Cartoons and Animation

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Words appearing in the text in bold, **like this**, are explained in the Glossary.

Cartoons and animation

For many of us, the first memorable characters we saw on-screen were funny cartoon characters. Most of us have seen TV shows or films about birds that can talk, such as *Donald Duck*, or cats that can crumble to dust after an explosion and then miraculously recover, as in *Tom and Jerry*.

Cartoon characters often look like exaggerated versions of real creatures, but they may also be completely imaginary creatures, such as dragons or aliens. Cartoon characters can be anything from cars and trains to robots and pieces of furniture.

What is animation?

To animate means to bring to life. Animation is the process of photographing or filming a sequence of still images and showing them quickly one after the other to create the **illusion** of movement. The images used in cartoons are drawings or paintings.

But cartoons are just one type of animation. Other types of animation use three-dimensional (**3D**) models. These may be real models or **virtual** models created on computers.

The great thing about animation is that there is no limit to what you can put on-screen – almost anything can be made to appear to move, from broomsticks and lamps to dinosaurs and skeletons.

Like most real cats, Tom chases mice. Unlike real mice, Jerry usually comes out on top. Anything is possible in the world of cartoons.

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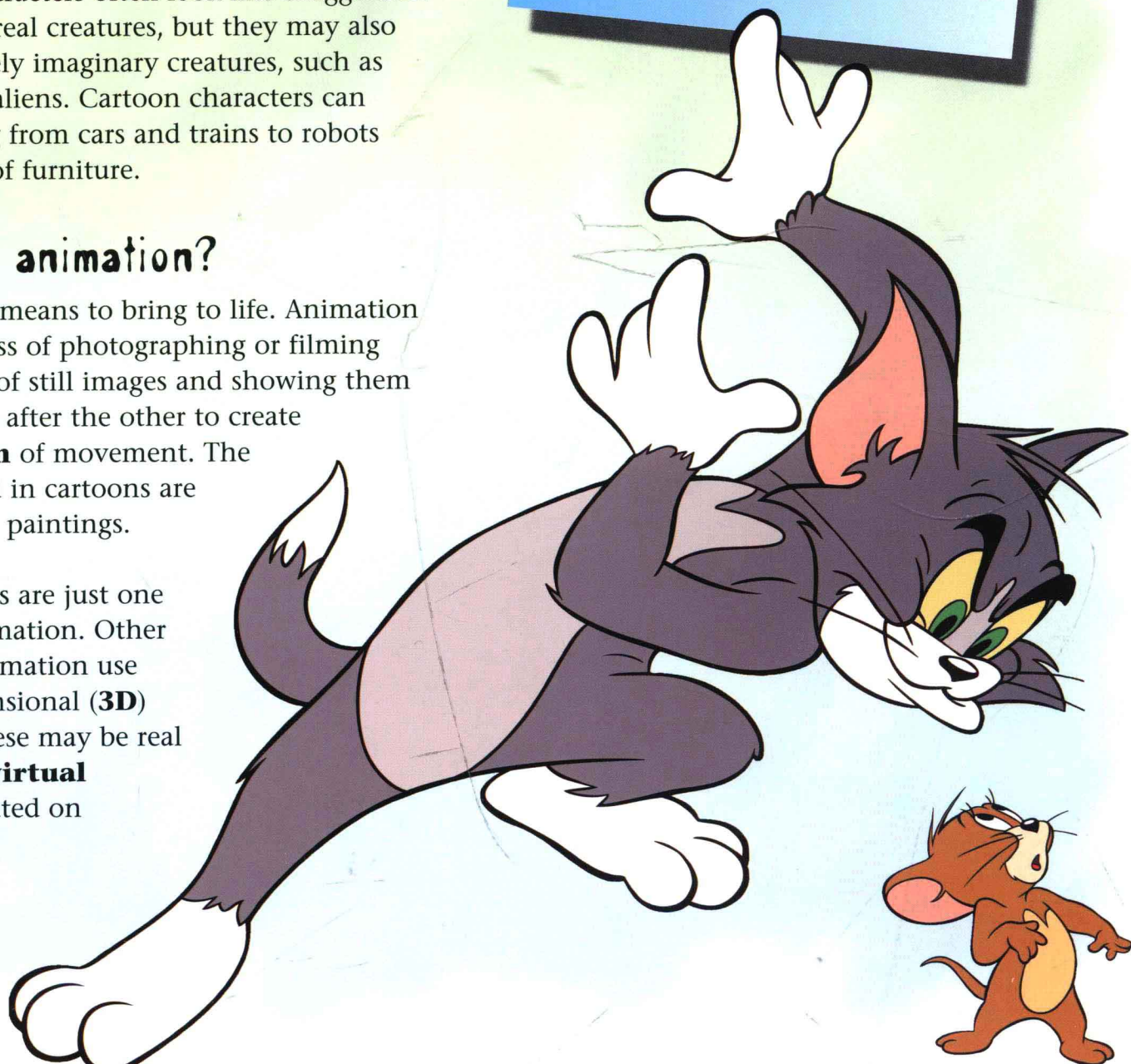
Tricks of the trade

