HOW YOU CAN CHANGE THE WORLD USING YOUR VIDEO CAMERA

HOW TO MAKE SCIENCE & NATURE FILMS

ROB NELSON, DAN BERTALAN


HOW TO MAKE
SCIENCE & NATURE FILMS

Tip: If things get crazy, keep filming!

SCIENCE & NATURE FILMS

EVERYTHING YOU NEED TO GET STARTED MAKING YOUR FIRST SCIENCE OR NATURAL HISTORY FILM

ROB NELSON - DAN BERTALAN

FOREWORD BY ROLAND KAYS

ILLUSTRATIONS BY ROB NELSON

Untamed Science
A nonprofit organization
2430 Belmeade Drive
Charlotte, NC 28214

Printed in the United States of America

Editors: Lauren Ray Burn; Tommy White
Graphic Layout: Meredith Ray
Special Help: Haley Chamberlain Nelson
Illustration: Rob Nelson

Contents

Foreword

Welcome to the new world of science communication

By Roland Kays.

Science lover, look around you. Better yet, go outside and find some non-scientists. What are they doing? Chances are, many of them are looking at a screen. The younger they are, the more likely they are looking at a screen. Check on them at home and you might find two screens going at once. If you want to get your message out to these people you need to get it on their screens.

We are smack-dab in the middle of a golden age of video, and nothing looks better on a screen than a well-produced video. Making your video look and sound good has never been easier. The tools you need are now cheap, high definition, and some even fit in your pocket. If you have a story to tell, the limiting factor is not going to be your equipment budget, but your know-how and your creativity.

If you are a scientist, you want your own work to be known past the narrow audience of your peers who read your journal articles. The old standard of writing a few popular magazine articles about your work is no longer sufficient. Of course you think you don't have time for this, but making

effective videos doesn't need to take a lot of time. Try a Vine video. For example, see if you can tell the world about your favorite scientific discovery in seven seconds using the Vine App. Post the video using #GreatestDiscovery and #6secsci and check out other's contributions. Six seconds - you have time for that. If you found that fun, try a short edited video. Keep it simple, you could even shoot and edit it all on your phone. This book will help you make your videos better, and your production more efficient. This book will help you get started with video; how far you take it from there is up to you.

If you are a science enthusiast, you want to share your passion for a field with others, and maybe even change the world. Compared to the scientist, you get to jump around different subjects. You have the flexibility to dive into the research on one subject, then switch to something else that sparks your excitement and become an expert on that. This research phase lets you never stop learning, and will lay the groundwork for your video production. If you are coming at this as an enthusiast, and not a full-time scientist, you will have more time to put into your production. Maybe you've made some small videos and want to go bigger, maybe you've participated in larger productions but want to lead your own effort. This book will show you the different ways you can scale up your effort to make a more professional and more effective video.

There are millions of crappy videos out there. You don't want to make a crappy video. No one else wants you to make a crappy video. This book will help you not make a crappy video.

In fact, the world really needs you to make an awesome science video. Although professional researchers con-

tinue to push the limits of knowledge and make amazing discoveries, much of the non-scientist 'general public' don't have any idea of how the process works. There are even some people that are anti-science, fearing how critical thinking jeopardizes their own particular status quo. Reaching them with your pro-science message will be difficult, but could have a real impact. But these science-haters are a minority, there is actually a giant audience of people open to learning more about the world through the scientific lens, as told through your camera lens.

Science communication has never been more important for our society, but also never been so difficult. The various fields of science are each barreling down their own paths of specialization. The faster a scientist pushes into the unknown of their specialty - be it chemistry, ecology, Dipteran Transcriptome genomics, or whatever - the more likely they are to discover something new. However, these paths to discovery also lead to such a specialized language of jargon and high-brow concepts that anyone who's not traveling down that same path is not going to understand what the heck they are talking about. Effective science communication requires a type of translation skill that's not unlike serving as a language interpreter at the United Nations. Not only do you need to understand what the scientist is talking about, but you also need to translate their findings into the language of people who are way, way back down the science jargon path. Yes, you need to learn the jargon of the field you are covering, but you also need to remember the language you spoke before you got so smart.

My own science career has taken me down the ecology and evolutionary biology path, leading to regular geeky, jargon-filled lunch conversations with colleagues where

we talk about the latest phylogenetic methods using SNP data or the implications of indirect predation effects on trophic cascades. Talking shop with my science friends is great fun and helps us all move the field forward. But when it comes time to tell non scientists what I'm working on I need to mentally shift-gears and think about who I'm talking to, what their background might be in my field, and what aspect of my work might have any relevance to their lives.

The more I talk with non-specialists about my work, the easier it gets, and the better I get at translating my own jargon into science messages and stories that others can relate to. I'm lucky to have a job at a museum where communicating about science is as important as doing science, and I have plenty of opportunities to practice my craft, including dozens of talks a year and a number of videos in collaboration with Untamed Science.

My work 'on the set' with Untamed Science has included midnight drives through the back roads of North Carolina, baboon trapping in Africa, and chasing animals through the rainforests of Panama. These have been adventures, and they were fun times. My scientific objectives were accomplished in these trips, but I think the key to the success of Untamed Science of turning these expeditions into compelling videos has been to have fun in front of the camera, and to keep the energy high.

Scientists are not typically good actors, so we aren't going to be as good at faking it in front of the camera. However, if you, the filmmaker, can create a scenario that is naturally fun you will bring out the charisma and energy from even the stodgiest scientist. Untamed Science uses a recipe including adventure, travel, sports, and nature to cook up the fun. As you plan your own productions, be

sure to think about the fun factor. The ingredients you bring to keep the production fun and exciting will define your video style, keep any on-camera scientists engaged, and grab your audience through their screens to connect them with your message.

Introduction

The power of filmmaking awaits you.

Congratulations. By reading this book, you're taking a big step forward in producing some of the most influential creations on this planet: science and wildlife films. They can wield tremendous power if done well, whether simply awakening us to global climate change or exciting students about science.

Consider how the future of the Earth, and everything that lives on it, may be influenced by scientists and environmentalists effectively telling their stories to the rest of humanity. These stories have the power to promote scientific solutions, launch careers in science, affect political and social change, or encourage someone to truly make a difference at a personal level. It doesn't matter if you're an ecogeek, student, aspiring filmmaker, teacher, scientist or already a media professional; this book will help you advance your skills and produce meaningful films.

Whether it's 30 seconds on YouTube or a box-office rave in theaters, most film media blends motion pictures with audio. Depending on how it's recorded or where it's shown, your production might be called video, film, movie, television show, or streaming media. Many call it filmmaking. Collectively, filmmaking media impacts al-

most every aspect of our lives. The choices of products we buy, the entertainment we watch, the styles we wear, who we elect as President, and even who we choose as prospective partners can fall under the powerful influence of moving media.

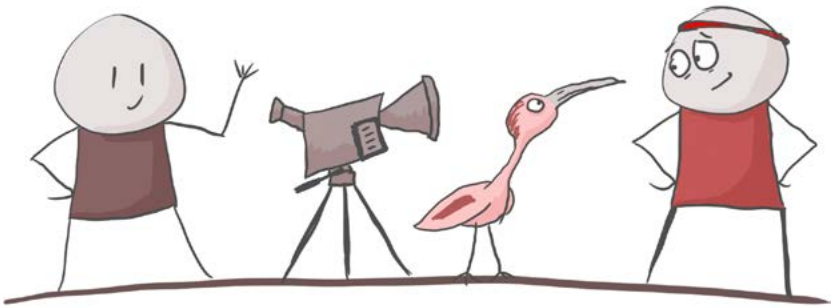
Though we're saturated with all kinds of printed and electronic media formats, films tower over the rest in their resounding power to shape perceptions and tell stories. It doesn't matter if you're watching *Avatar* in IMAX or a video blog post from UntamedScience.com on a smartphone, the end result is the same; in some measure your perception has been changed. Films have the power to reach deep inside our minds to our value systems, touch our hearts, and make us think critically about important stuff. This reach of this form of media is powerfully vast and posesses untold potential. That's why this book was written: to help you harness that power specifically in the realms of hard science or environmental and natural history films.

What's so exciting for you is the fact that today's digital technology makes it easier, faster, and more affordable than ever to create and distribute films. And never before have we been able to distribute them around the globe so quickly and easily. Today, web-delivered video is pivotal in engaging young audiences in environmental activism and revealing groundbreaking science.

If you picked up this book, chances are you have a story to tell. Perhaps you belong to an environmental nonprofit and want to prompt your members into action with a compelling video? Maybe you are part of a group of students who want to make the funniest science film ever to go viral on YouTube? Maybe, just maybe, you're a person with an incredible passion to reveal some untold yet remarkable story to the rest of the world? If you

already make films for National Geographic or the BBC, you'll still glean some interesting stuff within these pages to expand your skills as a filmmaker.

Although filmmaking can be your key to shaping perceptions both big and small, it's not an easy venture. It requires planning, hard work, and creativity. This book gives you the detailed plan and technical tools to make it all possible, based on decades of cumulative experience making hundreds of science and wildlife films that have impacted audiences of all ages.



This science and wildlife filmmaking book is distinctive because it's written by a pair of scientists who became professional filmmakers. Rob Nelson holds two Masters degrees, one in zoology and one in science filmmaking. His productions have earned international distinction for their gritty blend of genuine adventure and scientific discovery. Dan Bertalan holds degrees in earth science and geology that inspired his passion for environmental filmmaking. Dan's science and conservation films have impacted millions and earned multiple awards. Their science films are shaping the way people think about science and its role in our lives. Many of these films will be viewed by thousands of students in North America as part of classroom curriculum from Pearson Education textbooks.

The authors have participated in every step of the filmmaking process: concept development, client generation, fundraising, scriptwriting, logistics planning, camera operation, on-camera hosting, directing, editing, and national distribution.

Besides sharing their technical expertise on making films, they also reveal the secrets of creating captivating stories within your productions to reach audiences effectively. It's all presented in a step-by-step format with a logical "how-to" approach for turning your filmmaking ideas into head-turning, thought-provoking productions.

So let's get started!

One

Getting Started

Films that excite and inspire

The greatest tool you have as a filmmaker is the drive to engage and inspire your audience. Your passion can help create change and drive useful action. You will come up with an idea, determine your audience, and start making your film. But be sure to begin with an idea that truly drives *you* to inform change and inspire others.

In 2005, Jean-Michel Cousteau, the son of legendary ocean explorer Jacques Cousteau, traveled to the Northwest Hawaiian Islands, an uninhabited chain of islands 1,600 miles northwest of the main Hawaiian Islands. On the expedition, the diversity of sea life in the area completely blew away the team. However, they also witnessed a myriad of trash piled up on the beaches, washed there from the wind and waves of the Pacific Ocean. Watching the debris affect the fragile ecosystem, Cousteau and his crew knew they had to do something. It seemed only natural to make a film that would demonstrate the delicate nature of the area and warn people about the harmful impact of pollution. Like every filmmaker, Cousteau hoped

the film would make a difference. He didn't realize then just how important it would become.

Only a year after making *Voyage to Kure*, Cousteau found himself in the company of President George W. Bush and a powerful White House committee dedicated to preserving the environment. After watching the film, Bush turned to the committee and said, "Let's get it done." He proceeded to set aside the entire Northwestern Hawaiian Island chain as a protected monument. Cousteau's passion and story motivated this special audience to take action, and it changed the course of history for one very delicate ecosystem.

Though few viewers wield presidential-sized power, many of them, if motivated, can still influence powerful decision-makers or take action to ensure a message is heard. You never know who might see your film or be influenced by it.

In the past, breaking into the science and wildlife filmmaking industry was a costly and difficult process. Jean-Michel

Cousteau is a living legacy of his father, a family connection that no doubt helped him establish his name in the business. Fortunately for you, times have changed in the industry. You no longer need the fortune of family connections or independent wealth to become a successful filmmaker.

You do, however, need some basic equipment, education, and a little ingenuity to begin.

Equipment

In the past, the 35mm film camera that was typically used to shoot wildlife footage was the cost equivalent of a modest home. If you combined the purchase of the camera, film processing, and a professional editing suite, you are now in the price range of a very nice home.

Thanks to the dawn of the digital age, filmmaking has become much more affordable. Today you can buy a high-quality, HD camera for a few thousand US dollars (USD). The same goes for a laptop with editing software. Even more good news - today's cameras capture directly to digital storage, eliminating the need for expensive tapes and tape decks to play back and digitize footage. So with a relatively small investment almost anyone with the motivation can afford to make science or wildlife films.

If you are unable or unwilling to spend that much money, don't worry. You don't need the latest and greatest gear, and you might be surprised by what you find online in affordable, used, or discounted HD video cameras and digital equipment. The specific equipment you will need for various settings will be addressed in later chapters. Though your gear is important, remember that equipment does not define you as a filmmaker. What does? Keep reading.

Education

There are numerous ways to educate yourself about filmmaking. Reading this book is an excellent foundation. We also have created an online guide with the most updated information via our website at http://www.untamedscience.com/how-to-filmmaking/.

In addition to the many websites devoted to filmmaking techniques, a handful of schools have emerged to lead the way in teaching the specifics of science filmmaking. They allow beginning filmmakers to formally learn the trade with a small group of fellow students, guided by instructors who have established themselves in the industry. Some of these prestigious schools include Montana State's Science and Natural History Filmmaking program and New Zealand's University of Otago. (We discuss these and other programs in more detail in Chapter 10.)

Networking

Like many other professions, learning the craft of making films also relies heavily on networking with other filmmakers. Making connections is an integral key to success. There will be a point in your filmmaking career when you will need to sell others on your film concept. Having meaningful relationships with other filmmakers and producers will help you in this cause.

Networking may seem intimidating early in your career, but remember that every filmmaker, producer, director, host, or broadcaster you meet was once a beginner. And few forget what it was like to start a career in filmmaking. The people who are making their first films at the same time as you will be your peers in the industry for

years to come. If you're lucky, you'll also come away with creative and amazing friendships. Here are a few tips to consider when trying to establish and expand your connections in the business.

- Seek out Internet affiliations. This is even more important if you're planning to distribute your films online.
- Attend film festivals, such as Bristol's Wildscreen or the Jackson Hole Wildlife Film Festival.
- Contact other science filmmakers on the Internet. Compliment their work, ask questions, and offer to meet when in town. Most are willing to help, so don't hesitate to ask or to begin a conversation with someone whose work you admire. I've reached out like this to nearly everyone I now work with (including my wife, Haley).
- Attend local film clubs, or if none exist, start your own with a regular movie night.
- Join broadcaster or filmmaker associations.

A Little Ingenuity

Decades ago, one way for a beginning filmmaker to get his or her film in front of an audience was to produce multiple VHS tape copies and distribute them. This made for another costly investment, and unfortunately, the advent of DVDs did not reduce these distribution costs very much. In fact, without some funding mechanism, it is cost-prohibitive for most beginning filmmakers to reach a broad audience with their films. Broadcast television is typically exclusive to established production houses. Your chances of gaining immediate recognition as an independent filmmaker through these mediums are limited.

So, in an effort to save your friends and family members from watching countless hours of your films, you should consider alternate ways to broadcast your films.

The digital age has again given you a distinct advantage over your predecessors. It has never been easier to "broadcast" your films to either a small target audience or a mass audience with broad appeal. The Internet allows you to broadcast films on your own science or wildlife Internet channel, via iTunes or YouTube.

We started Untamed Science because three of us, fresh from a science education, wanted to produce science and natural history films that would impact the classroom. The twist behind our films is that we are trained scientists who use action and adventure to portray ideas and concepts. We mix in humor, high-adrenaline situations, and genuine action in our videos, elements that we thought classroom science films needed to connect with students. This approach was pretty atypical of science films at the time, and our iTunes channel quickly became popular. Soon we were having meetings with publishing companies and broadcasters like Nat Geo and Discovery. Eventually we were contracted to produce more than 200 science-education videos for the world's largest publisher of science textbooks. These films are currently being watched by half the K-12 students in America. Hopefully, our films will inspire these students.

Our story may be unique, but having passion and just starting the process are so important. We bring this ideology to our filmmaking process, and it's fundamental to the story of this book.

Of course, the craft of science and wildlife filmmaking is also a business whose ultimate success depends on the

right blend of passion, using that passion to motivate yourself and others, and marketing your ideas in the right way to the right people.

Now let's start planning that film!

Two

Making Initial Plans

As you'll discover, filmmaking is very much a creative endeavor, and one of the many beauties about the process is that there are no rigid guidelines. No two filmmakers will produce the same film about the same topic in exactly the same way. You are free to unleash your creativity and design any blend of elements to fulfill your filmmaking passion and to reach your audience. However, almost all filmmakers will agree that without following a clear plan, you and your film might come across as a jumbled mess of ideas.

If you want the film to impact your audience, you will need a plan designed for that audience and a clear vision of how you are going to **show and tell** your story. When you *tell* an audience what to think by presenting a series of facts and evidence, you may fail to engage them and inhibit them to think for themselves. However, if you *show* your audience a sequence of images accompanied by graphics and a catchy soundtrack, but leave out the facts, you run the risk of losing your message al-

together. A carefully planned design can both show *and* tell your film's story. Your plan should blend creative genius with a practical approach to reach your audience effectively.

To demonstrate how you can achieve the type of film that will show and tell your message, let's walk through a typical pre-production meeting at Untamed Science.

Start by laying some groundwork. Ask the following foundational questions of any filmmaking adventure:

- What are the goals of the film?
- Who is the target audience?
- What is the story?
- What is the take-home message?
- What distribution methods will we use?
- What are the production roles?

Your plan doesn't have to be an elaborate document; an outline works fine. However, the more details you include up front, the more clearly you define the vision of your production.

Choosing a Topic and Defining Your Goals

First, define the goals of your film. This will help make you aware of the information that you need to gather and the pertinent facts you need to tell your audience. Make a list or, better yet, have your production team brainstorm together. Once you have a list, pare it down to three or four complementary and realisticgoals. Here are some examples:

For a Wildlife or Natural History Documentary

- Make the audience aware of a species in peril.
- Make them care enough about the species to take action.
- Identify causes that harm the species.
- Inspire social change to end harmful causes.

For a Science Film

- Connect a science topic with a problem in the audience's lives.
- Reveal how science offers solutions.
- Explore how the audience can become part of solution.
- Change the audience's stereotype or perception of the topic.

Your goals may be something you come up with or something a client brings you. One of our clients, for example, simply wanted to save the Florida manatees. Your job as a filmmaker is plan a film that will do that most effectively.

Identify Your Target Audience

Your target audience is the group of people you want to watch your film. It can be as broad as the general population or as specific as the members of the Denver Geophysical Society. Knowing your target audience will help you plan the key elements of the story and relevant production techniques.

Armed with our defined goal to save the manatees, we would brainstorm with our production team to identify the potential audience. In this case, our audience might include:

- Florida boating and fishing associations
- Drainage commissions and engineers
- Florida travel and tourism
- Florida fish and wildlife officials
- Coastal residents near manatee habitats
- Nature and outdoor associations
- Students in the area

Though we ideally want the entire country to know about and help save the manatees, our target audience should be people who are impacted by our story and who have the most influence to help save the manatees. Perhaps we concentrate our efforts on Floridians in the age range of 16 to 29, a group that may not even notice the plight of the manatee until we bring it to their attention. Next we would define our story, gather information, ask our "big questions," and develop our "take-home message."

Defining Your Story

To help define our story, we outline the elements we might want in our story. Jot down whatever comes to mind, but try to think from the perspective of your target audience. Then arrange your ideas as key questions in an order that would create a logical development for a film, for example:

- What's a manatee, and why are they unique?
- What's happening with manatees today?

- What things are threatening them?
- Who is responsible for harming them? For helping them?
- What experts or personalities can offer quality content?
- What can be done to save them?
- How can the viewer get involved?

This list establishes a clear direction for our film. We can elaborate or refine each question as we gather the materials to answer them. The logical and progressive development of your questions helps refine your grand plan and increases your chances of a successful production.

