

Meaningful Learning Experiences

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|-------------------------|---|---|
| Strategic Commitment | ✓ | Part of a regional, ESF-funded 'Careers Local' programme |
| Curriculum Provision | ✓ | One of a series focusing on 'dry' Science topics |
| Employer Partnerships | ✓ | Developing a relationship with an existing school contact |
| Reflective Young People | | |
| Informed Career Choices | ✓ | Raising awareness about roles in Engineering |

Specialist engineering firm explains the need for accuracy in Science lab experiments

Tupton Hall School in Chesterfield asked the Science faculty to identify five curriculum topics that would provide a basis for staff development, showing how employers can bring 'dry' topics to life in the classroom. One of these involved teaching year 10 students about 'Forces' in Physics. The teacher's brief identified a classroom practical that required students to take a series of measurements using a 'Newtonmeter' and then plot results on a graph.

The school had previously talked with piston ring manufacturer Precision Products about working with the school. The Operations Director provided information about the company, including about the importance for accuracy when producing engineered parts. Students discovered how these products are used, for example, in the world's largest diesel engine that powers super-tankers.

The Operations Director provided a couple of large piston rings for students to handle in the classroom and sent a short message to accompany a task sheet he had prepared, but which was based on the teacher's usual Physics lab practical.

Examples of student work were sent to Precision Products. The Operations Director recorded another short video message, providing feedback and encouragement. With classes for the year group taking place on different days, this allowed all students to see this message.

Benefits for the Students

- *'It's different to normal ... it's better ... it gives us a chance to do new things'*
- *'... instead of just writing about it, you actually do it ...'*
- *'It makes you feel good – like you've actually done something'*
- *'It makes you feel you've achieved more because they are an employer ... if you put your mind to it, perhaps you could get a job'*
- *'It helps us understand what other people are looking for ... You find out that what you learn in the classroom is all useful and it could help us in later life'*

Benefits for the School

- All five Science projects involved topics that had been described as ‘dry’. The projects are exemplars for all teaching staff to see how classroom learning can be brought ‘to life’
- The Science team was having to cope with a period of staff absences, so this project avoided the need for special arrangements to manage out-of-school trips or guest visits
- Precision Products helped to explain the importance of accuracy when taking measurements, not only in the science lab, but also in working life

Benefits for the Employer

- Although involving a busy senior manager in the firm, involvement in the project had minimal effect on the Operations Director’s diary commitments
- Precision Products is a small firm. The project made modest demands on their resources, yet it had an impact on a whole year group of students
- Like many engineering companies, Precision Products requires a skilled and motivated workforce. This project helped to promote career opportunities in the sector

PRECISION PRODUCTS UK

Dear year 9 students

Our team of engineers and other staff have to work accurately if they are to meet the needs of customers who use our products in demanding situations. I want to see if you have what it takes to work in a precision engineering business like ours.

Task 1. You saw a video about the huge Wartsila RT96 diesel engine. Can you calculate the difference between in force produced by this engine and a Ford Fiesta?

| | Wartsila RT96 | Ford Fiesta |
|--------------------------|---------------|-------------|
| Number of cylinders | 12 | 4 |
| Cylinder bore (diameter) | 960mm | 73mm |
| Length of cylinder | 26.6m | 0.45m |
| Power output | 80,000 kw | 92kw |

Expansion pressure in the cylinder create the force on a piston to turn the engine. A diesel engine is an internal combustion engine that uses the heat of compression to start ignition to burn the fuel. Assuming the expansion pressure created in a diesel engine is 50 bars, can you calculate the force produced from the cylinders in each engine?

Task 2. I explained that our piston rings need to act like springs – pushing against the side of the cylinder to create a seal against the hot gases and pressure. A great deal of force is required to compress the piston ring so it fits tightly in the cylinder, closing the gap in the piston ring. You have used Hooke’s Law in an experiment. This law states that the strain in a solid is proportional to the applied stress within the elastic limit of that solid. We use different materials for piston rings and, using the same experiment you carry out in the school laboratory, I want you to tell me which of two materials could be used for a piston ring that would create the tightest fit in a cylinder.

Task 3. You have been shown a cross section of a piston and cylinder. I want you to use your knowledge of parallelogram of forces to draw a diagram to explain the different forces in action on the piston ring as it travels down a cylinder under the pressure.

| Force | Length 1 | Length 2 | Length 3 | Mean | Extension |
|-------|----------|----------|----------|------|-----------|
| 0 | 6 | 5.5 | 5 | 5.5 | 0 |
| 1 | 10 | 10 | 10 | 10 | 4.5 |
| 2 | 15 | 15 | 15 | 15.3 | 9.8 |
| 3 | 21 | 16 | 20 | 19 | 13.35 |
| 4 | 25 | 23 | 24 | 24 | 18.5 |
| 5 | 30 | 29 | 29 | 29.3 | 23.8 |
| 6 | 34 | 32 | 34 | 33.3 | 27.8 |
| 7 | 40 | 37 | 38 | 38.3 | 32.8 |
| 8 | 44 | 41 | 42 | 42.3 | 36.8 |

I look forward to seeing how you do with these tasks, which are

Mark

Mark Jenkins, Operations Director

EXTENSION

Method:
Hung the spring from the clamp stand
Measured the length of the spring
Added a mass
Measured the length again
Repeated this for 8 masses 3 times

Equipment:
Masses
Spring
Clamp
Boss
Stand
Meter rule

Conclusion: my graph is reliable as all the points have the same gradient and lie on the line of best fit, the relationships are directly proportionate to the results



‘Forces’ had been identified as a ‘dry’ topic by the Science faculty. Precision Products provided a video greeting and a challenge – based on an existing Physics experiment – to highlight the importance of taking accurate measurements. Students knew their work might be seen by the Operations Director, who provided feedback, which was shown in the classroom during timetabled lessons.