

► watch about 1 billion hours of video per day, according to the company's website. "There is just a hunger for visual media," says Dennis Aig, programme director of the science film-making course at Montana State University.

Science videos generally aren't as popular as, say, gaming or music clips. But there is a demand for them, Aig says, because they can show research in remote or unusual places, and explain difficult concepts more clearly.

It's easier now for interested researchers to learn the requisite skills and produce content, thanks to science-film-making graduate courses; general science-communication programmes that offer video courses; and short-term training workshops. Expensive equipment is unnecessary — often, an iPhone and basic accessories will do. Some scientists make outreach videos on the side, whereas others become full-time freelance film-makers, educational-content creators or staff members at production companies or non-profit organizations.

Projects such as TV nature documentaries are highly competitive, with limited staff jobs and many freelancers trying to break in. And the work can be strenuous: hauling heavy gear and filming in cold, wet weather are often part of the job. But when the right images, sound and dialogue come together, it is magical, says Charlotte Salvatico, a freelance film-maker, teacher and consultant. She is the Paris coordinator of Imagine Science Films (ISF), a non-profit based in New York City that runs science-film festivals and encourages connections between scientists and film-makers. (*Nature* sponsored awards at the Imagine Science Film Festival for several years, ending in 2016.)

SCIENTIFIC FINESSE

Gordon says that her field research prepared her to shoot nature documentaries. As a marine biologist, she performed delicate tasks such as collecting coral eggs with a syringe; jobs such as filming underwater, for example, require the same fine control over instruments. In the field, she grew accustomed to working in remote locations and fixing equipment, and knew how to avoid disturbing wildlife — skills that she uses constantly today. She says that the process behind her current work is similar to field research: collect observations, shape them into a story and distribute the product. "To me, science film-making feels totally equivalent to being a field biologist," she says.

Aig estimates that roughly 1,000–2,000 people with science backgrounds are making films professionally in the United States and Europe. In 2016, ISF launched an online database of science movies called Labocine, which now contains more than 2,000 titles, ranging from documentaries to avant-garde films; of those, about one-fifth were made by scientists, says Nate Dorr, director of programming at ISF. For example, the experimental film *The Mirror System* depicts a woman who dreams of memories while exploring a neuron 'forest'. It was

directed by Eva Zornio, an independent film-maker with a neuroscience background and based in Geneva, Switzerland. Some research organizations are pushing the medium as well. Celldance, a programme run by the American Society for Cell Biology in Bethesda, Maryland, provides US\$1,000 grants for scientists to produce videos about their research.

Science-film-making graduate programmes offer a structured route into the industry, and video experience may not be necessary to apply. "We assume they don't know anything," Aig says of students in his programme. Similarly, the science and natural-history film-making graduate programme at the University of Otago in Dunedin, New Zealand, looks for applicants with portfolios demonstrating a creative spark, but another medium such as photography or drawing is acceptable, says Lloyd Spencer Davis, founder of the university's Centre for Science Communication. Other wildlife or environmental-film-making programmes are offered at the American University in Washington DC, the University of Salford, UK, and the University of the West of England in Bristol, UK. Researchers can also enter science journalism or communication programmes that include video

coursework, such as those at Imperial College London or Boston University in Massachusetts.

If graduate school is not an option, researchers can seek unpaid internships on film productions to learn the ropes. For instance, a cephalopod researcher could assist on an octopus documentary by sharing knowledge about the creatures' habitat. Researchers can ask industry contacts for mentor suggestions, or attend film festivals. During the first year of her film-making programme, Gordon approached John Brooks, an independent director of photography and underwater cinematographer, at the Jackson Hole Film Festival in Wyoming, and offered to be his dive assistant. Partly because she was certified as a NOAA diver, he agreed to let her join a film project.

Scientists can also pick up video skills at short workshops or university classes. Science-Film in Bowen Island, Canada, for example, holds workshops of 3–12 days to train researchers and other professionals to make videos. Students are not expected to become full-time filmmakers but to use video as a tool, says Colin Bates, the company's co-founder and an ecologist at Quest University Canada in Squamish. For instance, a researcher could create a video of a field or lab technique for a conference presentation to help explain the method, he says. The training could also help scientists to satisfy outreach requirements in grant applications, or to produce video abstracts for papers. *Les Chercheurs Font Leur Cinéma* (Researchers Make Their Movies), a programme run by Doc'Up, a doctoral-student association in Paris, helps PhD students in the Île-de-France area to make five-minute movies about their research.

Creating videos allows scientists to better communicate their research to peers and the public, says Sally Warring, a protistologist at the American Museum of Natural History in New York City, who films microbes. She recalls a video made by a team at Harvard Medical School in Boston, Massachusetts, and the Technion–Israel Institute of Technology in Haifa showing the growth of antibiotic-resistant bacteria (go.nature.com/2bd0xjx), which she found more powerful than a graph. And if scientists are issuing a press release about a study, a companion video might pique journalists' interest, she says.

Scientists can dabble using basic equipment (see 'Shortcuts to filming'). Some people start by creating short videos for social media. In 2015, Warring began filming pond microbes under the microscope with her iPhone. Her simple videos captured processes such as green algae producing a colony. Warring posted them on her Instagram account @pondlife_pondlife, which now has more than 48,000 followers.

YouTube allows scientists to explain more-complex concepts. But videos should still be fast-paced and energetic, because users are easily distracted, says Dianna Cowern, who created the YouTube channel Physics Girl, now funded

PHONE SKILLS

Shortcuts to filming

Researchers can try out film-making without expensive equipment. "You don't need anything fancier than your phone," says Rob Nelson, director of Untamed Science, a non-profit in Charlotte, North Carolina, that makes science videos. And Apple's free editing software iMovie is generally sufficient for beginners. Film-making tutorials are available on the sites Vimeo Video School, Lynda.com, Khan Academy and Untamed Science's YouTube channel Rob & Jonas' Filmmaking Tips.

Extra equipment might be necessary to gather clear audio. Viewers can tolerate shaky video, but they will stop watching if it's hard to hear the person speaking, says Huw James, founder of Anturus, an adventure-education company in Cardiff, UK, that produces science videos. When interviewing someone on camera, the film-maker should record audio using a separate phone or microphone positioned close to the person. When outdoors, a lavalier microphone with a wind shield is essential, James says.

Amateurs should be prepared to improve through trial and error. "The most crucial thing is being okay with failing quite a lot," James says. "They're not going to look great straight away." **R.K.**