Develop the Big Question and Take-home Message

To keep our film on track and give it focus, we need to identify "the big question." What's the singular most important question that the film should answer for the audience? A logical choice from our example list could be, "What things are threatening the manatees?" Identifying the big question helps keep you focused during planning and production. It might be easy to get lost in the excitement of shooting your underwater segments with the manatees or interviewing some Hollywood personality dedicated to saving them. But if you remain true to answering your big question, it will help you keep focus.

Also, by presenting the big question early in your film, it frames the theme for your audience. You might have heard that to answer a question thoroughly, you have to ask several more questions. For instance, asking, "What things are threatening them?" will lead you to ask how a manatee survives in the wild, what type of environment

they live in, or how they adapt to living in a habitat affected by human intervention. The questions may become more specific: are pollution, changes to their natural ecosystem, or biological deficiencies threatening the manatee? Asking and answering these types of questions will develop a logical flow for your film. The answers also may help lead your audience to make their own conclusions.

Developing the big question can also help your audience anticipate the possible solutions. By summarizing all the facts presented by experts and science content within your film, you empower your audience and give them a sense of ownership in answering the big question for themselves.

You should also develop a clear "take-home message." From our list, the take-home message might be answering the question, "What can be done to save the manatees?" The answer might inspire them to do something about the dilemma portrayed in the film. For example:

- People have the power and resources to save the manatees.
- Government and organizations need to join forces to save the manatees.
- You can help save them with these five simple steps.

From these messages, select the one that is most realistic, concise, and that best matches the biggest segment of your target audience. Now you are ready to consider how your production style can best connect with your audience.

Style

This is also the time to decide on the slant, presentation style, point of view (POV), and feel of your film. In short,

you need to determine how you're going to tell your story. Will the story be narrated, host-driven, expert-driven, or a combination of these? Will the feel be edgy where the camera and POV are part of the unfolding action or discovery? Or, will it have the more classic feel of a "blue-chip" documentary, such as *Planet Earth* or *Blue Planet*? Establishing how the story will be told early on will help the production team preserve the feel of your film throughout the entire production process—from planning, to shooting, to editing. In our manatee example, we might decide to have an edgy, investigative, documentary style, realistically unfolding the facts to compel the younger target audience we have chosen.

Define Length and Methods of Distribution

Though you're a long way off from distributing your film, identifying exactly how your target audience will view it is an important part of your early plan. It will help you design the style, length, and presentation of your film. For example, if we want to air our manatee film on television or at film festivals, we might consider a 20- to 30-minute format. That gives us a number of options on developing the depth of our content and determines how much information we can present. On the other hand, if we choose to distribute it on a DVD or at formal meetings (to organizations we listed as other possible audiences), we might have the luxury of producing a feature-length production of more than 40 minutes. If we want to make a music video on saving the manatees that we want to go viral on YouTube, then we may want a three-minute format where we dive headlong into the message with fast-paced action and quick cuts between short segments.

Untamed Science has produced hundreds of science education videos that are intended to inspire students

in classroom settings. From this experience, we have learned that a five- to six-minute production works most effectively for classroom delivery. Four minutes is not quite enough time to add all the elements to engage, entertain, and inspire a student, and longer videos seem to test attention spans.

Define Production Roles

The final part of your plan is to list the key roles in the production process and consider who might be the most qualified in your production team to assume those roles. You might be talented enough to perform all the roles in making a film - planning, scripting, directing, shooting, hosting, editing, special effects in post-production, but it's a huge job for a single person. It's a good idea to spread the filmmaking workload across the ranks of your recruited talent.

Here are the key roles in making a film:

1. Producer

The producer's job is to assemble the entire crew. Producers are the team-makers. They don't have to be on location, write the script, or edit anything if they find the right crew. However, in most small documentary productions, the producer is often the scriptwriter and director.

2. Scriptwriter

Scriptwriters may write a treatment (a detailed first draft usually written like a short story) of the film content to present to funding agencies. After funding is approved, the scriptwriter crafts

a more detailed outline or script. This gives the director, hosts and camera crew something to reference while making the film.

3. Researcher

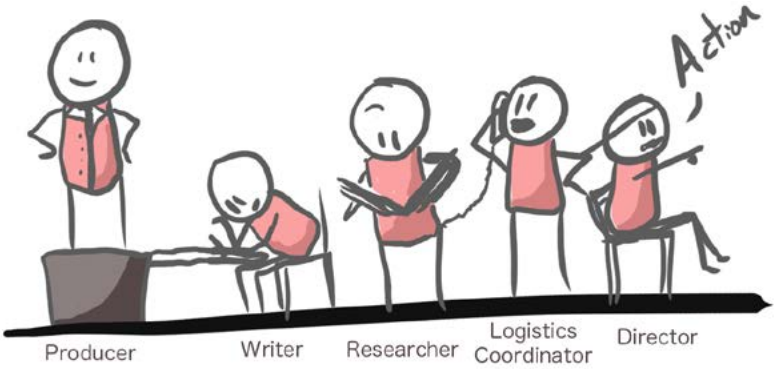
A researcher's role is to do the background checking on a topic to present the best focus for a film's content. For example, they might find the best sources for supporting our manatee film, list the possible experts, get the facts together, and make sure those elements actually can be shot. They often work with the scriptwriter to check facts and aid the logistics coordinator's job. Recent graduates with science degrees often make great researchers.

4. Logistics Coordinator (or Production Assistant)

The logistics person should arrange all of the physical concerns for the busy film crew. They make travel arrangements, contact experts, get location or facility permits, and generally ensure that everything at the location is ready for the shoot.

5. Cameraperson

Good camera operators are worth every penny. They should be able to take your shot list and capture everything to show your story through the lens of the camera. Most documentary camerapersons are skilled with lighting setups and may bring a light kit to a shoot. They are responsible for working with the location director and sound person.



6. Sound person

While a skilled cameraperson may also serve as the sound person, most documentaries with a decent budget will have an assigned sound person who knows her stuff. Having poor quality sound can ruin a segment. The sound person will generally carry a mixer and keep all incoming audio sources separated and at the proper levels before they feed the audio signal into the camera or separate recording device.

7. Location Director

The location director is in charge of envisioning and directing each segment. The director will guide the cameraperson and think one step ahead of them. For instance, directors will interview the experts while the cameraperson is getting the shot lined up. In addition, while the cameraperson is shooting manatees in the water, the director may direct the talent to quickly get in the shot and give an account of what's happening. A cameraperson can only do so much with his/her eye on the viewfinder, so a director who can think ahead and envision footage before it happens is key to a great shoot.

8. Host

If the style calls for it, a host has a huge role as the main character of the film. His or her voice and actions help carry the story. This might mean just having fun. While that sounds easy, it can be difficult to block out the stresses of a production and get into a fun mindset. The host should know the material backward and forward so they can give impromptu responses to the camera. The host should memorize any scripts the production requires. Hosts are the representative face and voice of the film and should take special care with their physical appearance and costumes.

9. Narrator

A professional narrator in a studio should work with the director to produce a quality narrative voice that fits the feel of the film. Professional narrators often have their own studio and can deliver narrative audio online. Also consider the advantages of working in-person with local narrators. If you are physically prensent with your talent, you can more easily direct the right pacing and inflection in telling the narrative story.

10. Editor

The editor does not have to be behind the camera or at the shoot location. On site, they will see what story elements were captured through the lens and can quickly assemble the essence of the story in the editing timeline. For some productions, though, editors need to tell the story objectively from the collected footage and not rely on the story as it appeared to the film crew. An editor who was not involved with the shooting may have a more open mind and only create an objective story with the footage that exists. Regardless, the editor should review the footage then work with the director to come up with the compelling story. The editor may also work with animators to come up with graphics that support the production.

11. Animator

Animators are often hired for sections of a production that need compelling 2D or 3D graphics to tell a portion of the story. Most animators work as sub-contractors and work under supervision of the director or editor.

12. Distributor

Distributors are often well-connected within the industry and can be brought in after a production. Ideally, it's better to work with a distributor *before* the completion of the film to develop a distribution plan that will build an audience for your film. Despite the potentially helpful role of a distributor, you ultimately have the most at stake in the suc-

cessful distribution of your film, so take an active role in planning the distribution.

Of course, you could probably come up with many other roles in a production. Where are the grips, PAs, executive producers, musicians, stunt coordinators and the casting directors? Compared to the credits listed in a typical Hollywood film, our list of roles is pretty sparse. Nonetheless, it represents the major roles you will need to fill with talent. How you fill those roles with talented people depends on your budget and the talent and interest of your friends, classmates, relatives, and fellow filmmakers. Let's assume that you're limited on budget and prospective talent pool, then you'll need to combine some roles. We often combine roles on smaller productions. Make sure to avoid assigning people with roles that may overlap, such as cameraperson and host. Here are some logical combinations:

- Producer, scriptwriter, director, sound person
- Cameraperson, editor, animator
- Host, narrator, researcher, logistics assistant

In this example, you may only have three people on your crew, but that can be enough to produce your film. To take full advantage of your small crew, be sure to exchange ideas openly and help one another during each phase of production. For instance, the director, host, and cameraperson can all help dress the set or prep the location, work with lighting and audio while collectively offering ideas on how to best shoot a segment. Having the camera person as the editor gives that person the advantage of knowing what shots to get during shooting for

the upcoming edit. Later on, the editor will already know the shot inventory that he or she filmed as the cameraperson. It can make for an effective overlap of roles.

Where to Get Talented Crew

Chances are that you have already gained some industry contacts that will help you assemble your production crew. If not, and if you will be hiring professionals, you should network with other local production companies for recommendations. If you are unsure about using a person to fill a role on your crew, ask for their demo reels or samples of their work. Hire the most talented crew members you can afford. Saving a few dollars on a cameraperson or editor with limited experience or talent could jeopardize your entire production. On the other hand, if you are on a small budget, you might have to get creative in building your crew.

Getting a Low-budget Crew

What if your friends, classmates, or relatives don't have the required talent or interest in filmmaking? You may need to search out and recruit "low-budget" talent for your film. First, let's make the job easier by further combining roles. If this is your film, you should be able to assume all of the roles except the host and possibly narrator. If you are a good host, you may need to recruit only a cameraperson. An animator might be one other role you may need to recruit. It depends heavily on the content of your film. Some science topics, such as chemistry, need to be revealed at the molecular level that can't be captured by the average video camera, so a good animator can make those concepts come alive for the audience. If the topic demands it, add an animator to your recruitment list.

If you can't afford to pay talent with hefty fees, consider paying them with a nominal payment for services, end-credit notoriety, experience in filmmaking, services traded (they help you and you help them), product or gear trade, or a creative combination of these.

But where do you find that potential host, cameraperson, and animator? Fortunately, they are often in similar places. Here's a list of where to begin your talent search:

- Community college or technical institutes that offer courses in your science topic, filmmaking, media, or acting
- College graduate programs that cover your science topic, filmmaking, media, acting
- Local television news stations - ask about intership
- Local filmmaking or production groups
- Local theater productions or acting schools

It is pretty amazing what you can accomplish in your search by using the Internet. Craigslist, batch emails, or casting calls can turn up dozens of leads in no time. And don't forget the timeless telephone cold call. Even if your prospective sources can't help, many of them will have other names and contacts they will pass along if you ask.

One final note about looking for narrators. If you don't have a quality host and need to add narrative flair to your film, take the extra time to find a narrator that fits the theme and feel of your film. Online searches will give you dozens to choose from and many of these sources will allow you to listen to samples of their voices. Just be sure their talent fee matches your budget.

Before we begin to actually film something, here's a review of what a completed plan should include:

- Brainstorm and set some clear goals for the film.
- Identify the target audience you want to impact.
- List the elements of the story in logical development.
- Develop a way to tell the story.
- Define your Big Question and Take-home message.
- Identify distribution methods.
- List and assign the various production roles.

Once you have completed planning, you are ready for the real meat of pre-production filmmaking.

Three

Pre-production

Though you are getting closer to shooting your film, you should need to finalize some details in the pre-production stage to ensure that shooting goes smoothly. Even with great planning, though, the best laid plans may go awry. In fact, glitches in the process are a part of the film-making process that can become fun challenges and push your creative abilities. Use them to your advantage.

In pre-production, you consolidate your initial plans and take the next steps for shooting your film. The essential information you will need to think about includes:

- Refining your concept (how you are going to tell the story)
- Researching
- Writing an outline or script
- Creating a shoot list
- Assembling production crew

- Finding on-camera talent
- Planning shoot logistics
- Raising funds and establishing sponsor relationships

Concept Refinement

After setting goals during initial planning discussions, we at Untamed Science find it helpful to let those elements simmer in our creative consciousness for a day or two to fully develop any thoughts or ideas about how we can create our film in the best possible manner. This allows us to regroup and refine the concept of the film. What other methods will enable you to tell your story and connect with your target audience?

This is also the time to ask yourself about how objectively you want to present your film's message. Do you want to persuade your audience to accept your take-home message? Do you want to persuade them at all or just inform? By planning your film's goals and take-home message, you have already encountered key persuasion techniques. It's almost impossible for a storyteller to remove his or her opinions entirely and to tell a story without any sort of subjective perspective. However, if you want your documentary to be as honest as possible, ask your interviewees open-ended questions, and let the true story unfold from the research you have uncovered and the perspectives of the different stakeholders.

Carefully phrasing your questions can help. For example, instead of asking a prominent marine biologist in Florida whether pollution is killing the manatee population, we could ask, "In your opinion, what are the main causes

for the dwindling population of manatees off of Florida's coast?" Asking a question like this will allow your story to unfold without too much interference from your perspective. Also, if your film is funded by a financial partner who wants to influence the target audience in a certain way, then consider how to fulfill their wishes and still present a factual story. Don't be afraid to shape your story by adding your opinions. Just be careful to avoid telling a one-sided story without the appropriate methods for qualifying and tempering your message.

If you have a financial partner, by all means include them in the concept refinement process. When Untamed Science produces a film supported by a company or organization, we plan a meeting with that sponsor to brainstorm concept development. They offer different perspectives to refine the take-home message, and this meeting builds their sense of ownership in the production. It is important to include the sponsors in this stage to some degree because it can alleviate communication problems down the line.

In keeping with our manatee-themed example, let's pretend we have a hypothetical sponsor for our film: an avid supporter of Manatees Alive, a fictional advocacy group. Once we establish some basic concepts for the film, we would likely meet with this sponsor and the advocacy group's educational staff or communication directors to begin refining our concepts. The outline may look like this:

- **Main theme**: Harmless manatees are defenseless against increasing man-made threats to their survival.
- **Style of presentation**: Use host to take audience on a first-person discovery adventure into the world of

the manatee and the dangers facing them. Various experts express different points of view.

- **How to hook the viewer**: Begin with a snorkel adventure into the manatees' habitats then introduce questions that define the story.
- **Shift from love to fear**: We fall in love with these gentle giants when we begin to discover fearful clues that something is horribly wrong. Introduce conflict or challenge.
- **Discover science-social content**: Use different experts and actual field investigations to increase tension and dramatic action.
- **Connect manatees with audience**: Look closer at the impact of threats. Make the film more personal as we show the audience the dangers facing the manatees.
- **Offer solution**: Reintroduce experts and offer new experts who identify possible solutions to the threats.
- **Conclusion**: Reveal the affirmative take-home message motivating the audience to prevent the destruction of the manatee population.

Now we've expanded the basic elements and concepts we need to develop our film. This part of pre-production further refines our concept by revealing the theme, slant, and approaches to reveal the story in a powerful way. It is also a starting point for research.

Research, Experts, and Locations

Before you can tell the world about your topic, you need to know as much as possible about it. Since our theoretical

film is about manatees, we need to research and define everything about them, from how they live to why they die and everything in between. Though the story is going to be supported by expert interviews, you need to know what crucial questions to ask to obtain the most relevant answers. You also want to appear credible to your interviewees. Research also helps tremendously in mapping out the logical development of the story during shooting and later during editing.

Learning about the science behind your story should be fun. Think of research as another way to help save the manatee or whatever your film's message may be. Once you have learned everything you can about your topic, you can make a film that stands on its own and does not need an audience that already has a master's degree or doctorate on the topic. Your research helps you act as a mediator between the general public and the array of well-informed experts you have assembled. Because an unfounded or poorly researched film is either weak in its story or is destined to fall flat on its face under public scrutiny, you need to be thorough with your research.

Not only will the facts you gather give your film validity and credibility, you owe it to your financial partners and the species or science topic you are featuring to be accurate. Consider for a moment how embarrassing and costly it would be to make and distribute your film only to be publicly denounced afterwards because some key facts were flawed or erroneously presented. However, if your film is about presenting different and possibly slanted, controversial, or error-ridden theories on a subject, by all means reveal them honestly.

It's equally important that you find the right sources for your research. If you do a Google search on "manatees,"

the first reference will likely include a page from Wikipedia, the free online encyclopedia. Though it can offer some helpful background information and provide a good overview, don't rely on it completely for its scientific accuracy. The information comes from a variety of sources and some of it may be outdated or questionable.

Your next series of information hits could be from special interest groups that also want to save the manatee. Their intentions may be good, but beware of any source that comes with a vested or slanted interest. If it's overly biased, it may not present all of the factual information. You also should consider if you want to be associated with that group's bias. If you use this information, make sure you recognize the bias and tell your audience about it or else you might appear biased or even ignorant of all the facts behind your film. Reasonably unbiased, accurate facts tell a credible story.

Though it is okay to build your general knowledge of your topic using Wikipedia and special interest sites, you also need information that is recognized by the scientific community. Go back to the Wikipedia site and scroll to the bottom of their page. Under "Notes" and "External Links," you will find more sources of information. Look for sources from government agencies, research institutions, or scientific journals. That is where you will be able to confirm your vital facts. For instance, the scientific *Journal of Mammalogy* likely offers more unbiased manatee science than a local newspaper that may have sensationalized a story to sell papers.

If you really want the nitty-gritty science on a subject, use the Google Scholar option at scholar.google.com for access to technical and research papers. It not only gives you detailed science from peer-reviewed journals, it may

even help you identify some great experts to include in your production. Also consider browsing the websites of well-known science communities such as National Geographic, the Smithsonian, the Library of Congress, or The Encyclopedia of Life.

That brings us to the final phase of research: on-camera experts. Revisit all those websites that you may have disregarded because they demonstrate a potential bias. To make a film that presents a balanced story while also introducing tension and conflict, you will want as many perspectives and personalities as possible giving their opinions in front of the camera. If our film only has one manatee scientist telling his perspective on the biological facts of a manatee, it may not engage the audience. However, if we also interview an impassioned person from a protect-the-manatee organization, a water discharge engineer, a commercial sport fishing captain, a manatee rescue veterinarian, and a tourism official, we would likely get diverse opinions from a number of credible and unique characters. Diverse opinions will also add interest and help the conflict of the story develop naturally.

At Untamed Science, we use a spreadsheet to build a list of potential interview contacts and experts and track their contact and biographical information. As our research evolves, we add names that keep appearing in journals, websites, or other media pertinent to our film. Consider creating a document in Google's free online word processing program, Google Drive. That way you can share and edit with the rest of your team. Team members who call or email these experts can add notes. By calling someone on the phone and asking a few questions about the topic, you will quickly get a sense of how they will probably sound in front of the camera. If they sound unsure or hes-

itant, they might feel insecure about appearing in a film or they might not be a good fit for your project.

In addition to gathering a list of interviewees, you should consider shoot locations. Making a location contacts list is as important as your interview contacts list. You might combine the two. Consider every potential angle you might use to tell your story, and try to brainstorm an image that could correspond with that angle. For example, our list of potential location contacts might look like this:

- Manatee zoos or parks
- Manatee tours on boats
- Manatee congregation locations
- Boat harbors in manatee areas
- Manatee research sites and programs
- Manatee protection group headquarters
- Water discharge sites in manatee areas
- Scuba or snorkel tours in seagrass beds

When making your location shoot list, don't overlook difficult-to-acquire footage that will support your film. For instance, quality underwater footage of manatees might be available from local underwater videographers or stock video sites such as Pond5.com.