Throughout this book there will be examples of the skills and techniques animators use to convert their initial ideas into finished pieces. To create their invented worlds, animators have to come up with imaginative solutions, ranging from sound effects to **special effects**. When they are successful, we are drawn into the world their characters occupy.

The imaginary 3D world shown in the animated film *Madagascar*, was constructed entirely using computers.

Try it yourself

Throughout this book are suggestions for activities that you can try yourself. Most are simple exercises to do with particular stages in the animation process. These activities will help you build up skills which may be useful in making your own animated sequences or even films.

You can use the completed exercises as part of an animation **portfolio**. This is a collection of your best and most recent work, such as drawings, notes, and recorded animation clips. It is a record of your development as an animator.

moving pictures

People first discovered how to make still images appear to move in the 19th century. However, as a way of telling stories or passing on information, cartoons and animation have never been more popular and widespread than they are today.

Using your brain

What happens when we look at a picture? Eyes sense patterns of light and shade, as well as colour and shape. Nerves carry messages about what the eye has sensed to the brain. The brain then processes the information into an image. It compares it to other images we have seen before and allows us to recognize things.

Persistence of vision

When the brain processes information about an image, it retains the image for a brief moment of time before it is ready to process another image. The way the brain stores images in this way is called **persistence of vision**.

When a very slightly different image follows in quick succession, the brain blends together the stored image and the new image as if it is seeing a single image. Any minor differences between the two images are smoothed out.

When we see a series of slightly different images one after another, the brain merges the images together to give us the illusion of smooth motion.

The need for speed

The brain stores images for about one-twelfth of a second. When sequences of different pictures or individual **frames** are shown at 12 frames per second, or faster, they blend together creating the illusion of smooth movement. Any slower than this and the movement appears jerky.

Most cartoons and animated films are shown at 24 frames per second or faster to help make the movement appear smooth and realistic. That means each minute of film has over 1,400 separate frames. This is a major reason why cartoons and animated films take so long to make – they need a lot of drawings!

The slowest animation?

