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# ENGINEERING *IN THE* MOVIES TEACHER GUIDE



# INTRODUCTION TO THE RESOURCE

From the early days of cinema to the latest blockbusters, movies have the power to amaze, inspire and entertain with incredible storylines, memorable characters and fantastic special effects.

Engineering in the Movies lets pupils explore the creative and practical side of STEM (Science, Technology, Engineering, and Maths) in the movie industry while introducing the important role engineers have in the movie industry.

Through 12 engaging activities, pupils will see how topics from their subject lessons can be applied in real-world engineering. This resource provides hands-on thematic education opportunities for pupils interested in the magical world of movies that can be taught in the classroom and as an enrichment programme.

## HOW TO USE THIS RESOURCE

There are 12 activities to complete. They can be used in sequence, or picked to suit the needs of the class and the resources that are available.

Each activity is straightforward, fun and achievable in the classroom. A selection of materials used in each activity are included in the resource box. A full curriculum map is included on page 6 so that you can see at a glance which activities best match your group, your aims, and the time and resources you have available.

A competition challenge, *Creating Movie Magic*, is marked with the Hollywood Star symbol.

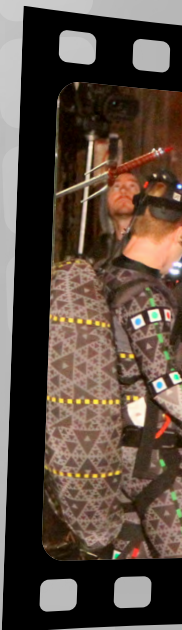
The *Engineering in the Movies* box features a wealth of resources that put movies at the heart of learning. This resource is designed to be used with the supporting PowerPoint presentation. The presentation can be adapted and is available to download at

[www.raeng.org.uk/education/schools/teaching-and-learning-resources/curriculum-resources](http://www.raeng.org.uk/education/schools/teaching-and-learning-resources/curriculum-resources)

## TYPES OF ENGINEERS IN THE FILM INDUSTRY

Filmmaking is generally known as a creative industry full of writers, actors, make-up artists, and visionaries. However, aspiring engineers with an interest in movie-making can rest assured that there are plenty of jobs in the industry for them as well.

From special effects and lighting to creating virtual worlds, engineers create settings and scenarios that help movie-goers engage with the story. There are many ways engineers contribute to the filmmaking industry. Here are four exciting examples:





# ENGINEERING IN THE MOVIES

Engineers contribute to the world of filmmaking in many different jobs. These jobs offer pupils interested in STEM a chance to use their skills to create exciting motion pictures!

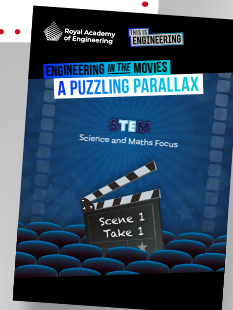
## 1 COMPUTER SOFTWARE ENGINEERS AND ANIMATORS

You can create any world you want inside a computer. A world where monsters roam and where robots fall in love.

There is a team of engineers at work on every computer-animated film. They develop and maintain software and create innovative new tools for the design and production of animated movies, striking a balance between science and art.

Engineers need a certain set of skills to create animations that make cartoon characters seem so real. A skilled engineer will combine coding and design, as well as work in close collaboration with artists and other members of the team.

These skills can be employed in both film and the gaming industry. Several universities offer courses that focus on 3D animation and interactive media. Passion is a definite must to land an engineering job in film industry.



Entertainment Pictures / Alamy Stock Photo

## 2 MECHANICAL ENGINEERS AND PROPS

A lot of hard work and creativity are needed to develop props and special effects.

Robots, mechanical rigs and set infrastructure are all used to make new worlds and creatures take shape.

Those who work in special effects have often studied mechanical or electrical engineering. Additional courses in advanced mathematics and physics are also likely to help. Qualifications are important but so are talent and passion.



Splash News / Alamy Stock Photo

### 3 CHEMICAL ENGINEERS

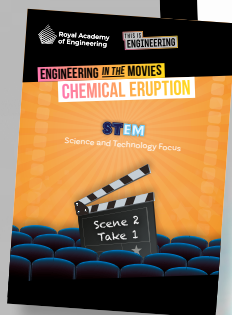
Lots of action movies include incredible explosions and fires.