Now that you have developed your research and have a list of experts and potential shoot locations, it is time to start crafting your compelling story. Putting your story together in an engaging manner is perhaps the most important element of your entire production.

Script or Outline?

To script or not to script? When you are on stage with other actors, you need to follow a script. But in a science or wildlife film, the needs are slightly different.

Few people can deliver engaging, believable scripted lines in front of a camera. For most of us, speaking someone else's written word from memory fails to convey genuine feeling and show emotion. To get content that comes naturally and in an almost spontaneous fashion from hosts or other characters, simply let your characters tell their stories. Ask anyone how they feel about careless boaters slicing manatees with their propellers, and you will likely get some genuine heartfelt responses in front of the camera. They will sound more convincing than any scripted lines you could write.

On the other hand, few people can consistently present scientifically accurate and complete phrases in front of the camera *without* memorizing scripted lines. A smart way around this is to script important science-specific content and see if your host is willing to talk specifically to those points if they didn't cover it earlier.

Try to capture a blend of unscripted vibrant stories told to the camera with an occasional scripted section on the stickier science stuff.

It's crucial that you are accurate and meticulous in the presentation of your research. You will receive plenty of accurate science from your host and on-camera characters, but it never hurts to double check. And if an on-camera expert misses an important science point, you can cover it with footage and a voice-over from your host.

Show Your Story

Storytellers tell stories. With film, you are obliged to show your audience a story. The difference may sound trivial, but the impact of both modes of storytelling is substantially different.

The film *Green* is a great example of this theory and one that you can actually watch online. *Green* is a contemporary film without music or narration. It simply presents striking footage of an orangutan rescued from a recently cleared section of rainforest. First, it shows the orangutan in its initial habitat - a rainforest full of flora and fauna. Then it shows a series of images of the orangutan surrounded by a muddy swamp replete with bulldozers and other industrial equipment. Because the film presents its story in an emotionally engaging fashion (without presenting a series of facts about how many acres of forest have been ruined or how many orangutans are displaced) it almost forces you to decide how you feel about deforestation. This can be a highly effective way to reach your audience, and, in the case of *Green*, it succeeded in bringing attention to the issue of deforestation. The film won several "best of festival" awards at the major wildlife film festivals in 2009 and 2010. It is also something we would highly recommend for its message as well as powerful cinematic presence and craftsmanship. You can see the film at greenthefilm.com.

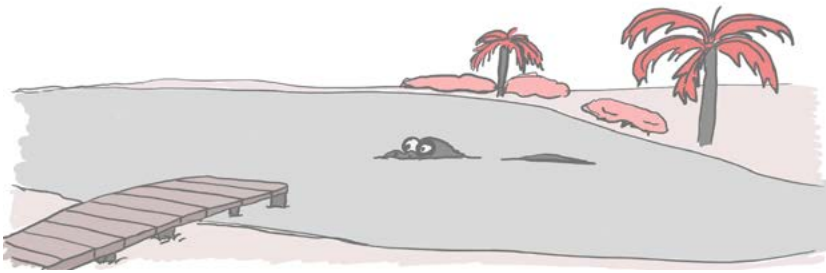
Creating Your Shot List

Some experienced producers like to shoot from the hip without a shot list. They may get all the various shots they need to tell a compelling story by simply pointing

their camera and pressing record, but they may also miss some vital shots. That's why many producers use a combination of relying on their experience along with a story outline to help them record all the footage they need. A detailed shot list can be a very helpful tool.

The good news is that your shot list is easy to develop when you consider your list of characters, settings, and story outline. Think about the images you need to tell your story, and flesh out a list of shots to portray each part. In addition to these primary shots, you also need to consider getting "B-roll" or cover footage: supporting footage of settings, characters, and action that help tell the story. If you don't shoot enough of this type of footage, you will end up with a film full of talking heads that will lull your audience to sleep. Plan on shooting a lot more cover footage than you think you'll need to show your story.

Here's an example shot list for our manatee film:



Setting

- Establishing shots: Aerial views of the Florida coast (flyover), Google Earth, maps, NASA imagery
- Wide shots of towns, water treatments, boat harbors, discharge outlets, manatee advocacy group headquarters, Department of Tourism offices, clearwater springs, research centers

- Medium, close elements of noted settings above that help tell story
- Static shots, wide angle, of settings that connect foreground elements with background elements that show your story. Connect people, manatees, and action with settings
- Water, waves, beaches, coastlines, canals, pelicans, seagulls, lively elements of settings, from big stuff to fiddler crabs

Characters (not your host)

- Interviews of characters: Have experts and characters look "off camera" during their interviews. Only the host should look at and interact with the camera. (The next chapter will offer more detailed advice on framing and shooting your experts during production.)
- Characters in action, doing their thing. Wide and close shots of action that support their stories and their interaction with other characters. Manatees in relation to their environment including the threats they face and possible solutions to these threats.
- Places and things related to characters: boats, buildings, co-workers, laboratories, facilities, and agency buildings.
- Close-ups of characters faces in thought, looking, working, interacting, reacting, hands in action, feet moving, picking up and putting down things relative to the action within the story.

Host

- Creative "action building" sequences of host getting to opening scene: arrives in car, unloads gear, takes off to meet expert, puts on gear to snorkel with manatee researcher.

- End the action-building sequence and pose "big question"
- Bridge shots: between segments at locations with action; wrap one segment and provide lead to next scene or event.
- Wrap shot with "take-home message".
- Similar shots to those of characters during host's discovery and interviews.

Main Characters (Manatees)

- Underwater shots, lots of variety, medium and close–interactions and head shots
- Above-water shots
- Establish connections between manatees and threats or solutions
- Connecting shots between manatees and various characters and host

Antagonists

- Boat propellers: boats, engines, docks, wakes, wheels, boat related items & action
- Fishing lines: people fishing, reels, rods, hooks, lures, casting, baiting
- Community discharge: facility, pipes, current, foam, water interface, fence, hand opening big valves, underwater interface
- Coastal climate change: sun, moon, steam, smoke-stacks, electric lines
- Sea grass impacts: sea grass, sea bottom, wastewa-ter plant, water discharge

- Sanctuary loss: human-dominated canals, dredging, boating, developments
- Time ticking by: time-lapses, weather, clouds, tides

Another good resource for choosing shots can come from your experts during an interview. When the interview is over, you can get cover footage of crucial elements they discussed.

If resources allow, you could also have a two-camera shoot and have the second cameraperson collect the needed B-roll footage.

Planning shoot logistics

If you can find someone who has experience organizing three-ring circuses, juggling flaming swords, or herding stray cats, do whatever it takes to sign that person on as your logistics coordinator. Poorly planned shoot logistics can quickly turn your well-intentioned film shoot into a chaotic mess on location.

Imagine having a talented host, two camerapersons, and one director driving to an early morning shoot in a location nobody checked out beforehand. Most of the crew has flown in from out of town, and they have only the one morning to shoot a crucial segment. They arrive at the location to discover that the person who owns the location is unexpectedly absent. Nobody will sign the location or on-camera release. Everyone who needs to be in front of the camera, other than your host, doesn't speak English. Toss in unexpected and overpowering noise and dust on location, and you're on the brink of a total loss. Fortunately, in this actual case, the director spoke some Spanish, a cameraperson knew some construction site

sign language, and the host kept smiling. Collectively they saved what could have been a disrupted shoot. But a bilingual logistics person to scout the site beforehand would have made for a much smoother shoot, saving time and money.

The logistics coordinator should plan well ahead of time and cover all the details. They should:

- Obtain location permits and permissions, including legal production releases (see the Resources section in the end of the this book for sample releases)
- Scout location for good visual fit, access, options, lighting, electricity, special needs or gear for the segment
- Coordinate on-site experts or people who will also be in your film (on-camera releases, including parent signatures of people under 18 years old), attention to apparel relative to their planned roles in the film
- Secure props* and gear that fit the talent and science content
- Secure travel, food, lodging, changing rooms, and bathrooms for cast and crew
- Rent/hire lighting, animals, trainers, special support crews
- Have secondary plans in event of rain, wind, location issues (consider setting up secondary location beforehand)
- Carry duct tape, wire, tools, first-aid kit, hot-melt glue

* Add a special "props" section to your outline or script. The last thing you want is to dig around for the right props during production with talent and cameras waiting on the sidelines. On bigger shoots, have each set of props arranged near their respective scenes. If it is a functioning prop, with electrical or moving parts, be sure beforehand that they function properly for the intended action. Or be prepared for blooper-reel footage.

Funding

If you are a self-made millionaire, you can probably fund your own film. However, if financial fate hasn't smiled as kindly on you in the funding of your film, here are a few creative ideas for raising enough money to produce your film.

First, consider every person, group, organization, agency, or corporation that would also like to see your film produced. If it is a science film, perhaps a related science organization or institution also wants your target audience to be informed about your film's message. The same holds true for a wildlife film. To get your creative funding juices flowing, here is a list of potential financial partners that might be interested in helping fund our example manatee film. Notice that we do not call them "sponsors." If you ask someone if they want to be a "sponsor" or a "partner," most will choose to be a partner that shares in the success of a film. So stick with the "partner in success" concept to win their support.

- Help-the-manatee organizations
- One or more affluent organization supporters (most .orgs have partners listed on their websites)
- Florida tourism
- Florida Fish & Game agency
- Manatee tour businesses
- Government education or public relations departments
- Wildlife education or conservation organizations
- Local manatee veterinarians or associations

- Any one of your "antagonist" groups (who want to improve their public image)
- Any one of your "protagonists" (other than the manatee) to boost their image and support what they care about
- Product companies benefiting from healthy manatees: kayaks, binoculars, cameras, marine companies
- Local chambers of commerce

Now you need to present them with a funding plan. This boils down to having a good answer when they ask, "What do I get in return for funding your film?" Below are some possible incentives.

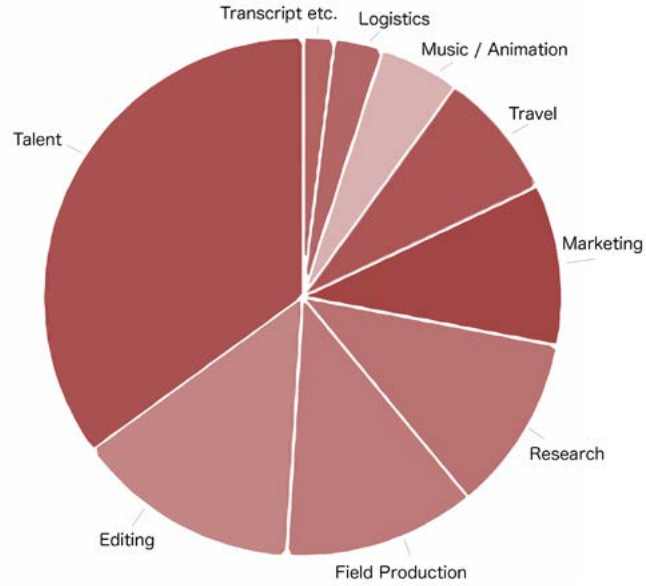
- Credits in the film as "partner," including contact information
- Copy of the film to use in various ways: education, promotion, online image (be specific; don't dilute your creative or distribution rights).
- One of their experts or spokespersons in the content of your film.
- Listed in promotional materials as partner.
- Listed on the film's website with hyperlink as partner
- Earn the right to have you produce a new opening or closing on the film for a custom version for their organization. They in turn, use it to generate members or support.
- Get unlimited copies of the film on DVD at a special or wholesale rate.

You might be wondering, "How much do I charge them?" Only you know what it might cost to produce your film based on your plans and content. That can vary substantially if you are a professional production company with 40 employees or a science filmmaking group at school. Where and how you make your film also greatly impacts the cost. Producing *March of The Penguins* cost a ton more than, say, a march down to the local landfill. Try to remember not to sell yourself short to the point of collecting very few funds, but don't oversell the production to the point of scaring off potential funding partners.

Estimating your production budget can be time-consuming, but is well worth some serious thought and planning. More often than not, you will encounter unexpected production delays, equipment costs, fees, and other expenditures that can quickly gobble up a slim budget. Plan a contingency budget of at least 20 percent extra to cover the unexpected.

As food for thought, Untamed Science often uses a rough estimate of 2,500 USD per finished minute as a starting point. We've found that figure works for our production shorts and that the quality stays at an acceptable level without scaring away clients.

We have put together a generic list of things to consider when building and calculating your overall budget. Though budgets can vary from hundreds of dollars to tens of thousands of dollars per finished minute, we have offered some relative percentages to the overall costs of making a science film.



- Research, scriptwriting, concept and story development: 11%
- Your talent and crew members and their costs (whether daily, weekly, or by the job): 36%
- Travel, lodging, food and support services for you and your crew: 8%
- Logistics, including permits, releases, fees, props, gear, lighting, extra support teams, rentals: 3%
- Field production, including HD videotaping, audio, booms, cranes, location setups, grips: 12%
- Music, sound effects, special effects, support footage, animations, custom music or songs: 5%
- Professional editing, from rough cut, to fine cut, to final cuts w/revisions: 14%
- Audio tracks transcripted if required, closed captioning: 2% for remaining items

Now you are ready to grab a camera, hire your host, and head to location. You finally get to push that red button, holler, “Quiet on the set,” and dive into the exciting realm of production.

Four

Production

Production, also called field production, the shoot, location shooting, or filming, are all different terms for the pivotal process where you capture the key visual and audio elements of your film on camera. Depending on the scope of your film, it may be as simple as a one-hour shoot at some science or wildlife site near your home or as complex as months of traveling, shooting, and interviewing at multiple locations around the world.

Camera

Now that you know where you're headed with your logistics plan) and what you want to capture on your shoot list, consider how you'll do it with the best camera you can get your hands on - by buying, borrowing or renting one. You could be shooting from a cell phone, but for the purposes of this section, we'll assume you have a camera with some professional settings.

Camera choice depends on your budget, your intended end product, and the ways you might want to deliver your film to audiences. Be prepared for any contingency by re-

cording on the highest quality camera and format available. The HD camera market changes quickly, and the selection is daunting; we ultimately suggest doing your camera research to find the best fit for your project. However, we'll also tell you about the cameras we've used for hundreds of productions and what we feel are some of their performance advantages.

Standard Features

As HD cameras get smaller and lighter, they offer increased shooting versatility, and most offer various recording format options. Depending on your needs, consider cameras that will also give you 4-channel audio options, with XLR inputs for channels 1 and 2 (on top of the standard array of other professional features). This feature will allow you to capture professional audio, an essential part of a professional video. Another consideration is whether a camera has available zoom-through, wide-angle lenses that can offer a fun perspective for tight, interactive shots.

Consider the limitations of the zoom lens relative to what you're going to shoot. Many cameras work fine for shooting general scenes and interviews, but some fall short on lens power, which might not be the ideal choice if you intend on shooting distant wildlife.

Choosing DSLR

One of the greatest breakthroughs for wildlife filmmakers since the switch to digital recording media is that of digital SLR cameras (often called DSLRs or HDSLRs). There is a wide range of high-end, interchangeable lens, still cameras that also shoot HD video. These cameras are affordable for the wildlife and science filmmaker, and though

they are designed to be still cameras, they take amazing video. To make a film with a DSLR camera, there are a few hoops you'll have to jump through. We'll offer some more advice on HDSLR filmmaking later in Chapter 7.

Handhelds

Don't forget small hand-held or GoPro cameras. They can offer the versatility and ease of shooting that some of the larger ones can't. We shoot on some of these little hand-held HD cameras strapped to kayaks, bikes, cable dollies, roller coasters, and just about anything that moves. And unlike the bigger cameras, when you use them for underwater shots, it doesn't cost nearly as much to replace if it ends up in Davy Jones' locker!

We've also used the mini GoPro HD video cameras that come with their own waterproof housings. You can strap it on just about anything, including surfboards, skis, cats, dogs, and skydiving helmets. But before you begin strapping cameras to everythig, let's take a moment to go over your Pre-Shoot checklist.

Pre-shoot Checklist

The evening before a shoot or before embarking on an extended production trip, you'll want to follow a pre-shoot checklist. Forgetting a key item can delay or mess up a shoot. And you sure don't want to risk missing a rare opportunity that can happen suddenly during wildlife and science shoots.

- **Bring additional, fully-charged batteries**. Have a backup plan to recharge them or work from direct power at your shoot location. If you're shooting for hours in a remote location—perhaps an acacia tree

overlooking an active lion kill in the Serengeti—consider a hefty, extended-life battery that fits your camera.

- **Clear camera memory**. Be sure that you've transferred existing footage from your camera's storage to another storage device or hard drive before you clear the memory in your camera. This is an unnerving process the first dozen or so times as the camera is essentially asking, "are you sure you want to totally delete all this irreplaceable footage?"

- **Check your recording settings**. In case you show up on location just as the manatees are mating, you don't want to record in some previously set time-lapse or slow-motion mode. If it's a multi-camera shoot, make sure that all cameras are set to the same recording parameters. It could save you tons of corrections in post-production.

- **Have a lens cloth handy**. As small as it seems, having a quality lens cloth and alcohol lens wipes is a biggie on your checklist. Few things will irritate you or your editor more than working with what should have been quality footage shot through a dirty lens.

- **Don't forget audio gear.** If you're using wireless or shotgun audio systems on your planned shoot, make sure their batteries, cables, and settings are all ready to go.

- **Don't forget tripods, dollies, cranes, steadicams, and lighting.** Depending on your shoot, have camera related-gear, such as support systems and lighting, in working order.

Location Check

You've arrived at location! Take a few moments to check your shoot location, and take care of any necessary busi-

ness. Though each shoot is unique, here are some good basics to follow.

Meet with the people involved in the shoot (the person in charge of the shoot location, the expert to be interviewed, and others) and secure talent and location releases. Waiting until later is often an invitation for trouble. On-camera people may leave early. You may get distracted with B-roll afterwards. Someone suddenly has second thoughts about how they looked or sounded on camera and want to think it over before they sign the release. Getting your releases signed is also a good way to break the ice with people by starting conversations about what's going to happen during the shoot. Plus, it shows that you're a professional. We've even offered you some boilerplate talent and location releases in the Resources section of this book that can be modified for your particular film or production company.

Tap into the talent and resources of the people you're working with. More often than not, the location contact person will have some helpful ideas on where to shoot scenes, what props might be available, and other helpful information. We've shot in hundreds of locations, from science labs to industrial facilities, and the people in charge have revealed hidden gems that helped our films sing with science. Request a tour so you can become familiar with your shooting environments. In a perfect world, you or one of your production team have scouted the location beforehand and have a good idea of where and how to conduct the shoot, but you may end up at a distant or restricted location without the luxury of a pre-shoot scouting trip.

Selecting Scene Setups

As you tour the location, look for setups that will visually reinforce your story. If you're shooting an interview with

an expert, avoid cluttered desks. Instead, have them stand near interesting lab backgrounds, devices with moving parts, or someplace where they can use their hands on science gear to lend authenticity to the scene. Though some scientists may wish to do the interview in their comfort zone behind their desks, reassure them that your job is to make them look and sound their very best, and scene selection is an important part of that. For instance, if it were one of our manatee experts, we would have them overlooking the water where they might see a manatee. That way they can look and gesture toward the water, which will be ideal points in the story to use underwater footage of manatees, too. If it were an interview inside a building, we might have them stand in front of graphics or maps showing manatee locations.

When reviewing the potential scenes at a location, use your eyes as you would the lens of the camera. Look for settings with interesting foregrounds *and* backgrounds. Bend behind items and imagine your camera floating across the rows of foreground lab gear to the main work area where your expert is standing. Consider natural light sources, available electrical lighting, where you'll set your lighting, backlighting, and how you might adjust these to avoid shadows. More on lighting later.

Try to avoid scenes with excessive movement in the background, such as road traffic or pedestrians. However, if your subject lends itself, it can be a bonus to have some background movement, such as flying birds, wave action on the water, boats cruising past, fisherman, or whatever else may help tell your story. Avoid setups with excessive horizontal and vertical lines, such as fences, electrical lines, poles, and cabinets. Instead, look for scenes with diagonal lines that will add interesting and more dynamic perspectives to your shots. Simply shifting the position of

the camera may change rigid horizontal lines into more dynamic diagonal ones.