Have you ever seen a film of a flower opening rapidly? Films like this are made using time-lapse photography. One photograph is taken from the same position each minute or each hour. When the frames are shown at 24 frames per second, persistence of vision means that slow processes appear to happen quickly.
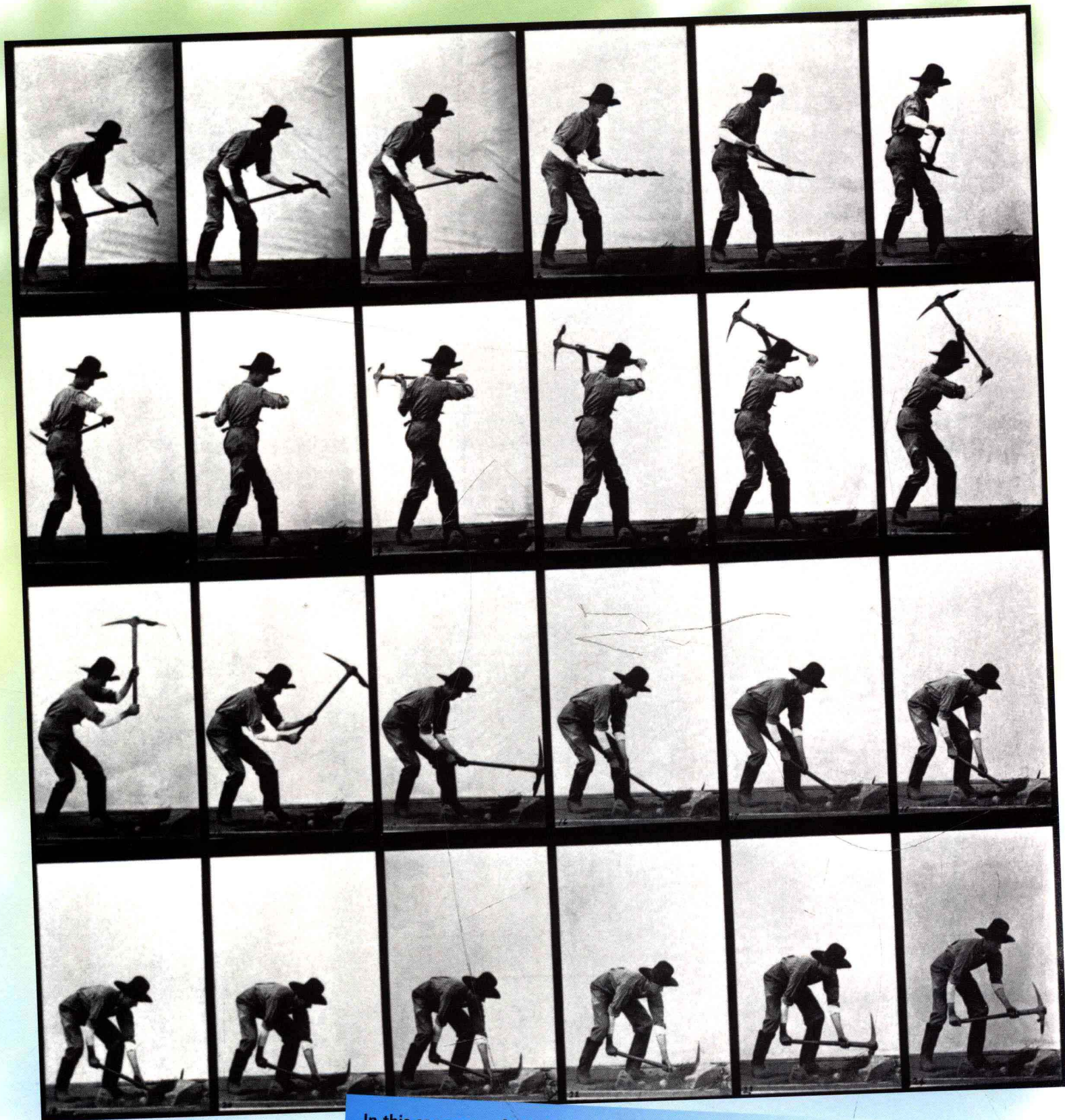
In this sequence of 24 photographs, taken in 1875, the position of the man changes slightly from one picture to the next. If the pictures were shown in quick succession, we would see the smooth movement of the man swinging his pickaxe.

How animation started

The first animated pictures were seen through magic lanterns and toys around the 1850s. Magic lanterns projected images on to a screen by shining light through glass slides that had photographs or painted pictures on them. A projectionist could create the illusion of movement by quickly changing the slides. People could also view short sequences of drawings using toys such as the **flickbook** and **zoetrope**.

