the groups to use the internet to research this job description.

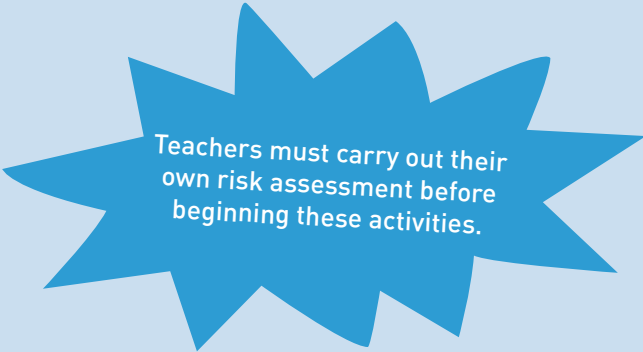
Next, use the components from a pneumatics kit to demonstrate how to build a simple circuit, and emphasise the following:

- the manifold;
- the pipes;
- how to secure components to the pneumatic board;
- how to link the manifold to the air that flows from the outlet; and
- how to connect airflow from the 3/2 valve to the single acting cylinder.

Stress the importance of health and safety with your pupils. Then, allow them to build their own circuit.

Afterwards, lead a class discussion about the advantages and disadvantages of this type of system. Discussion might include the following:

- uses (move, hold, form and process);
- health and safety;
- portability;
- noise;
- maintenance;
- flexibility;
- reliability; *and*
- cost.



Teachers must carry out their own risk assessment before beginning these activities.

ACTIVITY 5

Design and Spec Development

Begin by reminding the class of the three port valve and single acting cylinder circuit they used in Activity 4. Explain that when designing any system, it is easier to use circuit symbols rather than draw physical components. Use **Resource 2** to introduce the class to the symbols for these two components.

As a class, agree the definition of the term *specification*. Ensure that their definition is similar to: *a list of requirements that a product/system must do or have*. Provide some time for the groups to think about and develop a design specification for a labelling/stamping system. Provide the following prompts:

- In what way is size an important consideration?
- How will it function?
- In what ways will this system be economical?
- Why is safety important? In what way have safety considerations affected this design? (For example a protective shell around the stamping machine).
- What materials are most suitable for the prototype? Why?

Allow a spokesperson from each group to feed back their ideas to the class.

As a class discuss the problem of inconsistent labelling identified in the scenario, and encourage pupils to consider at this stage how this could be resolved. Responses may include:

- timing of the stamper
- timing of the conveyor belt
- size of stamp
- positioning of bag/packaging material

NOTE: Encourage individual specifications to promote creativity.

ACTIVITY 6

Manufacturing

Reinforce the importance of safety when your pupils are manufacturing their designs. Talk to them about health and safety in the school workshop, for example:

- acceptable and safe behaviour;
- how to select the correct tools or materials for the job; and
- how to use materials and tools correctly.

Provide time for your pupils to build their modified prototype stamping system using their design specification. As they build, remind them that engineers often test a product/system throughout the manufacturing stage. Encourage them to do the same. If any parts do not work as expected during testing, ask them to think about modifications/improvements. (**Resource 3** provides a Stamping System diagram.)

Encourage each group to evaluate both their product and system. Prompts may include:

- Which materials did you use and why?
- What went well?
- Did you encounter any problems? If so, what were they and how did you overcome them?
- How close was your finished product to your original design? What changes did you make and why?
- If you were making the product/system again, what would you change?
- In what ways did you work as a team?

Invite each group to present their prototype system to the rest of the class.