Take Charge of the Environment

Now that you've identified your main scene where you're going to shoot, it's time to take charge of your shooting environment. This is one of the biggest challenges facing new producers and even some with considerable experience.

Your control of the shooting environment should include being respectful to your location host and mindful of logistical restrictions. If we were shooting in a plant genetics lab and didn't like the bright grow lights glaring down or the temperature control fans humming, we can't simply turn them off and risk damaging the plant research. In most situations though, we can make the shoot more effective by taking charge and controlling various elements within the shooting environment.

Select shot angles and setups that will minimize the amount of distraction, whether audio or visual. Change all that you can. Adapt what you can't.

Audio

Though they present loud distractions, you can't stopoverhead screaming jets or flocks of honking geese. You have to accept those elements as part of the ambient audio or natural sounds at some locations. Identify what sounds you want to capture and which ones you want to minimize, whether man-made or natural audio.

For instance, if you're filming the spring courting rituals of sandhill cranes in an isolated marsh, you'll want to cap-

ture the natural sounds of their flute-like calls, the flapping of their wings, and the stomping of their large feet. Other natural sounds that might overpower the cranes could be wind whipping the cattails, insects buzzing or a pesky red squirrel scolding you from some nearby tree. To mitigate those sounds, you might place a directional shotgun mic in front of your camera by several feet to rid yourself of the bug sounds. A quality windsock over your mic will take care of gusty breeze sounds, and a couple of tossed sticks or a pile of peanuts should silence the red squirrel.

Although it's supposed to be quiet in an isolated marsh, the reality of overhead jets, nearby farm machinery, dirt bikers on wilderness trails, camera noise, and your crew whispering can all conspire to pollute the pristine sounds of your cranes. We can't use sticks and peanuts to quiet everything. But we can wait for the jets to pass or the farmer to take a break or even explain to those responsible for the unwanted audio that we're filming cranes and we'd really appreciate a period of quiet. Asking politely can go a long way.

If your film includes expert interviews, you may need to record them in such a way that minimizes both natural ambient audio and other man-made audio. Wireless lavalier microphones are small, dynamic mics (referred to as "lavs") that primarily capture the audio in close proximity to the microphone. So when placed near a person's mouth, usually on their clothing lapel, a lav mostly picks up their spoken audio and minimizes any audio in the distance.

Here are some ambient noisemakers that you may be able to turn off, deactivate, move off location, or stuff a rag into:

- Humming fluorescent lights
- Air conditioning or heating systems (adjust thermostat)
- Running water, bubbler pumps
- Radios and music sources (common in labs and some workplaces)
- People in conversation (politely explain the situation and ask them to be quiet or leave the area)
- Copy machines, lab machines, phones, office and lab devices that make noise (turn off, unhook, shut doors)

Now that you've taken control of the audio in your shooting environment (within practical limits), turn to the visual part of your shoot.

Dressing the Set

Before you begin moving things around in someone's lab or office, explain what you'd like to do and why, and politely ask for permission to dress the set. Once you have permission, here are some typical things to consider:

- **Clutter:** Remove papers, cups, soda cans, products with labels - anything that looks junky or cluttered. And don't forget the walls. There may be distracting calendars, post-it notes, or items leaning against them.
- **Window dressings**: Depending on the look you're shooting for in your mix of lighting, you may want to adjust curtains, blinds, or items near windows. Also look for distractions on windowsills, natural breeding grounds for clutter.
- **Lab counters or tables**: If your interview expert is going to be filmed in a working lab, take the time to

dress the counter area near them with interesting stuff that supports the story. On one shoot, we profiled the science behind refining crude oil, so we arranged bottles of various refined products and crude oils, glass cylinders containing various catalytic materials, and some working electronic lab instruments. You might consider setting up support lab stuff near one end of a counter to get interesting camera perspectives with both foreground and background lab materials.

- **Adding interest:** Once you've cleaned up and rearranged, take a moment to consider the topic content and ask the expert if there are other items that might make an interesting addition. They may have 3D models, scientific samples, or even supporting graphics on a computer screen. This is also the time to add any necessary props.

- **Props:** Choosing appropriate props is part of planning a successful shoot. For example, we did a science shoot on hypobaric produce storage at a lab and brought a basket of various flowers and fruits which were the focus of that particular science. The hosts and scientists had something to hold in their hands as talking points. Your list of props could include fossils, animals, plants, or the raw and end products of a certain scientific process.

Dress your Talent

It would be a shame to spend all that time dressing the set without dressing your expert or host. Make sure they are dressed to best support the content of the shoot.

Ask them to remove:

- Sunglasses from their face or the top of their head
- Brimmed hats that shade their eyes

- Distracting jewelry
- Logo-wear clothing or garments with printed art or slogans (unless it's part of their official uniform or safety gear)

You may ask them to put on:

- Proper safety gear, depending on the setup (Show the audience and peers that they know and respect the need for proper safety gear).
- If they're in a lab setting and you want them to look like experts, have them don clean lab coats.
- Disguise/hide the lavaliere microphone and wire.

Lastly, offer your host and talent a final chance to freshen up. Part of feeling good on camera is knowing that they look good right beforehand.

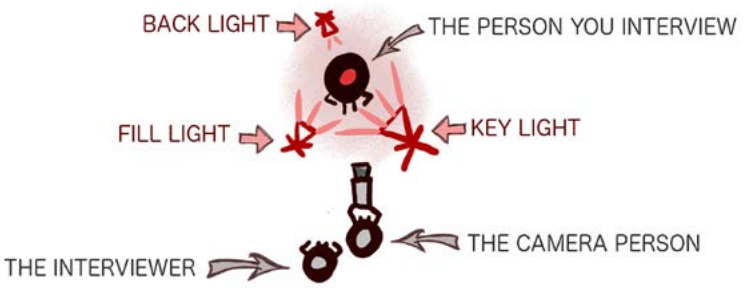
Lighting

There are volumes written on the subject of lighting. We'll show you the very basic setup that many filmmakers use.

For shooting indoors, most settings have limited artificial light and very limited to no natural daylight. A typical lab or office usually has one wall with some natural light coming through a window and overhead fluorescent lights. The challenge with the overhead lighting is that it casts most of the light directly downward, causing shadows. On the plus side, most office/lab environments have white walls, floors, and ceilings that help reflect light sources from different angles, which can help illuminate your talent. Because there are so many lighting variables that can affect your indoor shoot, the safest bet is to acquire a professional lighting kit.

A lighting kit should contain three lights for conventional "three-point lighting". Below are the three functions of the lights.

- **Key lighting** is the main and brightest light source. Place it above and in front of your talent and to one side of your camera, 15 to 45 degrees from the camera.
- **Fill lighting** is your secondary light source. Place it lower than your key, on the other side of your camera but still in front of the talent. It's less intense than your key light and will remove or reduce any major shadows caused by the key light while still preserving the contours of the talent's face.
- **Back lighting** is placed high behind the talent, casting light downward on the head and shoulders which helps separate your talent from the background.



An Internet search on "three-point lighting video" will also provide a variety of demonstrations on different lighting setups. Note the variations of light kits and how to adjust or diffuse them depending on the setup, backgrounds, and mood of the shot.

Become familiar with your lighting kit before a shoot, and make sure everything works. Pack spare bulbs.

One final note about three-point lighting: it's intended to light mostly stationary subjects while shooting from one angle, usually from a tripod. If your subject or your camera are going to move and interact with other things in the scene, the kit will only create distracting shadows. So if you're using more aggressive, moving camera techniques, and your talent is flitting about, forget the three-point setup and use the kit creatively (such as bouncing the light off ceilings, floors, or walls) to help light the scene without distracting shadows.

For nighttime shoots outdoors, you'll need to use some type of artificial lighting. If you have the luxury of using electricity with a professional light kit or even with some of the halogen work lights from the local building supply store, by all means use them. But many remote shoots will lack electrical outlets.

One of the more versatile and effective remote light systems we've used are Litepanels. They're compact, portable, dimmable, LED soft lights that attach to your camera. They operate with either camera batteries or their own rechargeable battery pack. We've used them in jungles, caves, and during a variety of nighttime adventures to illuminate our talent or action with just the right adjustable touch. They even come in handy shooting in dark museums or places where we need highly portable light to cast an extra glow on objects of interest or people's faces.

For general outdoor daytime shooting, lighting is relatively simple with natural daylight. However, to make the most of your natural lighting, consider these finer points:

- When interviewing experts outdoors, place them in diffuse lighting. The harsh contrast in direct sun-

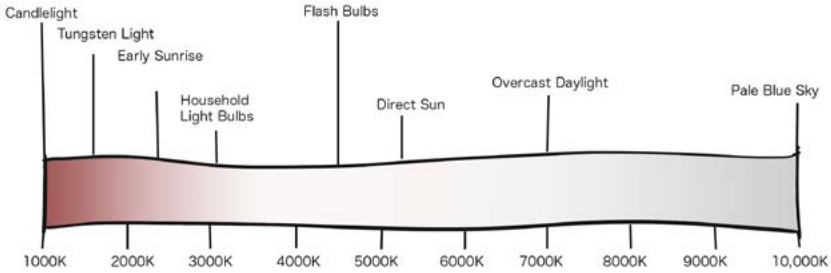
light usually makes eyes disappear in dark shadows or cause them to squint shut against the brightness. A brimmed hat completely shadowing the eyes isn't a solution either. Overcast days with light scattering throughout the cloud layers works to evenly illuminate your subjects. But if it's sunny out, look for a shaded spot under a tree or in the shadow of a building.

- If you have access to a reflecting disk or shield, you might consider reflecting more light from a low angle up and into the face of your talent to reduce shadows under the eyes and chin area. Just be careful not to blind your talent or make them squint.
- If you're stuck in the middle of a bright prairie or desert, shoot with the sun at your back, but keep your shadow out of the scene. You don't want shadows zigzagging across the faces of your talent, either.

Camera Setup

Okay, you finally have your camera out of the case, and it's in your hands. The pivotal moment is almost upon you. Set the following basic features on your camera.

White balance sets the camera to see the same colors as the human eye. Different types of artificial and natural light sources emit different wavelengths of light with different color temperatures. These are measured in Kelvins. Indoor tungsten bulbs are on the orange end, measuring around 3200 Kelvin. Sunlight can range from 2500 at sunrise to 5500 on a bright day to nearly 7,000 on an overcast day.



Though your eye naturally adjusts to see true colors, your camera needs you to set the white balance. If you leave it to chance, you could end up with images that have an unnatural blue or orange tint. Depending on your camera, you might have a variety of white balance settings to choose from, such as auto, tungsten light, fluorescent light, daylight, overcast, shade, and custom. Read your camera manual to become familiar with the options. However, the most accurate way to adjust your white balance is with the "custom" setting. This setting will allow you to set your camera to recognize a white piece of paper as white. Once it does, the true colors should be recognizable in the viewfinder or the LCD monitor. If shooting under multiple light sources, position your white reference card to reflect all the various light sources affecting your scene.

Iris setting - Next, adjust the iris to illuminate or expose your subject or scene properly. The iris is the adjustable opening or aperture, or f-stop, that allows more or less light to come through the lens. As with white balance, there is likely an auto option, but manual adjustment will help to avoid overexposure or underexposure. To set manually, first let the auto-iris adjust the incoming

light to expose the overall scene, then fine tune using the manual adjustment to expose your main subject. Depending on your camera, the iris adjustment could be a ring behind the lens or an adjustment dial on the camera body.

Don't worry about excessively light or dark areas in the foreground or background. Just adjust it for your main subject. You may have to check your iris setting from time to time when shooting, especially on partly cloudy days when moving the camera at different angles relative to light sources or during changing low-light conditions. For cameras with zebra stripe settings, consider using them to prevent overexposure of faces. Again, read the specific camera manual or online reference for using this advanced feature. (NOTE: the closest equivalent in DSLR filmmaking is the **aperture**.)

Focus – By now you should be able to see if your subject or scene is in focus. It sounds like a relatively simple point, but it's crucial that you focus the camera precisely on your main subject. Although it's possible to color correct footage with improper white balance and change the brightness of over- or underexposed footage in post-production, soft focus is hard to fix and really compromises the quality of your production. Take the extra few moments during your shoot to check and recheck your focus. This is especially important with the resolution of HD cameras, which is why many have various focus-assist features. One easy way to make sure your subject is in focus is to zoom in on the subject, focus, then zoom out for proper framing. An exception from this might be some "zoom-through" wide-angle lenses that won't focus properly if zoomed in too much. To make your movie shine, you need to start by recording crisp, focused footage.

Gain – Gain allows the electronics within the camera to artificially add brightness to the scene. The downside is that this electronically added brightness produces grainy noise within your recorded image. To keep your HD image clean, we recommend fixing low light scenes by either adding a light source or even changing the shutter speed. Leave the gain set to low or off. (NOTE: In DSLRs this is the **ISO**).

Image stabilizer – This feature reduces camera shake and stabilizes the image by either internal electronic correction or by an optical image stabilizer. Chances are your camera has the optical kind that doesn't degrade the quality of the image. You only have two choices here; it's either turned on or turned off. You turn it on when you're hand holding the camera and moving the camera intentionally. You might also use it on crane or dolly-assisted shots to smooth out the intended camera movement. You'll want to turn it off when panning from a tripod as it might make the pan jerky.

Audio levels – If you're recording your host or science expert on camera, your audio is every bit as important as the video image. Recording quality audio requires that your on-camera talent's spoken voice is recorded at a level that will allow the viewer to clearly hear what they're saying. Whether you're using a lav mic, shotgun mic, or just the camera's onboard mic, you'll need to be sure that you're capturing quality audio with good sound levels.

We'll assume that you're using a lav mic to get clean audio from your talent. Attach the lav mic near their collar or neckline and run the wire under the shirt from the waistline to conceal it. You may tape it directly to the ster-

num, under a shirt; just be sure it doesn't rub against the shirt during normal movement and create mic noise.

To check the audio quality and levels, use headphones plugged into your camera's audio monitor. Low battery power in the wireless mic transmitter or receiver, clothing rustle against the mic, loose mic connections or cables, and electrical interference can all contribute to excess noise or poor quality audio. Without headphones, you probably won't hear the bad audio until you're editing, and then it's too late to fix. Once you've worked out any issues causing mic noise, it's time to adjust audio levels.

Keep in mind that your wireless mic system and camera both have internal level settings and different levels of output. Read the manuals on both and become familiar with your audio settings and options. If you have a professional camera, you probably have the option to direct the audio signal to channel 1, channel 2, or both. Channels 3 and 4 are likely recording directly from the camera's built-in mic. If you only have one host or talent with one wireless mic, set the incoming audio to both channels with the levels for one channel lower, so as to act as a backup in case of peaks. If you have two wireless mics on two on-camera talents, one should be set to channel 1, the other to channel 2.

Now have your talent speak in a normal voice while you adjust the audio levels. We'll assume that your camera has some meter display for your audio levels. Adjust the levels so that their voice never touches the red or 0dB marker while bouncing in the -20dB to -6dB range. Peaking over the 0dB mark will result in clipping of the audio and introduce distortion. Most on-camera talent will talk louder when the camera is rolling. Be prepared for this surprise jump in your audio levels and simply pause the action un-

til you've reset the levels to match their adrenaline-driven "camera voice."

For random shots and support B roll footage, audio isn't a main concern. (We will address recording ambient audio later.)

That's the final check on your pre-shot checklist. Now let's move on to shooting basics.

Five

The Art of Shooting

This chapter will equip you with the basics on using your camera to show the story. In particular, we're going to look at the role of the cameraperson.

Making a *mov*ie is all about *move*ment. A bunch of static shots taken from a locked-down tripod might be very similar to watching a slideshow of still images. The more movement you capture through the lens, the more dynamic your film will appear to your audience. But static shots taken from a tripod and other shots with minimal movement can become important in editing your story seamlessly. Find a creative blend. We've presented a range of potential shots that best portray particular sections of your story.

Essentially, there are three types of movement that can be captured through the camera lens:

- Movement of the characters or events in front of a static camera
- Movement of the camera capturing relatively static characters or events

- Movement of the camera capturing moving characters or events

Static Camera

Watch any Hollywood movie from the early- to mid-1900s, and you'll likely see a collection of shots captured through the lens of a camera anchored to a tripod. They may have used different focal lengths, f-stops, camera heights, angles and lighting, but most of the shots were taken from a fixed point.

Today, Hollywood productions use various moving camera shots, either with tracking dollies, cranes, or steadycams. Nonetheless, static shots still provide an important element in showing certain parts of your story and certain types of stories, particularly when capturing wildlife.

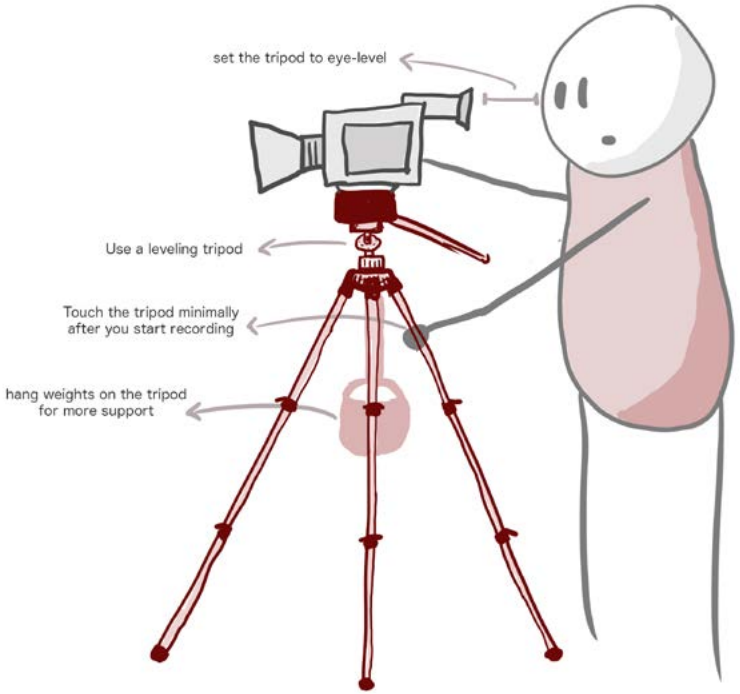
Wildlife films often contain a significant number of shots taken from a static tripod because the goal of the film is to capture the natural activity of some wild creature in a way the audience can best appreciate the action. A static shot helps the audience focus on what the wildlife is doing. You'll rarely see wiggly, hand-held footage in a quality wildlife production. The fact that most wildlife footage is also taken through a telephoto lens further compromises any hand-held camera techniques. Typically when shooting wildlife, lock your camera on a solid tripod and use framing and focal length for dynamic shots.

Tripod Tips

Set the tripod at a comfortable height that will allow you to easily use your viewfinder and camera settings (slightly below eye-level is usually best). This also min-

imizes your movements, which can be important when filming wildlife that can easily spook.

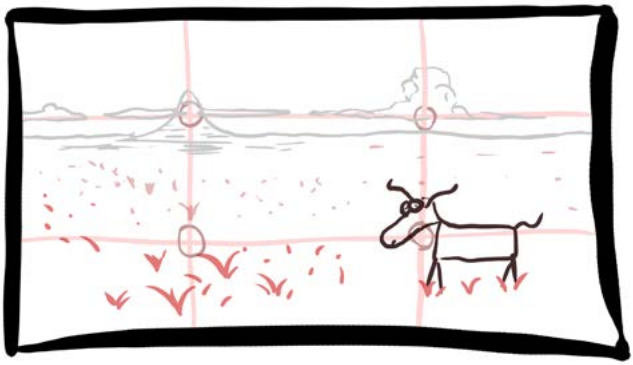
- Firmly plant your tripod to eliminate any shifting of the legs. If it's windy or the ground is unstable, hang a weight under the center of the tripod.
- Level the camera by either adjusting the angle and/or height of the legs or by using a leveling tripod head. One sure way to spoil a nice wildlife shot is to have the horizon or water line skewed at an angle.
- Adjust the tripod head so you can easily pan or tilt the head to a new position and quickly lock it into place.
- After you begin recording, remove your hands from the camera and tripod arm. Even your heartbeat can transfer a minor yet noticeable wiggle in the camera, especially with a zoomed-in telephoto lens.