Praxinoscopes

Animation took a great leap forward when Emile Reynaud invented the **praxinoscope** in 1877. Reynaud drew hundreds of drawings on to long strips of transparent film. He then wound the film by hand past a light and used mirrors to project the "moving" images on to a screen. This allowed much longer animations to be shown to audiences.

Cine cameras

Soon after Reynaud, the Lumière brothers developed cine cameras. These could be used to take sequences of photographs on long strips of film. With this new technology, cartoon makers could photograph different pictures, one at a time, on lengths of film. They could then run the sequences at speed to create animations.

The zoetrope is a horizontal drum with a strip of pictures inside and slots around the edge. By rotating the drum the pictures seen through the slots appear to move.
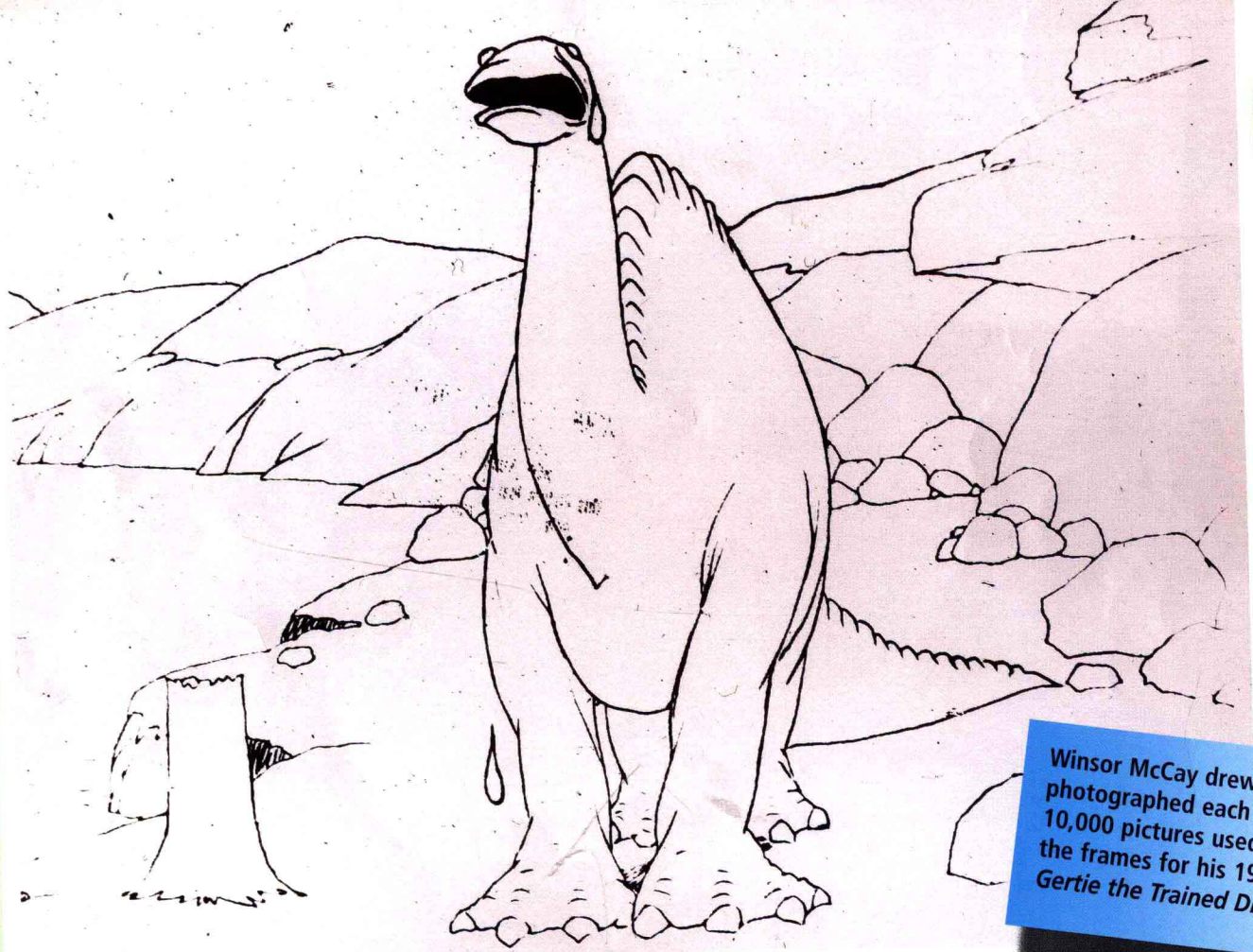
Moving models