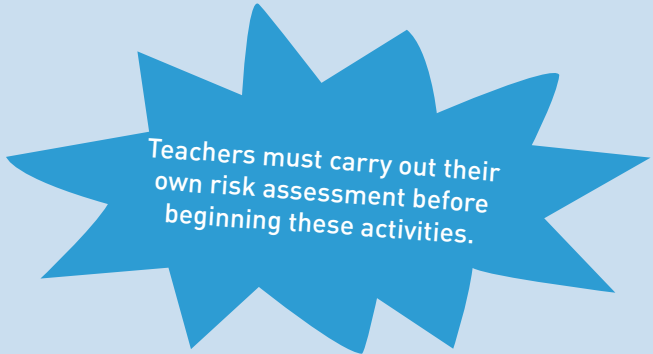
Afterwards, have one group present their design solutions, preferably to a real and relevant audience. You could request a link with a relevant STEM ambassador through the STEMNET initiative which is co-ordinated by W5. STEM ambassadors can act as role models and help inspire and engage young people about the value of STEM in their daily lives. For further information, please contact Mary Carson at W5 (marycarson@w5online.co.uk) or visit their website at www.w5online.co.uk/stemnet.

The pupils could make their pitch to their STEM Ambassador via video conferencing using the Elluminate software available through C2K. For advice and support to get started please contact the C2K Service Desk.

You may want to watch an episode of Dragons' Den as a class to provide them with an example of how to conduct a pitch, or, if possible, work in collaboration

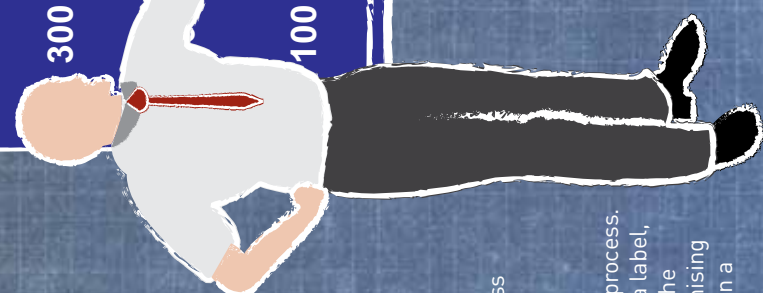
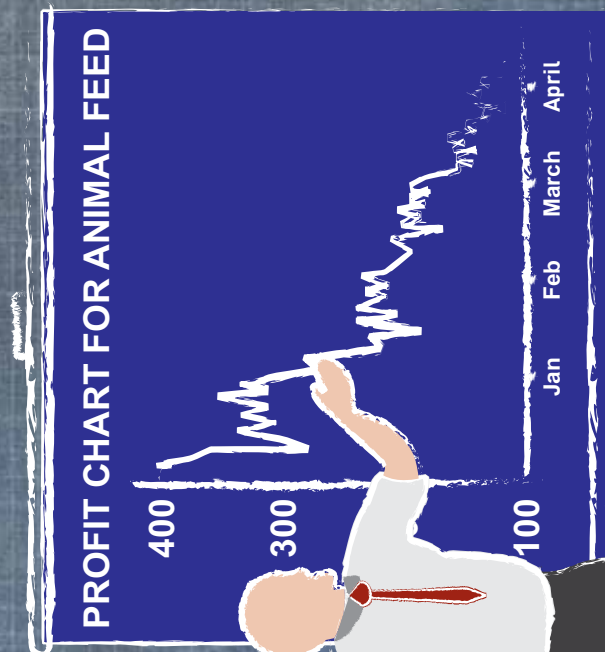
with the English Department to develop pupils' presentation pitches.

Provide time for pupils to research STEM career opportunities. Resources are available within the 'Futures – Skills & Employability/CEIAG' section of the STEMWorks website at www.nicurriculum.org.uk/stem