Now that you set your tripod, here are some static shot sequence suggestions. We'll use the example of a herd of Cape buffalo grazing across the Serengeti.

1. Establishing shot

This establishes the location or setting of the event and should be a wide shot, using a wide-angle lens or the camera's standard lens zoomed out completely. It's called an **extra long shot** (ELS), because the subject is extremely far from the camera. When composing the shot, frame something interesting at one edge of the frame in the foreground or distance to add interest and perspective, perhaps Mount Kilimanjaro looming in the background or the edge of an acacia tree in the foreground with the breeze moving the branches.



Frame the horizon either a third above or below the center of the frame, depending on whether you have cloud formations in the sky or something interesting in the foreground. Frame the herd of buffalo so that they are one third of the way into the frame with more open frame in front of their direction of travel. This gives the feel of progressive, dynamic action and allows you to seamlessly

edit in your closer perspective shots. During editing, use a similar shot as a re-establishing shot to reconnect your characters to their setting.

2. Action-Interaction shots

By using various focal lengths on the herd of buffalo, you can capture a variety of shots from l**ong shots** (LS) that show the herd moving through the frame, to **close up shots** (CU) that show horns, feet, or eyes. Show the story with a series of shots using the various focal lengths that best capture the action or interaction of the buffalo. They can also include **medium long shots** (MLS), **medium shots** (MS), and **extreme close ups** (ECU). These closer perspective shots are sometimes called **cut-ins** (CI) because they cut in on more of the details of what's happening in the scene.

3. Cutaway shots

A **cutaway shot** (CA) is of something that isn't in the main scene, thus requiring the camera to cut away from the herd of buffalo—perhaps to a lion stalking through the grass or a vulture sitting in an acacia tree. A very valuable cutaway is the static ELS of what the buffalo sees (or fails to see) to the left, right, or behind the cameraperson. The cutaway shot can offer point-of-view or the element of implied tension. The more cutaways you have in your shot inventory (from small items, such as flora and fauna, to bigger scenic shots) the more creative options you'll have during editing. A classic cutaway to complement an expert interview is the host attentively nodding.

By capturing and editing together these various static shots, we could show a wildlife story of the Cape buffalo living on the Serengeti reasonably well. But let's introduce movement of the camera on the tripod head.

Introduce moving shots from a tripod by:

1. Zooming in or out

Using the power zoom feature on the camera is usually overrated and often overdone by beginner filmmakers. Though it is tempting to use the zoom rocker to introduce movement with a focal length change, avoid it. If you want different focal length shots to help show your story, turn off the power zoom and manually zoom to the shots that you want to capture. Editing those series of shots with straight cuts will make your production look more

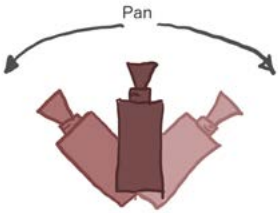
professional than using your best zoom. Zooming in can be effective at connecting characters in the foreground with characters or action in the background. We would zoom from the buffalo to the distant lion approaching in the grass.

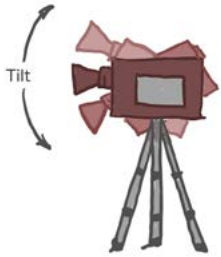
2. Panning

Panning is rotating the camera on the tripod head left to right, or the reverse, to get a horizontally level shot from one place to another. Like the zoom, it's often overdone but can still be effective as an establishing or revealing shot. An example might be panning from the herd of buffalos to a river filled with crocodiles. This would establish that they are headed for the river and possible danger. However you decide to use them, pans should be well-planned and accomplish a few things to make them effective:

- Plan your pan to have specific start and end points that reveal the action, setting, or characters. The end of the pan should reveal the main point of interest, action, or character.
- Roll five seconds on the start subject of your pan, pan smoothly at a constant rate, then slowly ease to a stop on your end point and capture five seconds.
- The actual camera movement of the pan between the start and end should be about seven seconds.
- Pans must be level during the entire rotation of the camera. Limit your pan to less than 60 degrees of sweep.
- Pans should be planned and practiced several times before recording.

- A great way to get a steady shot when panning the camera on a tripod is to never touch the tripod arm. Instead, use a long rubber band attached to the tripod arm. Pull slowly on the rubber band to create the ultimate smooth pan.





3. Tilting

Tilting is similar to panning in having a planned start and end point. In tilting, the camera makes a vertical movement from a low point upward to a high point of interest, or the reverse. The same principles also hold for planning and practicing your tilt shots. We might get a tilt shot on our buffalo from its feeding muzzle nosing in the grass upward to an oxpecker bird on its back. A variation of tilting might be a diagonal movement or "sweeping" motion from one point of interest to another. This is one of the more common shots if using a crane that moves the entire camera.

4. Tracking

Tracking is similar to panning in its motion but has a different intent. Loosen the adjustments on the tripod head to allow both smooth horizontal rotation and vertical tilting of the camera. Tracking follows the movement of characters or action in the frame.

As the herd moves along, we track their movement so they stay in the same relative position in the frame as the background moves past. On moving wildlife, try to track with slightly more open space in front of a moving animal. This will help balance the image in the frame and allow you to better keep up with changes in speed or direction of moving wildlife. You'll really appreciate both the smoothness of your tripod head and your practice tracking when the lion charges from the grass and the buffalo break into a full stampede. Just be sure you have an escape plan in case it's directed right at you!

With so many shot choices, perhaps it's best to present an entire shot sequence that lists a series of both moving and static shots and how they might be used to show your entire science film. Let's return to our example manatee production.

Build Sequence

One visual tool that we use in many of our adventure-based science films is the "build sequence." This is simply a series of shots, usually hand-held, that build a compressed short story of what we're preparing to do.

First, we need to consider where the beginning interview or hosted scene might occur. It could be at the edge of a clearwater spring with a biologist getting ready to snorkel among manatees. So here's an example sequence of shots that would help build the story of our host physically getting to that scene.

- Aerial shot over Florida estuary (ELS, camera moving in helicopter)

- Host - driving car past "Welcome to Florida" sign (LS, short, fast pan)
- Host - looking at GPS on dashboard, pointing to manatee location (CU two static POVs: looking at host's face and looking at GPS)
- Host - car driving past Manatee Springs entrance sign (LS, tilt down)
- Host - car tire coming to stop (CU, static)
- Host opens trunk (MS, static)
- Host gets out wetsuit and snorkel gear (MS and CU, static)
- Walks down path toward spring, past camera (MS, static)
- Sees expert and waves (LS, static)
- Looks at pool (CU, static)
- Underwater shot of manatee (MS, static)

Keep in mind that you can be endlessly creative on the point of view of the camera relative to the host and camera movement. If you have two cameras, shoot some behind-the-scenes shots where you also see the cameraperson shooting the host and expert. It can lend an element of authenticity and a gritty, documentary feel to your production.

Expert Interview

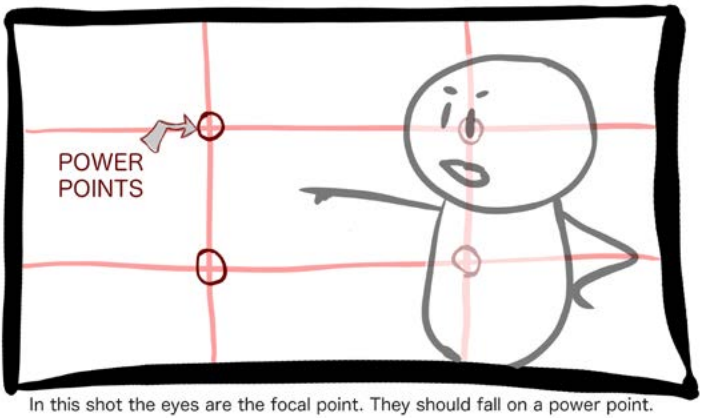
One key to adding credibility and content to your science or wildlife film is interviewing experts to reveal the science behind your story. The producer is responsible for keeping the experts calm. The cameraperson is in charge

of making them look good. Though there are several techniques for shooting the interview, we will focus on the classic interview setup. In editing, the interview footage will be covered with supporting footage as we hear the speaker's audio track, and we will only see their face during brief pivotal moments in the interview.

First, position your expert with an interesting background that supports the content, such as the edge of the manatee spring. The interview should be shot from a tripod, the camera level with the expert's eyes.

Set the camera about 15 feet from the expert. This will allow you to zoom in and reduce your f-stop and field of focus. Ideally, you want the expert to be in sharp focus with the background slightly out of focus. Zoom in to frame the expert from the chest up just past the top of their head. This is known as the **bust shot** or a **three-button shot**.

Next, have your expert position their body so they are facing slightly off camera looking directly at the person asking the questions. This will help them relax and become more natural with their answers. If you're operating the camera plus asking the questions, you should stand as close to the camera as possible.



In this shot the eyes are the focal point. They should fall on a power point.

Now frame the expert's eyes at the intersection of two imaginary upper lines where you divide the frame into thirds both vertically and horizontally. This is called the **rule of thirds**. Your expert should be facing slightly off camera toward the more open two-thirds of your imaginary grid.

Don't be afraid to try some other focal lengths for certain effects. For instance, if some background action is taking place that supports the story or location, you could begin the interview with a medium long shot where we see more of the expert's body and more of the background, such as a manatee surfacing. During most interviews you can sense when the expert is getting to the pivotal or emotional point of the interview. This is when you zoom in. Stick to the rule of thirds and keep rolling the camera. Chances are good you'll capture the intensity of their expressions.

Supporting the interview with additional footage is crucial. Collect a good inventory of B-roll to keep your production from looking like a bunch of talking heads. The proper footage genuinely supports your expert's dialogue. Ideally, take notes during the interview that can lead to shots that support what the expert talked about. Some fail-safe shots should include:

- Expert walking (without talking) through various scenes that relate to the storyline, such as along the edge of the clearwater pool
- Expert looking at the manatees
- Simple closeup of expert gazing intently or lost in thought
- Expert getting into snorkeling gear

- Expert inspecting and/or using variety of gear related to the story
- Expert interacting with places or people related to the story

Once you become familiar with shooting your interviews from a tripod, you might want to experiment with some hand-held techniques. Here are some to consider that can add movement and a more dynamic feel to your film. (These techniques require a separate interviewer so your expert stays focused.)

If you've seen any police, courtroom, or medical television shows, you've likely seen the induced camera movement on a character's face. Though it's easy to overdo during an interview, you can add more of a dynamic feel with just a touch of it. Hold the camera on your shoulder about 15 feet from the expert. Turn on your image stabilizer (OIS) and zoom in to bust framing. Move the camera slightly with an irregular motion during the interview. It takes some practice to get the right feel but it can add another gritty dimension to your production.

Another technique is the floating camera. This time, you're standing closer to the expert and zoomed in slightly to get proper framing. As they answer questions, shift the camera using your arms or body to the left or right in a super slow sweeping motion. Shooting past items in the foreground or your host can add dimension and depth to this type of shot.

The walking-talking interview technique, where the camera and expert are both moving, adds considerable movement and perspective if your expert has the presentation resources to pull it off. But walking, talking, and staying

poised while facing a moving camera lens has the tendency to unravel some experts and hosts. So shoot a few test runs with talent before committing to this style of interview. If you try it, the subjects should be walking at the same pace before starting the interview at slower than normal pacing. Select a stopping point to anchor both the talent and camera near the end of a shot. This provides a smoother look and feel for transitioning to the next segment or topic.

Finally, there's the interactive shot. The camera chases the action during interview. If done well it offers the opportunity to capture the story plus gives the viewer the feel of being part of the action. The technique works best if the expert is actually in the process of performing some action relative to the story while explaining the science. Here are some tips for making interactive shots work well:

- Turn on the OIS.
- Use a zoom-through wide angle lens, and start with it zoomed out all the way.
- Begin framing the expert and their action.
- As the subject of discussion or action changes, "float" the camera to a new perspective and/or focal length that offers a slightly different view. Don't zoom in to get a closer perspective. Simply move the camera closer.
- Move the camera slightly every five to seven seconds, even if the action or subject of discussion remains the same. It takes some practice, but if you listen to the content combined with the action, you'll gain a sense of when and where to move the camera.
- Shift the camera perspective to connect and interact with the expert, host, and/or action.

Besides connecting the audience more with the story, the interactive shot also helps you to capture support footage that presents both the big and smaller visual details of the topic. Here's how we might shoot a manatee biologist inserting a microchip ID tag in the fin of a manatee while they are explaining the process to the host.

Begin with the lens hovering over the microchip in a box full of devices as a hand comes in and picks up a chip. The camera moves back and swings up to reveal the biologist placing the chip into an insertion needle with the host looking over their shoulder. Now the camera swings behind the biologist as they bend over the manatee and lift a fin. As the biologist begins to insert the chip, the camera floats down the arm of the biologist to the manatee, pausing as the chip goes into the fin and the needle is pulled out. The camera then continues along the side of the manatee and stops by looking into its big eye. It pauses on the face of the manatee before rotating back to the onlooking expert and host. Though this sequence of interactive camera technique is only hypothetical, it offers you some creative options to consider how to adapt moving, interactive camera techniques into your filmmaking.

Transition Shots

It's easy during the excitement of shooting interviews or cool science stuff to overlook some other important shots. Capture transitional elements to help connect the various parts of the story with progressive action. Think like an editor when you're shooting on location. When you're wrapping up an interview ask yourself how you will connect the scene you just shot with the next one.

The answer depends on so many variables that are unique to your story and series of shots that we can't offer a sim-

ple list. Consider something visual that offers closure to one scene while offering a connection to the next segment.

Ours might be:

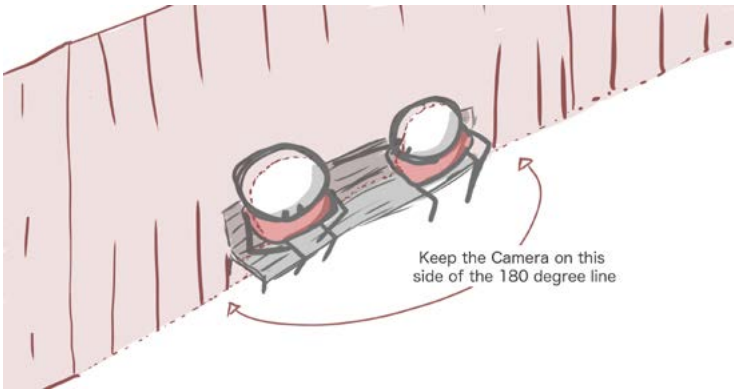
- Manatee swims off while biologist and host watch.
- They nod in approval and walk out of frame.

Or the host might use a line of dialogue: "I wonder what other science is helping these manatees?" The transitional shot doesn't have to be included in the closing of the segment. It can be included in the opening shot of the following scene. Transitional shots can also be as subtle as a wide scenic shot with characters entering or exiting scenes, or close-ups of feet walking past the lens.

You'll also want to think about point of view (POV) and perspective. In most of our daily interactions, our eyes are about five feet off the ground and we see many things from a medium long shot perspective of about eight feet away. If you want your shots to be more interesting than this average visual perspective and focal length, change them. As you do, be sure to consider the following.

- **Orient the audience** with sequences that match the flow of action. For instance, our eyes normally go left to right, down to up, close to far, and sometimes far to close. A good camera angle calls attention to the action, not to the position of the camera.
- **Be consistent with the flow of action** in your shot sequences. If the camera is moving from left to right, don't change the movement from right to left in the same series of shots. Change the angle or focal length, but keep the direction the same.
- **Follow pictorial continuity** in the movement of the camera and characters. If your characters exit

the left side of the frame and then enter from the left, it violates directional continuity. Or if a character starts out wearing safety glasses and in the matching action scene they aren't wearing them, it looks like a mistake. A good rule to follow to help with pictorial continuity is to draw an imaginary line from the POV of the establishing shot from the left to right side of the frame. That divides the 360 degrees of perspective into two 180 fields of perspective. To avoid shots that challenge the viewer's sense of pictorial continuity, keep that camera POV in your original 180-view and don't let the camera cross over the other 180-degree perspective.



- **Match the action, not perspective.** A "jump cut" is an undesirable visual hiccup where you have two almost identical scenes edited together with only a slight change in angle. Generally, if you don't change the camera perspective by at least 30 degrees, it's a jump-cut, and it looks amateurish. Some easy cures are to shoot identical scenes using several different shot angles and focal lengths. Use cut-ins and cutaways in editing to break up potential jump cuts.

- **Clean scene entrances and exits** of your host and expert adds a few seconds to the overall production,

but they can give your audience a smoother ride along the storyline. **In to Frame** (ITF) and **Out of Frame** (OOF) scenes can serve to:

- Indicate the passage of time between scenes
- Provide a smooth transition for location or action changes
- Re-establish players and/or action
- Create bridges between segments

The Seven Common Sins

We'd be remiss if we didn't warn you about the common mistakes that many of us make in our early attempts behind the camera. Here are the top seven sins of production and some simple ways to avoid them.

1. **Fire-hosing** is recording while waving the camera around from one piece of a scene to another (as if spraying everything with a fire hose) in a desperate attempt to get everything at once. If you're unsure of what to shoot, you may try to shoot everything. The end result is footage that may cause motion sickness.

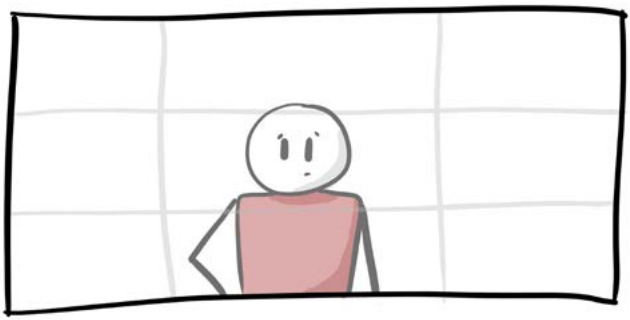
   Fortunately, the solution is simple. Consider the most important element of each shot then frame your composition to show that pivotal piece of the story. Make planned, purposeful camera movements, and stop recording between shots to consider the logical sequence that will help show the greater story.

2. **Snap-shooting** is the opposite of fire-hosing; the cameraperson uses the video camera as if it were a still camera. You'll end up with very short shots that fail to capture the essence of the progressive

action of the scene. The tendency also may be to hold the camera perfectly still on a non-moving setting or event, resulting in a slideshow.

Good camera practice should start with recording five seconds of "heads" and "tails" that might capture some of the action. We mentioned earlier that you should move the camera every seven seconds or so, but you can extend this to 20 seconds for key subjects or action.

3. **Head-hunting** is lining up the prime character in the exact center of the frame. This violates the rule of thirds and creates a static feeling. It might work okay if you're making a sniper movie and you want the subject in the crosshairs, but consider other options in your science films.



4. **Back-lighting** is underexposed characters standing against an overexposed bright background. Although this works okay for Darth Vader on the Ice Planet, it's an unfortunate result when the auto-iris takes over on scenes with bright sky or water in the background. The result is an inky silhouette of a person, framed with a halo from the overexposed background.

   Overcome this by setting the camera to a manual iris (or your ND filter) then dial in more light

until the subject's facial details show clearly. If their face is still in shadow, use a light reflector. Lightweight, fold-up reflectors are an affordable solution to avoiding backlighting. Or better yet, take charge of your setting by moving the subject and/or camera to position a darker object in the background to better balance the contrast between the subject and background.

5. **Motor-zooming** is the tendency to use the power zoom rocker to capture all the close-ups and wide shots at once. It may be popular on some quirky sitcoms, but your viewers will quickly feel like they're on a roller coaster. Plus, all that power-zooming eats up your camera batteries.