In the early 20th century, animators were already beginning to show weird and wonderful things on film using animation. The French film maker Georges Méliès loved magic shows and illusions. One day his cine camera jammed for a minute when he was filming in a street. When he was watching the film he noticed that, by chance, a bus had moved while the camera had been jammed and its place taken by a horse-drawn hearse. When he showed the film, the bus appeared to turn into a hearse. Méliès was the first film maker to use **stop motion** animation (see page 14).

Try it yourself

Your task is to create a short animation of someone jumping off a diving board. Stack 12 small pieces of paper together and staple them on the left-hand side. In pencil, draw on the top piece of paper a person standing on a diving board with a swimming pool below. The last picture will show a splash as they enter the water. The other pages should show the stages in-between. The person should change position only slightly from one picture to the next. When you flick the pages, the dive should be smooth. Top tip: make sure the diving board and the pool are always in the same position in each picture.

Animation studios

Early animators created their cartoons alone and their work was very time-consuming. But in the early 20th century there was a growing demand for **feature-length** animated films, and animators wanted to save time making them. So they formed animation studios and divided up the work between people with different skills and different roles. For example, artists created the drawings and cameramen photographed them.

In the 1930s, more and more studios were set up, including the Walt Disney Studio and Warner Brothers, and many animated films were made. Many of the original studios still survive alongside newer studios such as DreamWorks and Pixar.

Walt Disney is pictured here with his best-known cartoon character Mickey Mouse.

Creator focus: Walt Disney's studio

Walt Disney was the founder of the most famous cartoon animation studio of all. He moved the Walt Disney Studio from New York in 1923, where many animators worked, to Hollywood, California, the home of the US film industry. Here there were many technicians to produce his animated features. Walt Disney was a good artist but he only did the drawings for the studio's earliest films, such as *Steamboat Willy*, which was made in 1928. On later films, including *Snow White and the Seven Dwarfs* and *Pinocchio*, he employed artists such as Vladimir Tytla and Freddie Moore, who were able to make characters appear more realistic. The Disney look became popular across the United States and beyond. One of the studio's most famous cartoon characters, Mickey Mouse, remains the symbol of their global entertainment corporation.
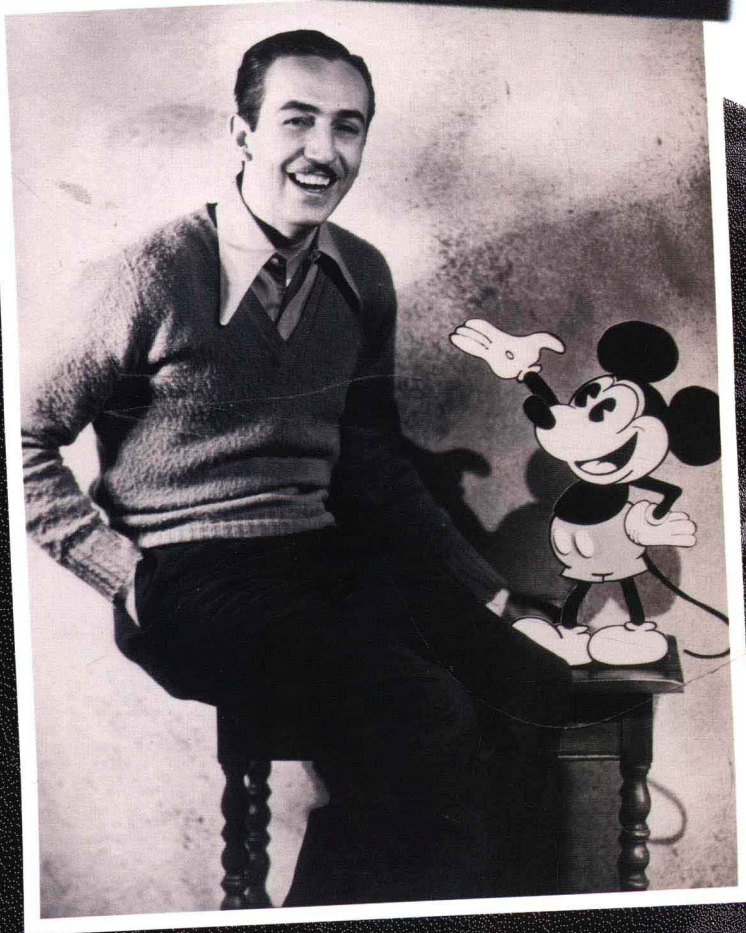
This trainee pilot is practising landing in a flight simulator. He is landing on an animated representation of an airstrip.