To incorporate these stunning displays of pyrotechnics, engineers are involved in the setup to make stunts and scenes look realistic while keeping the actors and staff safe. An understanding of physics and chemistry is vital to work in pyrotechnics.

One of the most famous directors is James Cameron. Although he doesn't have a degree in engineering, he studied physics and became very interested in special effects.

Best known for films such as **THE TERMINATOR** and **AVATAR**, Cameron is an engineer, philanthropist, inventor and a deep-sea explorer as well as a director, producer and screenwriter. He helps to develop and produce the most advanced and innovative special effects for use in his films.

*Now, tell me an engineer can't be a great movie director!*



### 4 LIGHT AND SOUND EFFECTS ENGINEERS

Light can be used to tell a story, to set the time of day, to create a mood, to guide the audience's eye, or to make a character look appealing or stand out on a busy set.

A sound engineer creates, mixes and manipulates sounds from different sources, creating compelling effects that add to the image. You need to have a very detailed understanding of the equipment to succeed in this position. You also need specialist skills to easily use computer software and various programmes.

Good quality knowledge is also a key in light systems operation as each shot will need specifically designed lighting. A lighting technician knows a great deal about equipment such as cables, wires and generators, as well as technology and electricity.

Operating the lighting and sound equipment found on any movie set requires a comprehensive understanding of electronics.

Without a base understanding of how electrical systems work, light and sound engineers wouldn't be able to effectively operate the equipment that enhances the stories told by filmmakers.





# HISTORY OF THE MOVIES

An interest in engineering and passion for filming are not mutually exclusive, and both can lead to your dream job.

The two have been working side by side ever since the beginning of the film industry. In fact, the pioneer of the motion picture industry, Léon Gaumont, was a French engineer born in the 19th century. He was always fascinated by photography and pursued it in his career.

He created the synchronised functions of cinematograph and phonograph, giving rise to film with sound. Knowledge of light and sound effects is a crucial element of every production, especially when special effects are becoming more popular and sophisticated by the day.

*The people behind these achievements are engineers.*



## THE BIRTH OF CINEMA

The first films were made in the 1890s, when motion picture cameras were invented and film production companies were established.

Because of the limits of technology, these first films were under a minute long, and until 1927, motion pictures were produced without sound.

The first decade of motion picture saw film moving from a novelty to an established mass entertainment industry. Rotating camera shots, special effects, animation and action sequences were introduced not long after.

The American film industry, or Hollywood as it became known, soon established itself as the creative and geographic centre for the movie industry. By the 1920s, America was producing over 800 movies per year, including classic films such as **A TRIP TO THE MOON**, **METROPOLIS** and Charlie Chaplin's **THE KID**.





## THE GOLDEN AGE OF CINEMA

Advances in sound and technicolour enhanced the quality of movies, and by the 1930s, Hollywood was home to one of the most visible industries in America.

Most people were watching films at least once a week. With better sound and film technology emerging, the industry could pursue new creative directions, entering a 'golden age' of creativity and exploration.

The film industry attracted audiences with strong narratives involving romantic characters struggling to overcome heavy odds. Movies of the golden age include a long list of classics: **THE WIZARD OF OZ**, **GONE WITH THE WIND**, **KING KONG**, **BEN HUR** and many more.



## THE DIGITAL REVOLUTION

A renewed interest in film realism influenced motion picture technology after World War II, and the space race in the 1960s and 1970s led to a science-fiction boom.

Filmmakers used smaller, lighter cameras that could shoot on location without tripods or heavy equipment. The introduction of the Steadicam in the 1970s stabilised a moving camera, allowing it to be at the centre of gravity.

More recently, Hi-8 cameras, camcorders and digital cameras have increased personal and professional handheld filmmaking practices. Computer and digital-based filmmaking technologies introduced special effects, interweaving digital or virtual settings with live action, conveying scale and reducing the labour involved in setting up difficult shots or constructing complex settings.