   To avoid this, simply switch your setting from rocker zoom to manual. If your camera only has a powered rocker zoom, plan and reframe each shot before recording. This isn't to say that you can't capture that well-planned zoom-in or zoom-out that is part of your shoot list as a reveal or establishing shot.

6. **Tunnel-vision** is shooting everything from the perspective of your eyes in angle, height, and focal length. The results are quite boring. Consider different perspectives from the camera's POV. It's still okay to shoot things from eye-level and eight feet away, just not everything. Science subjects look much more interesting from above and below eye-level and from inches to miles away.

7. **Camera-Jogging** is when the camera bounces around as if it were secured to the hip of a jogger. It's usually caused by harsh camera moves when the operator is moving around. Though we mentioned how purposeful camera movement can add life to your production, too much of a good thing can make your audience dizzy or seasick.

To minimize camera jogging, try these stabilizing techniques:

- Make sure the camera is zoomed back all the way to wide angle to minimize effects of shake.
- Hold your camera like a cup of hot coffee and use the LCD viewfinder if your camera has one. Cradle the camera with one hand underneath and use your arms to help stabilize the movements.
- Bend your knees and arms to reduce the up-and-down camera movement.
- Move more slowly than normal and hold the camera at waist level and away from your body.
- Turn on the camera's image stabilizer (OIS).
- Check out the variety of camera-stabilizing systems for your camera. An easy trick is to attach your camera on the tripod, fold in the legs, and hold the tripod as you move around. This adds weight to the setup, decreases bounce, and spreads out the center of gravity.

Now you're equipped with a solid understanding of how to use your camera lens with your various shots. It's time to employ some directing skills to capture the essence of your film's story.

Six

The Art of Directing

Directing Talent

Knowing how and what to shoot is a big part of your challenge as a producer. The other main challenge is effectively directing your host, on-camera talent, and experts to get their best performances - which may be easier said than done. The realm of directing people in front of the camera is full of pitfalls, most of which you have limited control over. But these pointers can help you become a more effective director.

A Comfortable, Confident Host

Your host can make or break your film's impact and connection with the audience. They represent your film's face and voice in presenting the topic, the big question, and leading the audience through the discovery process. They are the trusted tour guide throughout your film. Even the way they read their narrative lines influences the success of your film.

The more your host knows about the subject of your film, the better equipped they will be to vocalize those concepts in front of the camera. Get them involved early in the planning process so they have the opportunity to contribute to or work on the concept development, the research, the script, shoot logistics, and shot list. We commonly get our scientist-producer hosts involved in multiple facets of the production, so when the cameras begin to roll, they are comfortable and confident with the information they will be presenting.

Accommodating their confidence and comfort is where the director can help the host perform at their very best. If your host is tired, thirsty, cold, hot, hungry, angry, or irritated by insects, it will affect how they look and sound in front of the camera. Plan ahead and during the shoot to address the physical elements that might make them uncomfortable.

To assure a confident host, have them review the script or outline in advance. Sit down with your host and verbally go over the shoot to find consensus about slant, audience engagement, tone, and presentation style. Don't wait until the day of your shoot or you may be forced to shoot segments where your host appears and sounds disconnected from the topic.

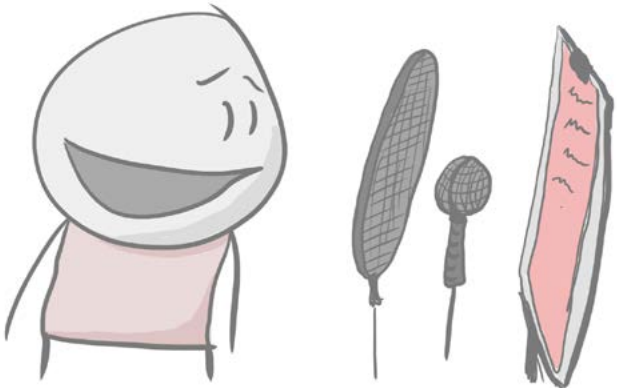
It may require lots of takes for your host to even get the first scene down. But before you sigh, "Take 13," you should be saying a number of things to boost their confidence. Here are a few to consider:

- You look terrific in this lighting and setting.
- Your energy level is great today, so let's try to feel it in the big question.

- Now we've got the kinks worked out. I think you're going to nail this one.
- That last take was a real keeper. Now let's try one more just for fun.
- I can feel the engagement with the camera when you move closer like that last take. So try coming in even closer and let's see how that works.
- You're so awesome I can give up my directing job. I think I'll just shut up and roll tape as you run with it.

Of course these are only a few suggestions. You'll want to adapt to the personality of your host. Whatever you try, avoid over-directing to the point of frustrating your host. And even if you get to Take 23, don't become negative, frustrated, or angry. Realize that they want to perform at their peak as much as or more than you do. Positive reinforcement works best. Giving them a short break can also work wonders if they are having trouble.

After you've recorded them successfully saying the scripted lines, let them go off script. Have them summarize the scene in their own way. You may never use it, but chances are this will be the most natural take of all.



Voice-over directing is another important facet of directing your host. Much of the narrative voice of your film may be your host reading and recording from a written script, and achieving a natural sound from them may be a hurdle. Most people sound as if they are reading a script. There are ways to improve this:

- Have them practice well beforehand, reading the script aloud.
- Have them stand when recording VOs as sitting compresses the diaphragm.
- Set up the printed script so they can easily read it hands-free.
- Encourage facial, hand, and body gestures for emphasis.
- Highlight keywords that you want them to punch for effect.
- Encourage variety in pacing, inflection, and effective pausing.

After you've worked a while with your host, you'll get a good feel for how to best direct them and what to expect when the camera rolls. Your various experts offer similar yet very different challenges.

Directing the Expert Interview

Like your host, you'll get the best performance from your experts on camera if you focus on their comfort and confidence. Unlike your host, experts may prefer to do things their own way, which may not be the way you want them portrayed in your film. For instance, it's not uncommon for an expert to prefer being interviewed sitting behind their work desk. This may compromise the quality of your

film if their office and desk are cluttered, poorly lighted, and allows them to slump back in their chair. This is a pretty common circumstance. However, there are a few tricks to making your expert feel and look their best in front of the camera.

- Begin with a friendly visit to get to know them.
- With your host present, explain what your film is about and the subjects you would like to cover.
- Ask them for creative options on where to shoot the interview to make them look good and support the film's content.
- Tell them they look and sound great as you're making camera and audio adjustments.
- Tell them you enjoy interviews and to relax and have fun with the answers.
- Encourage them to use hand gestures.
- Assure them that you're only going to use the very best takes.
- If you need a shorter version of an extensive explanation, ask them to condense it into a few sentences, or around 30 seconds.

A final word of caution here about interviewing experts. Some will want to see the questions beforehand so they can study them and collect their thoughts. Though this sounds reasonable, it often leads to interview answers that sound unnatural. Also, don't let your host ask the interviewee any of the questions before you roll; it can lead to an unnatural response the second time they consider the answer. Their answers may feel forced and they have to constantly fight the urge to say, "As I just told you," or "as I showed you earlier." So before the camera rolls, simply make small talk by asking about their research or facility.

Seven

Post-production

Post-production occurs after footage is shot on location. Here is the workflow we follow.

Transfer Media from Cameras to External Hard Drives

While media transfer is sometimes done on location during a shoot, it is a good place to start our definition of post-production. When the camera's storage device is full (almost all cameras now use digital storage) filmmakers must offload the data to an external device. It is extremely important to have redundancy on a shoot. Back up the footage right away to a RAID device (redundant array of inexpensive disks) or two separate external hard drives.

Untamed Science uses a single mirrored RAID drive as well as a separate external drive that we keep in a different location. If we accidentally lose one drive because of fire, flood, or any other mishap, the other drive is intact. We usually have a total of three backups, but many filmmakers will swear that four copies is the optimal amount for file redundancy. While this might seem like overkill, on very important shoots we often have a fourth backup

to tape. Tapes tend to fail less often and will last longer than hard drives.

Log and Name the Footage

Now it's time to name the files. This is a great opportunity to review all the footage you have and name it in a logical way. We like to name footage something like Green-River-Kayaking-001-unloading.mov, Green-River-Kayaking-002-launching.mov, etc. This naming convention puts the name of the shoot at the start followed by a chronology (001-999). This allows for quick searches during editing too. For example, if we want a kayaking shot, we'd search for "kayaking," and the operating system would pull up all our shots with this descriptor. We encourage you to stay away from shorthand naming because it can confuse others who need access to it. For example, if we named the file GNRKY-01-unld.mov, it wouldn't be searchable nor would anyone know what the abbreviation meant later on.

Choosing Editing Software

If you're new to filmmaking, you may not know the benefit of a great editing setup, a suite of software that allows you to drop in music, assemble clips, and add simple effects. The three big players right now for professional editing are Avid, Final Cut Pro (Apple), and Premiere (Adobe). The one you choose depends a lot on your personal preference. We recommend first asking your filmmaking buddies what they use. Chances are, you will eventually need their help. If you're using the same setup as a colleague, your life will be a lot easier.

Edit a Rough Build

One of the most useful steps to take when assessing raw footage is to piece it together in a timeline before leaving the physical location of your shoot. Take the pieces of the interviews or the hosted sections that turned out best and drop them into a "rough build." If you're handing off footage to an editor later, this will help them, too.

Add Music Tracks

Adding music early on helps unify the look and feel of a piece as it is edited. Many editors will argue that you should edit a piece first and only add music at the very end. This advice usually comes from editors who have backgrounds in narrative filmmaking, in which case they're probably right. However, in science and natural history programming, unlike fiction filmmaking, most scenes are built by the mood —a combination of the music and visuals. By choosing a rough music track early on, you can edit the piece to work with the musical selection.

Add Temporary Narration

Now that the piece is starting to take shape, you can start thinking about how a narrator might help explain sections of the film. Even if you're not planning on using a narrator, you may want to add temporary audio that you intend to get from interviewees, etc. This added soundtrack will help you and any first-time viewers conceptualize the flow of the piece better. This can also help you decide the final script if you do hire a narrator. Narrators aren't cheap, and they won't want to try different narration while you are figuring out what you want to say. Save the final narration for the fine cut.

Animations

Before you're finished with the rough cut, you may want to request graphics from animators. You can drop pencil sketches into a rough cut before spending the money on work from an animator. Or, ask an animator to help conceptualize your idea with some simple sketches. (Learn more on Animation in Chapter 8.)

Create a Rough Cut

Different production companies may have different definitions for what a "rough cut" really is. In essence, you want something cohesive to show clients and other crew members. If you're working with clients, the rougher it is, the more they feel they need to add their own creative input. The more polished you can make a rough, the better.

Color Correction

To start polishing the rough cut, you'll need to adjust the color tones in the video. If you're producing a film for broadcast on television or in the cinema you may have to send the film out to a specialist color correction house. If you're on a low budget, you can do it yourself pretty easily within your editing program.

Audio Mastering

While there is no magic button to correct problems in field audio, a skilled audio technician can make subtle changes that make it sound amazing. Here are some of the things that improve audio quality:

- Level the audio so that you can hear the dialogue at a medium volume. Make sure the background audio isn't so loud that you can't hear the words of the experts or hosts.
- Equalize voices so that they have just the right amount of treble and bass. This is especially important if voices are competing with the music.
- Remove background hums and hisses from scientific equipment.
- Add necessary sound effects.
- If you're the only one that has edited the film, make sure to have a second set of ears listen to the audio. If you've heard a segment a hundred times, your ear may not hear it the way someone does the first time.

Fine Cut

The fine cut is the last stage before the final draft is submitted. This is where you have friends and peers review the video so they can identify any lingering glitches in the product. If you're working with clients, have them sign off on any corrections that you intend to make so that you can move to the final cut.

Last Thoughts on Post Production

A common feeling in the industry is that you're never really finished with a film. There can always be things that you could improve upon. At some point you're just going to have to decide you've changed it enough. After multiple revisions, you'll have to send forth a final product and move on to the next project! It's a great feeling; enjoy it.

Also note that the stages of post-production that we presented here are very basic. There can be many stages to each of these steps. For instance, we often produced as many as 10 “rough cuts” before moving on to the next stage. If you have to work with a production company, follow their tried and true model. If you’re doing this all on your own, this simple flow should work to get you started. You’ll find out what works for you soon enough.

Eight

Successful YouTube Channels

We decided to dedicate an entire chapter to making videos specifically on YouTube because of the impact this type of video is having on the world today. At no other time in history has the distribution of videos been quite as easy. No longer do you have to pitch your idea or finished video to a few executives at a TV station. Every single person can become a distributor for their own videos. However, if you want a large number of people to see your videos, which should be the goal, there is still a lot to learn about this new media.

You may also notice that we titled this chapter how to make a successful *channel* on YouTube, not just how to make a good video. YouTube is a great place to showcase all of the work you do. Building an audience and keeping them is key. A successful channel has a few easy-to-identify traits. Let's start by taking a look at what sets YouTube apart from other media.

The Big Differences

Like any other media, you need to understand what YouTube is and what it's not. You need to understand how

your films are being watched so that you can make the best possible film for that venue.

Theatrical movies are very different from YouTube. At a movie, you pay money, sit down, and are more or less bound to your seat for 90 minutes or more. These sorts of movies can gradually build in tension. The payoff can wait until the very end because of the length and style of the format.

Television is closer to YouTube. The viewer is sitting around a television with a remote control in hand, ready to change it if they're not engaged with the program. The TV model is to keep viewers engaged with content for about 10 minutes then leave them with a cliffhanger every time they cut to commercial. They want viewers to watch the commercials; that's what makes the network their money.

YouTube is an even more fragile environment than television. On the web, most people aren't even deliberately sitting down to watch a video. They're usually taken to the videos by chance or in between things they may be working on. The chance someone will quickly click away from your video is high. Because of that, you have to immediately begin with something highly engaging just to keep them watching. It's an entirely different model of filmmaking. Snaring viewers in the first five seconds to keep them watching is only part of the challenge.

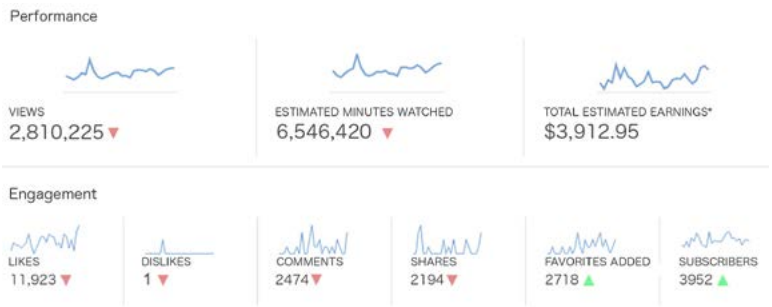
YouTube puts the success of your channel into the hands (or clicks) of your audience. No longer are you having to convince one person if your show is good enough to fund. Now you're actually having to convince every single person to follow your show. In some ways, this is

extremely scary. If your show is a flop, who's to blame?

On the other hand, YouTube is a wonderful media through which you can interact with your audience. Everyone who watches your video is essentially voting whether or not they like your show. They do this directly by "liking" the video or by watching all of it (you can see this information through YouTube analytics). YouTube integrates the analytics of how videos are being watched into a neat little algorithm. The full details of this algorithm are a mystery to us (they change all the time), but doing your best to figure it out really is the key to making it in this new genre.

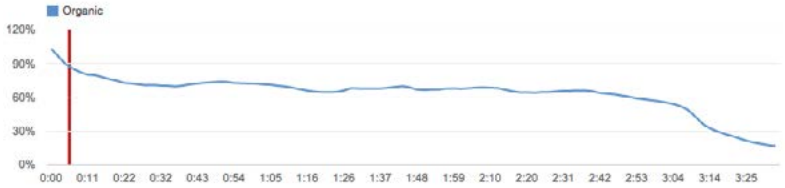
Beating the Algorithm

The YouTube algorithm is likely a lot like the Google Search algorithm. It takes into account how the video is watched - entirely, partially, etc. We were able to get in contact with a YouTube partner specialist to help fill us in on how it works. The first thing she explained is that you should look at your YouTube analytics as a way to see how people watch any of your videos. It gives you options like this:



While there are a lot of important factors, some of the most important are audience retention and total amount of time someone watches your video.

Audience retention is a way of calculating how long someone watches your video. It's generally shown as a percentage of time maybe in a graph like this:



This graph is one of our three minute videos. You can see that a lot of people dropped out at the very beginning. But when we got them engaged, they stayed with us for most of the video. The sharp decline at the end is when we put up the credits and the "subscribe for more" slates. This is pretty good looking retention curve.

Total View Time is different though. Even though the average retention here is 65%, our video is only a bit over three minutes. If a similar hour long video had an average of 65%, the algorithm would favor that video tremendously. The longer you can keep viewers watching, the better!

Learning the Tricks

These are details YouTube keeps track of, but there are other things you can do to make a channel successful. Here are the top three tricks:

1. **Start watching and subscribing to other channels.**

   This may sound obvious, but you wouldn't believe the number of people I've talked to who

want to be successful on YouTube and do not subscribe or even watch many videos on YouTube. Interact and see what works for the people you like. It's even helpful to watch some popular channels you *dislike* to see what makes them successful. Here are two we like: **BrainCraft** and **TheCuriousEngineer**.

2. **Study YouTube's best practices.**

   YouTube has a whole training site dedicated to training content creators. They call it the Creator Playbook. A Google search for "YouTube best practices" or "YouTube creator playbook" will pull it up. They even have playbooks designed specifically for science YouTubers. It is a must read for anyone getting into it.

3. **Make your own, and see what works.**

   There is no better teacher than starting your own channel and seeing what works. With every video, you'll start to see what works and what doesn't.

The 6 Biggest Things to Do Within Your Video

If creating a strong channel is your goal, you have to start with making great videos. Remember, these videos need to be made specifically for this audience: the person with mouse in hand, ready to click away. Here are six keys to creating a good video on YouTube.

1. **Start with a bang.**

   Put your best, most engaging work right at the beginning. You want to keep your viewers as long as possible, and pulling them into the show in the first five seconds is key!

2. **Keep drawing the audience along.**

   Remember, one of the keys to the algorithm is total view time. That means that you have to write the content in a way that keeps your viewers wanting more. Maybe you pull them in with a crafty title, such as "Why Protect Elephants?" The rest of the video should be spent taking them on a journey through your topic. But save the answer to your title question for the end of the video.

3. **Use silence carefully.**

   There are few film venues where jump cuts (abrupt transition cuts in editing) are the norm. On YouTube, jump cuts are an accepted style. One reason for this is in an effort to chop up dialogue so information is transmitted as fast as possible. Silence can also be effective, but use it sparingly for dramatic effect.

4. **Use annotations at the end to link to more videos.**

   YouTube was the first big video streaming site to allow you to click on selected places in your video that take you to other links. You can add your own text bubbles or encourage people to go to external websites. The idea is brilliant and a great way to direct user traffic where you want it to go.

5. **Ask people to subscribe.**

   YouTube is a relatively new medium for videos, and many people aren't familiar with subscribing to channels. Because of that, it's important to tell people how to subscribe to your videos. It's a call to action you should put at the end of your videos. You want to make it as easy as possible for people to find you and follow you. Ask them

to subscribe and give them a text box (perhaps saying "Subscribe") to click on.

6. **Engage with the audience and encourage them to write comments.**

   The more people interact by writing comments, the better you do in the algorithm. Plus, it's always nice to see what people like about your video. A great technique to drive comments is to simply ask the viewers questions at the end. If you're doing a video about protecting elephants, ask them to leave their solutions to the elephant problem in the comment section. This gives you a great opportunity interact with your audience and share ideas as you reply to their comments.

Making a Plan for Success

Just like any successful business, having a successful YouTube channel should start with a plan. You're playing the role of a network executive here, and you have to think long term. Here are six steps you should add to your plan.

1. **Figure out your target audience.**

   Who are you trying to target? Is it mushroom enthusiasts or sports fans? What age range are you targeting? Will your demographic have a mix of males and females, or will it be slanted to one gender? All of these are important to ask.