The animated world

When televisions became more widespread in the 1950s and 1960s, people could see animation in their homes for the first time, not just at the cinema. At the beginning of the 21st century, animation can be seen on many different types of screen, from laptops and mobile phones, to enormous advertising hoardings on buildings and around sports grounds. Animation is no longer limited to short cartoons and feature films. It is used in interactive games on computers and consoles.

Beyond entertainment

Animation is also important in teaching complex subjects. For example, short animated sequences can help students visualize certain scientific processes such as reproduction or the formation of oil.

Flight simulators allow trainee pilots to learn how to operate complex and expensive aeroplanes before they use the real thing. Flight simulators have display screens showing animated versions of landing strips, created by computers, as well as different landscapes to fly over.

ways of animating

Traditionally, animation always involved photographing sequences of different drawings or models in different positions. But today most animation is created on-screen using powerful computers.

Time saver

Imagine having to copy or trace the drawings in each frame of a long cartoon. Thankfully, in 1915, J.R. Bray came up with the idea of **cels**. Cels are transparent sheets of film or **acetate**. Bray painted one background on paper and drew characters in different positions on separate cels that could be laid over the top of the background. This meant the background did not need to be redrawn for each frame. This saved animators a lot of time.

## Building up pictures with cels

1. First a background is drawn or painted.
2. Outlines of characters are then sketched on paper in pencil.

3. A cel is placed over the background and a character is traced on to the cel in the right position, using the sketched outline.

4. The character is then painted in on the cel. For this it is necessary to use a permanent marker and/or paint mixed with a drop of washing-up liquid so the paint sticks to the surface of the cel.

5. Steps 3 and 4 are repeated for other characters, using separate cels for each character.

6. The background is then photographed, overlaid with all the cels together. This forms one frame.

7. To create the next frame, a new cel is created for each character that is to move. Only the bits that need new positions are redrawn. The parts that do not need to move are traced from the previous cel showing that character. Then the new cels and any cels that have not changed are laid over the background and another photograph is taken.

Are you registered?

When animators use cels, the sequences will appear jerky if the positions of characters and other objects relative to backgrounds shift about, even slightly. Animators avoid this by punching holes in the same place on each cel and placing them on metal pins so they are all in exactly the same position before they draw characters and other objects on the cels. This process is called **registration**.