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Trotter & Sons - Pig Feed



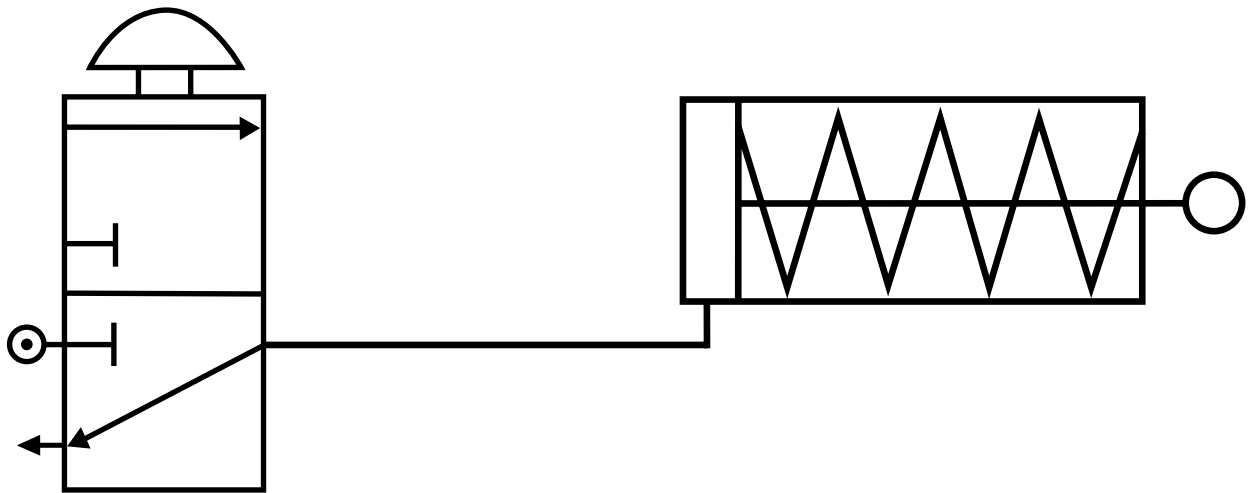
Scenario

The animal feed company you work for has recruited a team of business consultants to advise on how the company can make improvements to increase profits.

The consultants highlighted problems with the quality of the labelling process. They identified inconsistencies, for example some bags were missing a label, while others had been labelled twice. They recommended a review of the labelling process to resolve this problem. They also suggested modernising the pig feed label, including branding, to promote the company brand in a more modern and positive light.

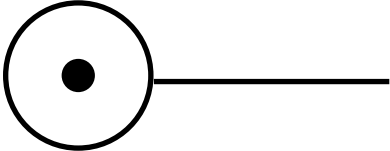

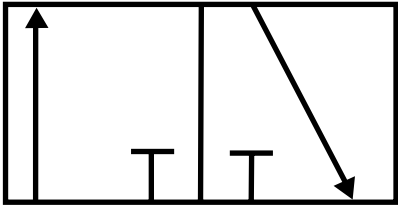
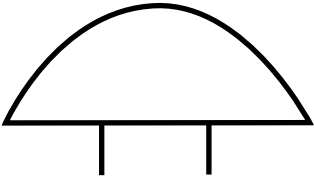
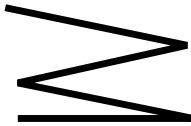
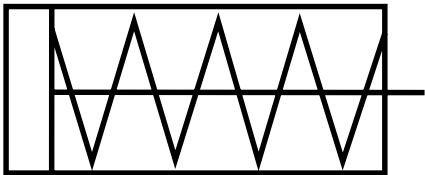
Resource 2 (1 of 2)