   If you're new to making videos, we suggest making videos that you and your friends would watch. First time YouTubers sometimes make videos for a group they're not really a part of, and the result is a video that is confusing and does not draw the target audience. If your peer

group isn't going to watch the videos, it's going to be hard to build an audience.

2. **Let your audience guide you.**

   After you've passed a certain threshold of viewers, the people watching will start to tell you what they want. This may be directly in the comments or indirectly through the ones you see they're watching the longest. For instance, our most popular videos are ones with a strong conservation slant, so we continue gearing our efforts to please this audience.

3. **Make a release schedule.**

   This step relates to human psychology. If you have a release plan and stick to it, people know when to expect your content. For example, if they know to look for a new video every Tuesday at noon, they can reliably look forward to making it part of their week. This garners anticipation trust between you and your viewers. The most successful channels release a video every week.

4. **Team up or partner with other YouTubers.**

   YouTube is currently set up to favor those creators who have teamed up with other popular (massive views) YouTubers. There are two reasons for this.

   First, if a popular YouTuber physically likes your video, it comes up in a *lot* of feeds. Second, teaming up to create videos and showing up in other creators' videos is way to aqcuire subscribers that may have never seen your content!

5. **Make videos that have social media sharing appeal.**

   You want to make videos that people want to immediately share it after they've watched them.

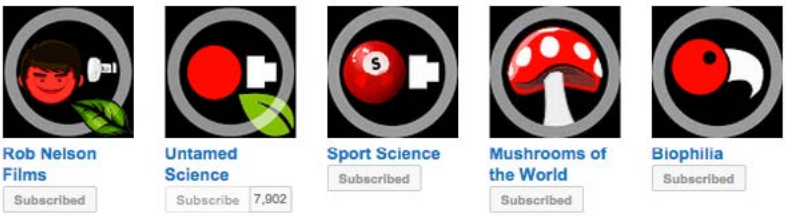
One great way to boost sharing on social media is to make videos centered around particular current events or calendar events. Making a Valentine's Day themed video that is released on the holiday could make it more likely that people will share it through their social networks. While topical "tent pole programming" like this may have a short shelf-life, it can be a useful tool to draw in previously untapped audience.

6. **Start learning from your successes (and failures).**

   Once you hear what people want, listen to them. The bigger your channel, the more people will be sharing what they want. If you're not reading comments, you can learn a lot from the YouTube Analytics. Remember, YouTube is a lot like any other media. You have learn the game and play it well.

SUBSCRIBE TO US!

We have a lot of channels; subscribe to them all:



Search "Untamed Science YouTube" and it will lead you to our multi-channel networks!

Nine

Ethics in Filmmaking

As science and wildlife documentary filmmakers, we have a great deal of public responsibility. Much of what the public learns about the natural world comes from the films we make. If we explain the aerial acrobatics of the great white shark, the mating behavior of paradise birds, or the burrowing habits of the pygmy armadillo, people should trust that what we're telling them is true.

Specifically, we are trusted to share science and natural history stories as accurately as possible and to interact responsibly with animals while we're in the field.

Telling a Truthful Story

Science and wildlife filmmaking is about telling stories, but there is a delicate line between fact and fiction. Most audiences know they can't believe everything they see in the movies or in fictional television programming, but we don't want to get to the point where they are doubtful of natural history programming, too.

A few years back, the filmmakers of a popular show on a respected science documentary channel got into trouble. The show claimed to be a two-man crew following the host as he was trying to rescue himself in the wild. It proved to be a false statement. People were outraged when they found out that the crew actually spent a few weeks shooting the purported three-day survival trip and that the two-person camera team actually consisted of closer to a dozen people, all staying in nice hotels at the end of the day. After this was leaked to the public though, the show remained on the air with only a small disclaimer at the beginning of the show claiming that not everything was real.

A colleague of mine accompanied this crew to the tropics as their survival expert. He told us of one particular shoot where they wanted to hunt piranha. He fished a bunch of piranha from the river, put them into a small backwater pool, and fashioned a bow for the host to use. Unfortunately the host couldn't shoot the arrows well enough to catch a piranha, so our expert shot the piranha then threw the host the bow as the camera panned up. Is this kind of truth-bending okay? Are they breaking any fundamental ethical rules in documentary filmmaking?

Another recent ground-breaking show took the technology of *Jurassic Park* and put a natural history story to dinosaurs. Unlike other shows that theorized how dinosaurs might have behaved in the wild, this show used high-tech computers to render the life of dinosaurs from birth to death, often making up facts in order to tell the story.

A third wildlife documentary from the 1950s about the Arctic contains a famous scene of the mass suicide of lemmings. The lemming populations increase dramatically, only to run out of food and force them to commit suicide

into the ocean; we saw it for the first time on the film. The idea was later proved to be fake and there were accusations of animal cruelty.

We give these three examples so you can start thinking about the issues. Where is the line?

Treating the Animals Right

Telling animal stories in nature is innately difficult. Consider shooting a film on wolves, for example. Most people will never see a wolf in the wild. Now imagine trying to tell the story with a 70-pound IMAX camera loudly whirring and scaring away the subject. Filmmakers may get past these problems by using tame wolves. If an expensive film shoot demands it, why not get trained animals to perform for the camera?

It might depend on the narration of the film. If the film claims the wolves are wild, then this is untruthful storytelling. However, the narration could be written to tell the natural history of the wolf and avoid mentioning whether these particular wolves on camera are wild. It allows audiences to see how wolves behave and earn an appreciation for their beauty without endangering them. We'd argue that this protects wild wolves.

Under no circumstances should filmmakers put animals in physical danger simply for a shot. We've heard horror stories where a group of filmmakers pulled an exhausted wildebeest out of a mud pit in order to film the kill by waiting lions, or a film about Hawaii where a pig was tied down to be included in a shot panning through the forest. Untamed Science takes the stance that filmmakers must avoid all acts of animal cruelty when making wildlife documentaries.

Ethical Code of Conduct

Fortunately, there are certain codes that organizations like the BBC and Filmmakers for Conservation have instated for wildlife filmmakers. We support and follow these guidelines.

Principles

1. Always place the welfare of the subject above all else.
2. Ensure that your subjects are not caused any physical harm, anxiety, consequential predation or lessened reproductive success by your activities.
3. Don't do anything that will permanently alter the natural behavior of your subject. Be aware that habituation, baiting, and feeding may place your subjects at risk and may be lethal.
4. It is unacceptable to restrict or restrain an animal by any means to attract a predator.
5. Subjects should never be drugged or restrained in order to alter their behavior for the sole purpose of filming.
6. Be aware of and follow all local and national laws regarding wildlife where you are filming.
7. Be courteous to your contributors (give appropriate credit where it is due). Whenever possible give copies of the finished program, a copy of a long edit of an appropriate scene, and/or publicity photographs to the people who helped you.

8. Images or script that give an audience abnormal, false or misleading information about a subject or its behavior should be avoided.

9. Always research your subject prior to filming.

Guidelines for Working in the Field

- Restore all sites to their original state before you leave (for example: tie back rather than cut vegetation).
- Be aware and take precautions, as some species will permanently quit a site just because of your odor.
- Keep film, video equipment, and crewmembers at a distance sufficient to avoid site or subject disturbance.
- Night shooting with artificial lights can require precautions to avoid making the subject vulnerable to predation.
- Be prepared to meet unexpected conditions without damaging the environment or subject. Be especially prepared and deal with any people attracted by your activities as they could put the subject at risk.
- Be aware that filming a den or nest site could attract predators.
- The use of tame or captive animals should be acknowledged. If using tame or captive animals:

  a. Ensure the subject receives proper care.

  b. The subject's trainer or custodian should always be present during filming.

A good bottom line to consider is, if it feels wrong or questionable then it probably is.

Ten

More Education

Today there are several ways educate yourself in the art of science filmmaking. If the pages of this book are not enough for you to launch your career, you may want to get into a science filmmaking program.

Schools

Going to school to become a science filmmaker was unheard of before the turn of the 21st century, but today there are a few different schools that offer courses to get you started in the field. Each offers a slightly different perspective and thus is worth looking at for its strengths and weaknesses.

Montana State University

Science and Wildlife Filmmaking Program

The Science and Natural History Filmmaking Department at Montana State University offers the most rigorous program of this type in the United States. It is a three-year, terminal degree program in the fine arts, after which you

receive an MFA. Graduates pursue filmmaking careers and are also qualified to teach at the university level.

Each new group of students accepted into the program forms a "cohort," 12-15 people who will go through all classes, projects and other assignments together. The first two years of the program are spent doing course-work in Bozeman, creating tight bonds among those that know each others' work and progress intimately. In the second year, a film project is require. The third year ends with a thesis film and a written Master's thesis paper.

Learn more about all the specifics of the MSU program at naturefilm.montana.edu

Benefits

First, there is no better way to jump-start a career than to start living and breathing science filmmaking with people as passionate as you. The relationships with film-making colleagues and professors a student will be interacting with on a daily basis will last their whole career. Secondly, this program is academically rigorous. It helps students think about filmmaking from different points of view. "Why are we making these films?" and "What really is nature?" are common philosophical questions in the program. Too many filmmakers, it seems, make their films without paying attention to these larger questions. Finally, students from the program have consistently proven the worth of an MSU degree by making some quality films and will help you get a job. Historically, NASA, Smithsonian TV, and National Geographic have acknowledged the quality of the MSU student. That's a good thing in a small field like science and wildlife film-making.

Negatives

Any student that is looking into a program like this should also know the downsides. In reality, this program, unlike other academic fields, is not paid for by grants from professors. Students pay their tuition which is currently about 70,000 USD. Most students apply for and get student loans. This financial burden can weigh heavily on young filmmakers after their degree. In-state tuition costs are lower. Student's should also remember that they won't have a job for the better part of those three years, so there will be little money coming in to offset the costs. However, it is a career move, so it is a great way to jumpstart one's job potential.

From a filmmaking perspective, the program's goal is to train producers and directors. If your interest lies in becoming a cameraman, sound recordist, or host, there may be better for you. But volunteering to shoot video or record sound for other students' projects is great for your career.

Montana State University is also a long way away from almost everything. Flights in and out of Bozeman tend to be expensive, so travel on a student budget is limited. Bozeman also has a higher cost of living, considering US averages. Plus, Bozeman is a small town saturated in science filmmakers. To successfully get a job post-degree, most graduates will have to leave Bozeman.

Example films from the program:

- *Angels of the Forest: Silky Sifaka Lemurs of Madagascar*by Sharon Pieczenik
- Untamed Science Video Series by Rob Nelson

- *Malice in Wonderland: The Red Queen Theory* by Edward Watkins

A full list of award-winning films from the MSU program is on their website.

American University

American University is a fair competitor to the Montana program. It's based in Washington, DC, and is directed by the market-savvy Chris Palmer. One selling point for this school is that it is in the same city as National Geographic, Discovery, and the Smithsonian channel. It is a great way to get close to some of these production houses and start producing films.

University of Otago

The University of Otago offers a one-year postgraduate diploma in Natural History Filmmaking and Communication or a two-year Master of Science Communication. Based in Dunedin, New Zealand, this program has a close partnership with Natural History New Zealand (NHNZ), one of largest the producers of factual television.

Taught by a mix of academic and industry professionals, the classes are geared toward a range of film and communication theory and hands-on practice. The first year is spent on five classes, or papers, ranging from storytelling to editing and camera techniques. The second year is spent producing a commercial-length film and writing a thesis. (If opting into the one-year program, a short film is created in lieu of a commercial-length, and the thesis is omitted.)

The classes are limited to 12 students a year, which creates a fun and intimate dynamic. And the relationship with NHNZ is particularly beneficial, as students get an insiders perspective on the industry.

Benefits

Access to NHNZ and working industry professionals are valuable aspects of this program as it exposes the students to the working reality of the natural history filmmaking industry. The course instructors tend to have a long history with filmmaking and science communication outside of a university setting, which adds to the real-world perspective. Additionally, artists, writers, photographers, and other creative professionals are invited to be guest lecturers.

Students get a crash course in production, and within two years, they will have producing, sound, lighting, and editing experience under their belt. Unlike the MSU course, the Otago course focuses more on technique and practice over theory. This tends to lead to edgy, industry-relevant films, rather than classic blue-chip pieces.

The location of the course—the south island of New Zealand—is a nature-lover's dream, with rainforests, mountains, glaciers, oceans, and farmland within a two-hour drive.

Negatives

Unlike some Master's courses, there are very few grants available for this type of study. As an international student, tuition can be expensive.

The classes and instruction are not as structured as typical Masters programs in the US. Students have access to great mentors with great experience, but must be willing to hustle and go above and beyond to take advantage of it.

Dunedin is the hub of Natural History Filmmaking; this creates a great community but saturates the job market. In an industry based on who you know, international students may find that the New Zealand-based connections they create during the program may not be of assistance as they initiate careers in their home countries.

Other schools

A few other schools have popped up that give degrees related to wildlife filmmaking. Here are a few others to consider.

- **University of West England** offers post-graduate degree in Wildlife Filmmaking. This course is taught in Bristol, a current hub for wildlife filmmaking in the world, and thus has some very good instructors to teach the course. It's step in the right direction if you want to make this your career and live in England.
- **Imperial College London** offers an MSc in Science Media Production. This school has a reputation for being a bit old-school and is centered around traditional broadcast and journalism.

Non-School Options

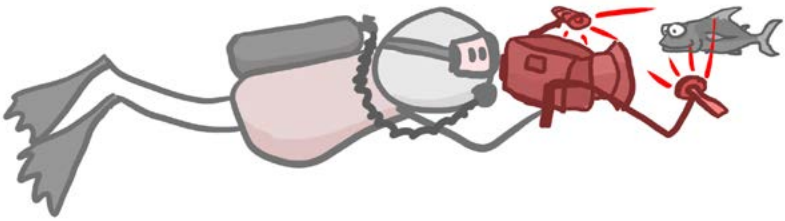
If you're not interested in actually enrolling in a filmmaking program, you can learn in other ways. Film festivals, such as Wildscreen and the Jackson Hole Wildlife Film Festival, offer great workshops and panel discussions. It's

an alternative way to get into the industry. At these festivals you may just run into the right people and land an internship with someone like National Geographic! Then you're learning by doing!

Resources

Advanced Camera Techniques

R.1 Underwater Video



Jacques Cousteau produced some of the world's greatest underwater videos. These videos inspired thousands of deep-sea explorers and avid wildlife filmmakers, including Untamed Science. As a result of his work, many people saw for the first time new species of flora and fauna, famous historical shipwrecks, and unexplored underwater caves. Thus, Cousteau's films gave underwater filmmaking greater prestige and attention. Now the world relies on underwater videographers to share this uncharted environment with the rest of the world.

Not all of us can become Jacques Cousteau, but preparation and hard work can make you an exceptional underwater filmmaker. Here, we introduce some of the key elements you must consider before beginning your underwater adventures. From learning how to SCUBA to adjusting for light and color, this guide will wade through the basics of underwater filmmaking.

Learn to Dive

Becoming a certified SCUBA diver is perhaps the most obvious requirement for underwater filmmaking. Filmmakers often bypass the bulky SCUBA equipment when taking video of large animals such as whales, but you'll need to learn the basics of SCUBA diving to take your skills to the next level. Understanding how to dive properly will allow you to get close to coral without damaging it or capture footage of wild marine life without endangering yourself. It will also help you learn to keep a camera steady while the animals perform their behaviors.

In addition to SCUBA training, we also recommend that you learn to free-dive. The disadvantage of traditional SCUBA is that you often scare large fish and marine mammals with bubbles. Free-diving allows you to swim freely with these creatures. But be safe; always practice free-diving with a buddy around.

Rebreathers

If you don't want to make bubbles but you need to stay down for extended periods, you can use closed circuit rebreathers, self-contained dive units that recycle the air we breathe so as not to release any bubbles. A rebreather

adds oxygen to the system and filters out carbon dioxide. These systems generally allow a diver to stay underwater for a long time.

Know the Underwater Environment

When shooting video underwater, you want to make sure you don't break or damage anything in proximity. This may sound obvious, but it can be a bit difficult maintaining your focus on your subject while making sure you are not sinking, floating up to the surface, or crashing into rare coral or dangerous rocks.

If you are diving in blue water without a fixed reference, it can be hard to know if you are heading up or down. This can induce vertigo and lead to a potentially dangerous situation. Before you start playing with the camera, be sure to practice good buoyancy skills so that you can stay at a constant depth.

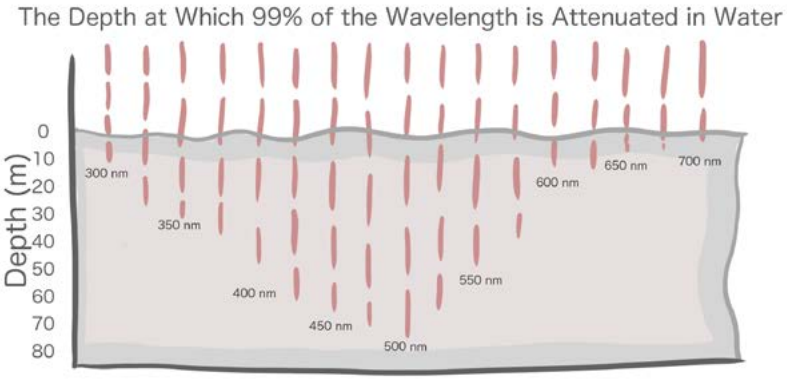
To get close to wildlife underwater, you want to stay relaxed. Move slowly and controlled; don't chase fish or other marine life, or you are likely to scare them off. Plus, your footage will look better if you pace yourself.

Avoid kicking up silt and dust from the bottom. It will get in front of the camera and make the water murky. There is nothing worse than thinking you have a great shot only to discover later that the cloud of dirt you just kicked up ruined the clarity of the image.

Colors and Light

Colors are different underwater than they are above. The intensity of certain colors like red and yellow diminish

quickly the deeper you dive. This graphic shows how different colors diminish with depth.



With increased depth, water absorbs color at different rates. Water absorbs red first causing video to appear more blue or green than you hoped. In clear tropical waters, blue remains the longest, and when you are diving in temperate waters, plankton and other particles create a strong green hue.

There are two easy ways to compensate for these color issues when underwater. The first one is to use a color filter on your camera, usually red. It will bring back some of the red in the image you are shooting, making it appear richer. The second option is to use underwater lights. If you are shooting in shallow water, or in clear tropical waters, you probably won't need them. Always make use of the natural sunlight. The deeper you go, the darker it will be. When you know you will be diving to depths where sunlight is limited, you will need to bring a few extra lights.

Equipment

The UW Camera Housing

The underwater housing for your camera is arguably the most important (and expensive) item

for underwater filmmaking. It is also the best investment you will make because it protects the camera from the hazardous elements of an underwater environment.

For the hundreds of cameras on the market there are relatively few underwater housings. If you don't already have a camera, you should first look for a quality housing and let that lead you to a camera. In other words, shop for housing first and camera second.

In general, camera housings are mechanical, digital, or a combination of the two. For instance, Amphibico housings are made to work digitally. They usually tap into a digital port on the camera. Many cameras, such as those made by Panasonic, don't have this port and can't be used in an Amphibico housing; they require a mechanical housing. Knowing the advantages and disadvantages of each setup will help you choose a camera that suits your needs and filmmaking style.

Mechanical Housings

At Untamed Science we have two different mechanical housings. Generally, they have buttons and pins that go through the hard casing to physically push buttons and turn switches on your camera. The benefit of a mechanical housing is that parts can be replaced if something breaks in the field. The buttons and switches have to be kept in good condition so they don't jam or get stuck, but you don't need to worry about electronics getting wet and ruining the electronic board. Gates and Ikelite are two manufacturers who make me-

chanical housings. There is a huge difference in the final price, but, oddly enough, we tend to like the resulting footage equally.