This artist is tracing characters on to thin paper held in position by registration pins. He can use the sheets to create cels to overlay on backgrounds.
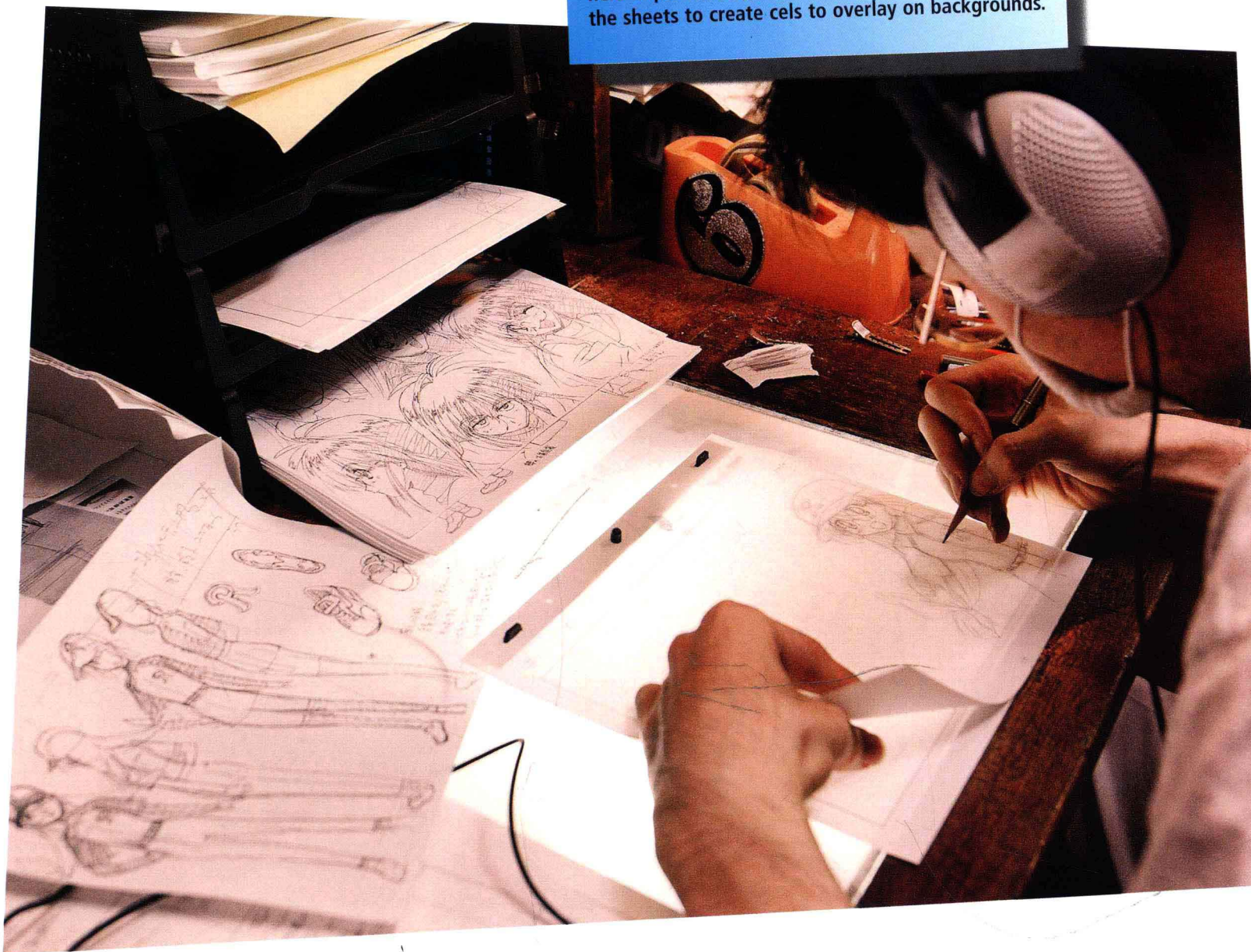
Try it yourself

If you have access to a digital camera, try using cels to make a cartoon dog walk. First create a background, such as a park. Then on an acetate sheet draw the dog starting its walk on the left-hand side. Create enough cels to show the different positions of the dog's legs as it walks to the right of the background. Photograph each cel against the background using the digital camera set up on a tripod or chair so it remains still and in the same place. When you run all the frames in sequence, your dog will appear to walk!