Pneumatic Circuit and Symbols



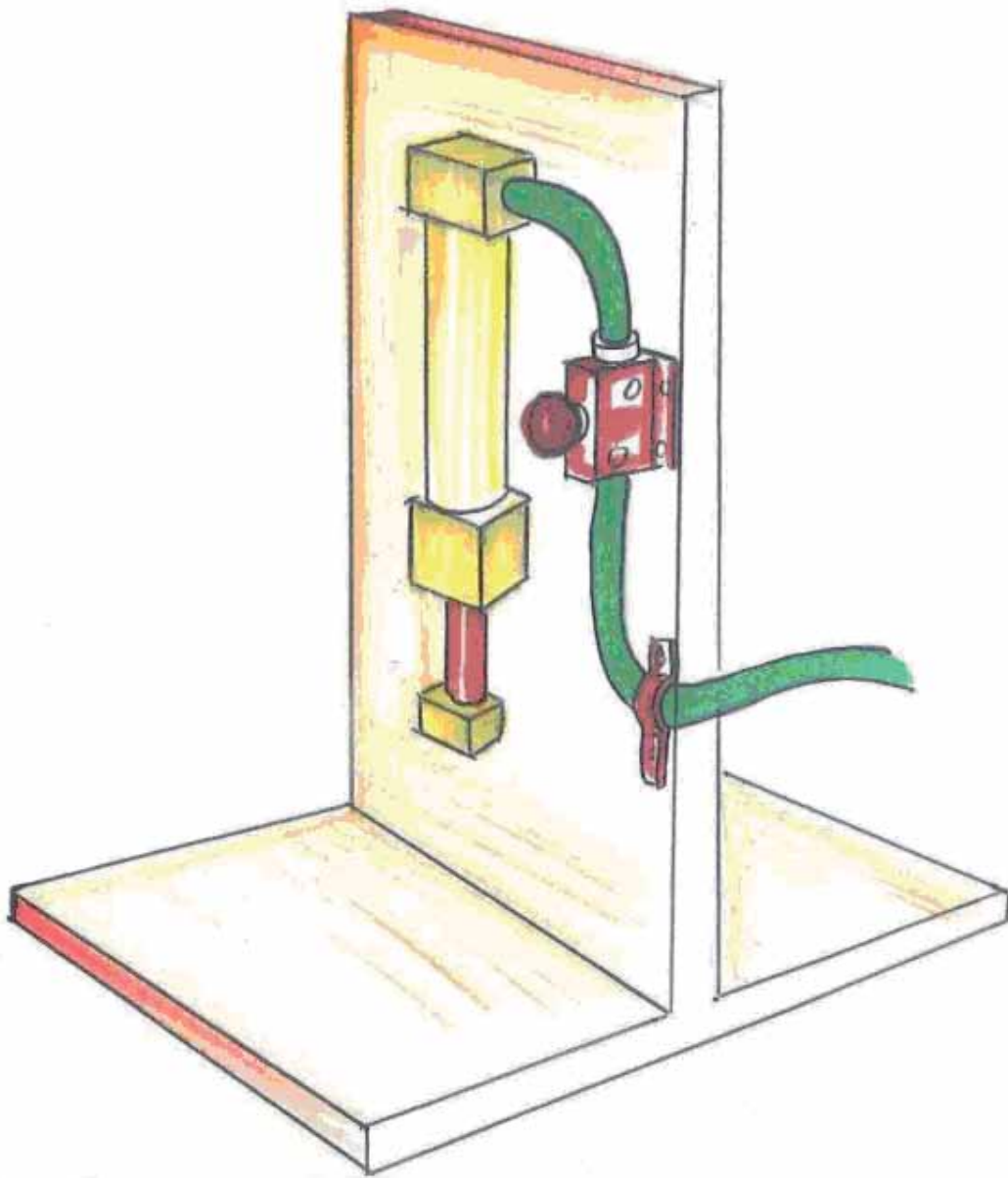
Resource 2 (2 of 2)

Pneumatic Circuit and Symbols

	Main air supply
	Exhaust air
	3/2 valve
	Push button activator
	Spring return
	Single acting cylinder

Resource 3

Stamping System Diagram



useful websites

These links were active at the time of publishing.

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Article on the Future of Pneumatics

www.theengineer.co.uk/channels/process-engineering/pneumatics-back-to-the-future/

Application of Pneumatics in Society: Waste Management

www.waste-management-world.com/index/display/article-display/368646/

Application of Pneumatics in Society: Transportation

<http://zapatopi.net/inteli-tube/>