Disney's **TRON** (1982) was the first movie to include high-resolution digital imagery. This was an important innovation in special effects and marked the start of computer-generated imagery, or CGI as it is known. CGI has changed nearly every aspect of motion picture special effects.

Digital compositing allows for far more control and creative freedom than traditional analogue film. Digital worlds and characters can be created on a computer screen with the flexibility of computer software.

Arguably the biggest and most spectacular use of CGI was in the creation of photo-realistic images of science-fiction and fantasy characters, settings and objects. Images are now created with computer software using the techniques of animated cartoons and model animation.

In 1993, stop-motion animators working on the realistic dinosaurs of Steven Spielberg's **JURASSIC PARK** were retrained in the use of computer input devices. By 1995, films such as **TOY STORY** and **FINDING NEMO** showed that the distinction between live-action films and animated films was no longer clear. Other landmark examples include a tentacle of water in **THE ABYSS**, the T-1000 Terminator in **TERMINATOR 2: JUDGMENT DAY**, hordes of armies of robots and fantastic creatures in **STAR WARS** and **THE LORD OF THE RINGS** trilogy, and the planet Pandora in **AVATAR**.





# NATIONAL CURRICULUM LINKS FOR ENGLAND

Please note that curriculum links for Scotland, Wales and Northern Ireland are available at the links at the bottom of this page.

ACTIVITY	SUBJECT AND KEY STAGE	NATIONAL CURRICULUM DISCIPLINES
01 A Puzzling Parallax	KS3 Science KS3 Maths	Experimental skills and investigations; analysis and evaluation Geometry – position and direction; statistics; measurement
02 The Magic Drum	KS2/3 Design & Technology	Develop creative, technical and practical expertise; design and make high-quality functional products; test, evaluate and refine their ideas and products
03 Creating Movie Magic	KS2/3 Computing	Use software on a range of digital devices to design and create content that accomplish given goals; undertake creative projects that involve selecting, using, and combining multiple applications to achieve challenging goals
04 Chemical Eruption	KS3 Science KS2/3 Design & Technology	Chemical reactions; energetics; energy changes and transfers Select from and use a wide range of materials and ingredients, considering their properties; test, evaluate and refine their ideas and products
05 Pop Rockets Blast Off	KS3 Science KS2/3 Design & Technology	Motion and forces; pressure in fluids Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions; design and make high-quality functional products
06 Over the Rainbow	KS3 Science KS3 Maths	Experimental skills and investigations; light waves Geometry – properties of shapes; geometry – position and direction; solve problems
07 Good Vibrations	KS2 Science KS2/3 Design & Technology	Sound, light and energy waves; experimental skills and investigations; analysis and evaluation Develop creative, technical and practical expertise; achieve functioning solutions; test, evaluate and refine their ideas and products
08 Earthquake Proof	KS3 Design & Technology KS3 Maths	Use a variety of approaches to solve design problems; Develop and communicate design ideas using annotated sketches and mathematical modelling; Understand how more advanced mechanical systems used in their products enable changes in movement and force Ratio and proportion; Measurement
09 Removing Resistance	KS2/3 Science KS2/3 Design & Technology	Forces and motion; Magnetism Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions; Test, evaluate and refine their ideas and products
10 Fossil Making	KS2 Science KS2/3 Geography and DT	Describe and compare the structure of a variety of common animals Locational knowledge; identify the habitat of living and dead animals; develop creative, technical and practical expertise
11 Smartphone Projector	STEM	Interdisciplinary skills and expertise developed from each of the STEM curricula
12 Pinhole Photography	STEM	Interdisciplinary skills and expertise developed from each of the STEM curricula

## CURRICULUM FOR WALES

<https://hwb.gov.wales/curriculum-for-wales>

## CURRICULUM OF EXCELLENCE - EDUCATION SCOTLAND

<https://education.gov.scot/curriculum-for-excellence>

## THE NORTHERN IRELAND CURRICULUM

<https://www.education-ni.gov.uk/topics/curriculum-and-learning>



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**The Royal Academy of Engineering** is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

## **What we do**

### **Talent & diversity**

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

### **Innovation**

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

### **Policy & engagement**

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.