Stop motion animation

Have you ever seen the original *King Kong* film? Believe it or not, audiences in the 1930s were awestruck by the great gorilla climbing the Empire State Building. These sequences were created using stop motion animation. The basic process is to fix a model, such as Kong, in one pose, film or photograph it, stop the camera, change the pose a little, and then photograph the model again. When the individual frames are shown in quick succession, the model appears to be in motion.

Animators still use stop motion animation today. They often film models within detailed three-dimensional worlds, rather like mini stage sets, to make feature films such as *Chicken Run* and *The Corpse Bride*.

Trained beetles?

Around 1910, an animator called Ladislas Starevich made a stop motion film about a beetle called Leukanida and her two male suitors. He did it by filming dead beetles. However, his animation made the beetles appear to move so realistically that some journalists of the time claimed Starevich had filmed beetles that had been trained to act!

An animator repositions rabbits between frames for a sequence from Nick Park's stop motion film, *Wallace and Gromit: The Curse of the Were-Rabbit*.

As animators build up modelling clay around an armature, they check the proportions of the model are correct.

Model citizens

Some of the earliest stop motion animation used moveable toys such as teddy bears and dolls. However, to increase the range of facial expressions and movement, most animators create their own models. All kinds of models are created, from jointed wooden puppets to flexible clay figures. A soft, oily clay similar to Plasticine was used to make the models for Nick Park's *Wallace and Gromit* series of films (see page 30). Animators generally build up this clay around a jointed wire skeleton or **armature** to stiffen the models and allow particular poses to be held.

Try it yourself

Try making a model of a person using pipe cleaners and Plasticine. Twist together two pipe cleaners to make the backbone. At each end of the backbone, loop around a pipe cleaner to make the legs and arms. Leave a bit of the backbone sticking up above the arms for the neck. Cover the pipe cleaners with Plasticine, about 5 millimetres (0.2 inches) thick. Smooth the Plasticine over. Add a separate Plasticine head on to the neck and feet on to the legs. Remember to make the feet broad enough for the person to stand up. Take photographs of the model in different poses and from different angles and stick them on to a sheet of paper for your portfolio.

Escaping the cel

Today, cartoon creators mostly use computers to create animation. Some use a computerized version of traditional cel animation. Outline drawings of characters are scanned into computers or drawn directly on **graphics tablets** to produce outlines on-screen. The outlines can be coloured in and positioned against different backgrounds using graphics software. The final images are then converted into frames that are put together to form animated sequences.

Morphing

To cut down on the number of frames that need to be created, computers can be programmed to generate frames by themselves. This is called **morphing**. The start position and final position of a moving character are programmed into the computer. The computer then produces the frames for the character's positions in-between. Whether the character appears to move smoothly depends on how well the computer has been programmed to morph.

How do computers help animators?

Using graphics software to create animation means there is no need to trace any drawings to create new frames. This is because anything from the previous frames can be copied by the computer. Different elements within a frame can be changed without major redraws. For example, after watching an animation sequence an animator can change the colour of a character's clothes or smooth out a movement. Registration is also easier on a computer. Computers can accurately position characters against backgrounds.

Controlling movements

In computer animation, characters are given coordinates that determine their position on-screen, rather like map coordinates. To make a character appear to move, the animator changes its coordinates slightly from one frame to the next. This means that characters can be moved, rotated, stretched, enlarged, or reduced at the click of a few buttons, so there is no need for extensive redrawing.

A brief history of computer animation

Computer animation started in 1961 with the first computer game, *Spacewar*. This was created on an enormous computer by a researcher doing a university project. Animation development in the 1960s and 1970s was driven by aircraft manufacturing companies, which needed flight simulators to develop their products, and by games companies. However, computer animated effects began to appear in films, such as the Death Star diagram in *Star Wars*, made in 1977. The first completely computer animated feature film was *Toy Story* in 1995. Since then computer animation has progressed rapidly as the processing power of computers has increased.