Digital Housings

Digital housings plug into a port on the camera and operate all the camera functions from digital controls on the housing. They are often constructed so that the buttons are in an ideal place for the diver to control in the underwater environment, usually where your thumbs would naturally grab the camera. This is a real plus. But be advised; an occasional failed circuit board can leave you stranded if you are in a remote location.

Amphibico housings work well with Sony cameras and are a great example of a quality digital housing.

Watertight bags are a less expensive option, but they tend to restrict your range of depth. In our experience, some tend to leak slightly when you dive below 15 feet or so.

Lights

When filming underwater, you can't just bring your dive light and expect to get good results. There are specialized underwater video lights designed to give a wide, even beam of light. There are three options.

1. HID (High-intensity Discharge) Lights

More and more underwater videographers are using HID lights with greater effect than conventional halogen lights. Traditionally, they have a much bluer light than halogens. However, their battery time is limited. HIDs also require large battery packs that mount to your light rig.

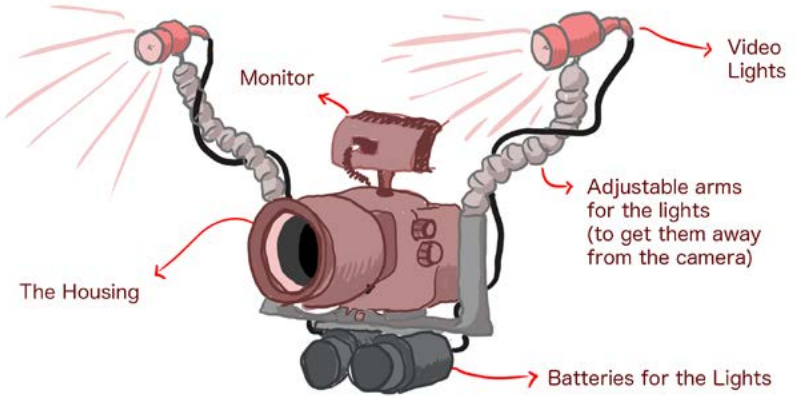
2. LEDs

More energy-efficient LEDs are also gaining popularity with deep water filmmakers. With greater battery life and the decent colors they produce, they are a reasonable alternative to HIDs.

3. Halogen

Small halogen lights are what most divers carry with them to see things at depth. But these lights cannot be used for video work, as they produce a concentrated and focused beam. If you want your video to look like daytime, you would have to get stronger halogen lights made specifically for use with video equipment.

You also want to consider how you are going to hold both the camera and the light or lights. Most divers use a mounting mechanism that attaches to the camera housing. Lights and mounting is are usually bought separately. If you are customizing your own lighting system, just remember that you will want to be able to adjust the lights underwater without much effort.



The Intricacies of Filming Underwater

White Balancing

To compensate for the change in the color of light at depth, you will need to adjust the white balance as you descend. Remember, white balance is basically the camera's way of calibrating what white is and all you have to do is hold down the camera's white balance button when shooting something that you know is white. You can improve the quality of your shots if you consistently adjust white balance as you descend to different depths. All you have to do is remember to bring a white slate. Experienced underwater cameramen may use white dive fins in order to achieve white balancing without hauling along extra equipment.

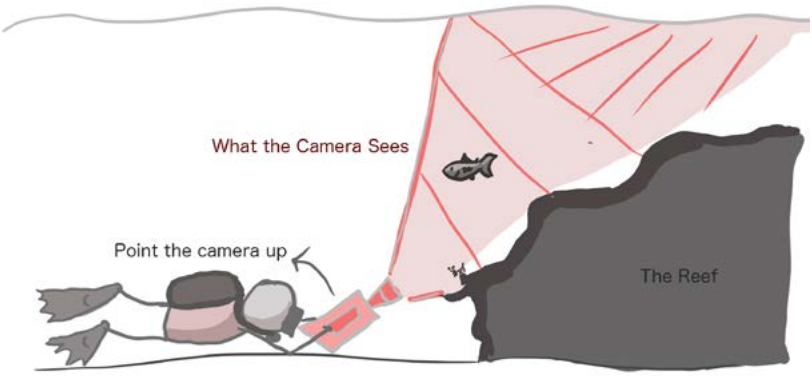
Focusing underwater

Most of the time, you'll want to turn off the auto-focus feature on your camera. The camera's auto focus features work by finding "edges" to focus on. If the camera pans up towards the end-

less, fuzzy blue of the ocean, the camera will start searching for a focus. At Untamed Science we avoid this by focusing on an object that is about 6 feet in front of us. If you're always shooting with a wide angle, (you're not zoomed in) while shooting, this puts almost everything in sharp focus. From here you can fine-tune the manual focus settings.

Think About the Angles

To make your underwater video feel more alive you'll need to consider the perspective of your shots. Novice underwater filmmakers tend to shoot the entire time from a diver's perspective: facing down. We encourage filmmakers to get as low as possible and shoot slightly up towards the surface. This creates some very cool effects from the sunlight coming down and illustrates the perspective of an underwater creature.



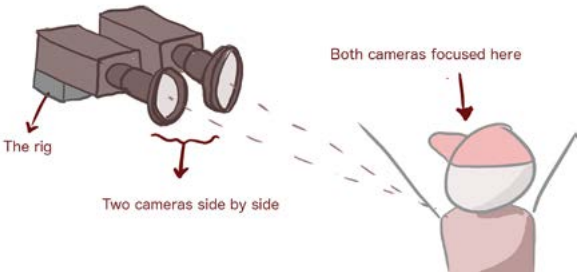
Stable Shots

If you have a cleared area where you can set the camera down without damaging anything, you could stabilize the camera for a steady shot. Do this by diving with soft dive

weights on a weight belt. Then set the weights on the camera at depth. Traditional tripods are difficult to use underwater, especially with a large heavy underwater housing.

Now that you understand some of the basics of underwater filmmaking, have fun and experiment with your own creative style. Jacques Cousteau did not become the world's preeminent underwater explorer by doing everything according to a book.

R.2 The Basics of 3D

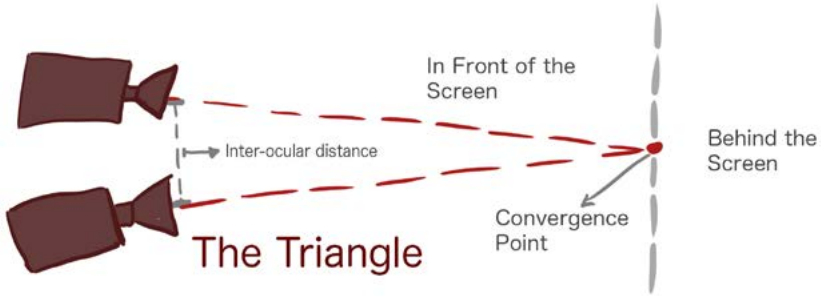


Since about 2007, 3D filmmaking has become more of an interest for the general wildlife filmmaker. And 3D filmmaking is not nearly as complicated as it might sound initially. All you need is two cameras of the same model, shooting side by side. In post-production, you can sync the two shots together with a simple plug-in or two that allow you to export the file as a 3D render. Here are the main steps.

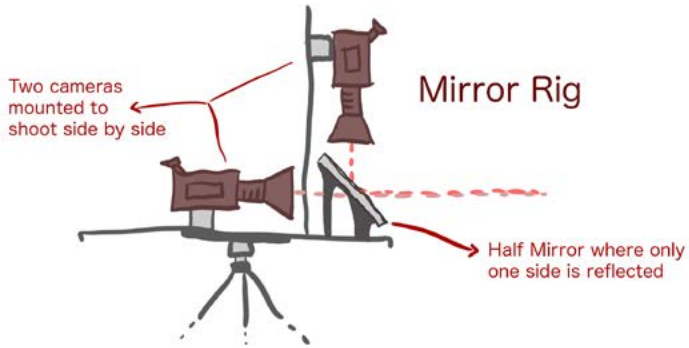
Setting the cameras

There are a couple of arrangements you can use to set up your cameras for 3D video, but the end result is the

same. You're trying to set the cameras at the ends of an isosceles triangle. The distance between the two cameras and the angle they then need to point all depends on how far away the object is that you want to pull out of the 3D frame.



The first thing you have to adjust is how far the cameras are apart. This is known as the interocular distance. Roughly, you're looking for a 30:1 ratio. If your object is 30 feet away, you can have your cameras 1 foot apart. That should allow you to set two cameras up side by side. However, if your object is 2.5 feet away, then you need to have the center of the cameras only an inch apart. To achieve this, filmmakers use big mirror rigs, so that one camera is shooting down into the mirror, and the other is shooting through the lens.



The second thing you have to adjust is the angle of the cameras. The cameras can't both face the same parallel angle. Instead they are going to have to angle in towards the object you're trying to bring out in 3D. Again, think about the triangle.

Editing the footage

In the editing phase you'll bring in footage from both cameras. This can be done in Final Cut Pro or Adobe Premiere with the help of programs like Stereoscopic 3D or Cineform neo3D. These programs and plug-ins allow you to sync the right and left cameras into one single clip and choose a 3D output mode. YouTube has made it even easier by doing it all for you. All you need to do is export the right and left cameras side by side and YouTube converts it into all 3D formats. Then viewers can decide what version they want, depending on their setup (red-green glasses, blue-green glasses, polarized glasses, etc.).

Popular 3D Wildlife Films

A good place to start your quest in 3D wildlife filmmaking is to research what has been done before. Almost everything done in 3D has had a huge budget (though this is changing). The cameras are large and heavy, giving the shots a particular look. There is little dynamic movement and almost no hand-held work.

Here is a list of some popular 3D wildlife films in the last decade:

- *Bugs 3D*
- *Wild Ocean*
- *Born to be Wild 3D*

- *Under the Sea IMAX 3D*
- *Deep Sea 3D*
- *Into the Deep 3D*
- *Flying Monsters 3D*
- *To the Arctic 3D*
- *Tornado Alley 3D*

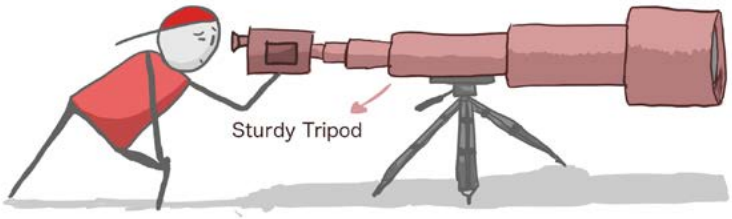
3D Filmmaking on a 2D Budget

The following consumer cameras have been released to the market (as of 2014) as inexpensive 3D devices so that filmmakers can shoot in three dimensions on a small budget. We understand these cameras will change with time, but the list should help you realize there are a lot of options out there.

- Fujifilm FinePix REAL 3D W3 1
- Sony Cybershot
- Panasonic Lumix 3D
- GoPro Hero 3D rig
- Olympus SP

While we haven't explained all of the details of 3D filmmaking here, we wanted mainly to emphasize that it's not as hard as it seems. To explore 3D further, do a simple YouTube search for DIY 3D filmmaking. You'll find examples of how to setup simple cameras and how to render the final video in post-production. 3D filmmaking is finally within reach for the aspiring filmmaker...and the market is just begging for content.

R.3 Shooting with a Long Lens



If you've ever dreamt of filming snow leopards or capturing an amazing lion kill, you may wonder what equipment you need to capture footage of distant animals? We'll cover the camera, the tripod, and the lenses needed to start this type of story.

Of course, you *want* to get as close to the subject as possible. But in the interest of safety and not disturbing the subject, you also need a steady camera with a long lens to help get closer than you can be physically.

Cameras

Generally, the more expensive the camera, the better the lens will be able to zoom to far off distances. But even high-end cameras are built for different purposes. Most cameras are built to be generalist, allowing for everything from macro- to telephoto photography. If your goal as a filmmaker is to capture extreme telephoto shots, it's important to find a camera that will allow you to change lenses.

Lenses

When considering lens quality, the key features are good glass that will allow the most light to come in and mini-

mum to no distortion of the image. One of the best indicators of the quality of the lens is the f-value. Cheaper lenses will generally only allow enough light to get an f-value of f 1/5.6 or so. The larger the f-value the better prime lenses (lenses that don't zoom) might get down to f 1/1.1. Telephoto lenses, by their very nature, are difficult to get a good, low, f-value. The best ones have giant optics, like the ones you're likely to see the media use in the end-zone of a football game.

Aperture and F-Value

Lenses with large apertures are the best. The aperture relates to the amount of light you can let in. F22 (small aperture) is shorthand for f 1/22 (a small f-value). F1.2 (a large aperture) is shorthand for f 1/1.2 (a small f-value). Technically, the f-value indicates the size of the aperture. Sometimes people will simply say they have a lens with f4, f1.4, etc. They drop the fraction. (It may get confusing, and there is no easy way around it.)

We recommend buying at least one high-quality telephoto lens to get started. You can get by on the lower quality zoom lenses. As you progress, you'll really notice the difference.

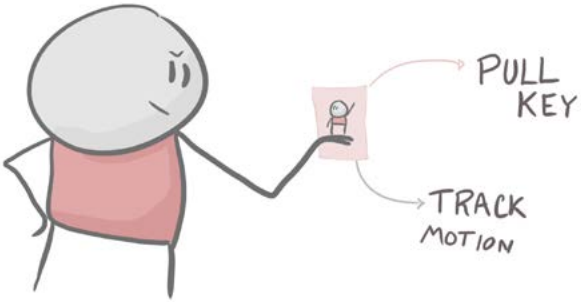
Tripods

The further you zoom the camera, the more a small shake in the camera is amplified. In fact, a light breeze, as subtle as it might seem, can wreck a shot. Thus, the quality of the tripod is extremely important. Unfortunately for would-be remote filmmakers, the best tripods for long-lens filmmaking are also extremely heavy. The heavier and more sturdy the tripod, the more stable the shot is going to be.

The minimum quality tripod that a wildlife filmmaker will need to purchase will cost about 500 USD. Very nice systems for higher-end cameras start around 2000 USD. This includes collapsible legs and a fluid head. The head, where the camera is mounted, is the most important piece. Quality fluid heads allow steady movement in panning shots across the horizon, perhaps following a soaring eagle in the sky or tracking a lion across the savanna. Make sure the legs are designed for field shoots; many are designed for studio shots, where the ground is always level.

For more information specifically about tripods, read reviews from B&H Photo.

R.4 Animation for Science Docs



Science and natural history films are designed to explain natural phenomena on Earth. Recently these documentaries have started to include more animations to tell a story quickly and graphically, in ways that standard footage can't.

Animations can also be used to add humor to an otherwise heavy topic. Take *An Inconvenient Truth,* for example. It used a *Simpsons*-esque animation to explain how the sun's rays work in relation to our atmosphere and greenhouse gases.

We feel strongly that animations are a great tool for the science filmmaker and something that everyone should learn. You don't have to be a master; there are several simple techniques/programs that you can use to start. We'll highlight the ones we have had the most success with and that seem to be the most commonly used.

The Basics

The first thing to learn is a basic photo-imaging tool, such as Photoshop. Knowing this program will allow you to change aspects of your video in post-production. You may want to change the name on a sign, animate a still image, or show a simple graph. It's the most basic tool and the building block for complex animations.

The second basic editing tool is a motion-graphics package. Most editors we work with use Adobe After Effects. It is the workhorse for most motion graphics and will likely remain that way for some time to come. You can manipulate images in 2D or 3D. But if you're going to start doing a lot of 3D animating, you may want to consider some of the other programs we suggest in that field (see Chapter 8.2).

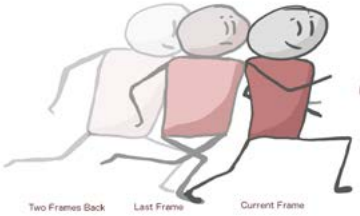
Stop-Motion Animation

One of the simplest way to create an animation is by taking photographs in a sequence, a process called stop-motion. Often we'll get approached by filmmakers who have never done any form of animation but want to use it to explain a concept. This may involve setting a camera toward a white board and snapping photos as you draw, or setting up clay figures like *Wallace and Gromit*.

Fortunately, you can actually get programs that help with the process. They allow you to see how the animation will look as you're building the sequence.

Programs

One of the best programs for the amateur stop-motion artist is iStopMotion by Boinx. It allows you to preview the animation as you create it. It also allows you to do onion-skinning, a technique that shows you the previous frames screened over the frame you're about to capture. It makes the entire process much easier.



Onion skinning shows past frames

2D Animation

Most of Disney's animations are done by traditional 2D animation techniques, where each plate is painstakingly drawn by the animators. Today, computers allow animators to speed up the process with digital format. The computer can create the in-between motion when we want a graphic to move across the frame. Flash and After Effects are the main programs that achieve this .

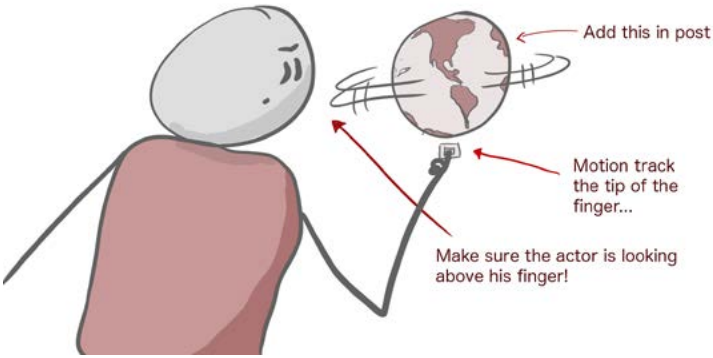
Flash Animation

Adobe Flash is a perfect tool for animators working on the web, but it's also ideal for broadcast production.

Flash allows the user to create movies within movies. For instance, we could create a Flash clip of waves going up and down to place behind a fish we want to animate.

Adobe After Effects

Adobe After Effects (AE) is the mainstay for animators and editors in the industry. Often, a Flash animation will be exported then composited in AE. Graphics and text can be given motion, and objects can be tracked to a specific reference point. For instance, one thing we've done in a few of our series is have the host hold out their finger. We then animate a spinning Earth on top of it. The hosts can then talk about the mini-Earth while explaining the science. Few other programs can do this as easily as AE.



3D Animation

Many 2D animations attempt to give the reality of a 3D world. When we talk about 3D animation, we usually refer to animations that were created by moving a camera around a three-dimensional object to give a perfect repre-

sentation of the model. For certain applications, rendering something in a 3D world saves a lot of time.

Let's say we want to animate a molecule of water by having the molecule spin. Animating this in a 2D space would require us to create images for every frame of the spin then cycle those images together to create the illusion of a 3D environment. With a 3D editing program, we simply model three spheres into the shape of a water molecule, and tell the molecules to spin for any length of time we desire. The computer renders the in-between images perfectly. There are several programs on the market for 3D animation, including Blender, Maya, Lightwave, 3d Max, Vue, and Google Sketchup.

Expert Science Animator, Keren Albala

From 2009 to 2013, Untamed Science collaborated with science animator Keren Albala. While we do many of our own animations in house, Keren is really an expert in the field of science animation. We asked her a series of questions about the topic, which we think you'll find extremely useful.

How did you get into science animation?

I got started doing science animation while getting my animation MFA at USC. I was very lucky to be surrounded by faculty that encouraged interdisciplinary work. The natural world has always been my biggest artistic inspiration, so when an internship was created between my department and USC's Wrigley Institute for Environmental Studies I jumped at the chance to apply. It was an amazing experience; I learned so much about both animation and science, and I've continued seeking out opportunities to combine the two.

What programs do you use?

As for what I use to make things, I employ a wide range of 2D and 3D animation software, and often photo-, sound-, and video-editing software. I choose whatever is best suited for each project; sometimes it's plain old ink and paper.

What advice do you have for those trying to get into science animation work?

My advice for those trying to get into science animation work would be to tap into the local resources available to you. There are many schools now that have science tracks within their animation, visual effects, film, or illustration departments, or that would allow students to collaborate with scientists in other departments. Make friends with folks doing interesting research and see if there are ways for you to participate. There are also many guilds, meet-ups, and online collectives for scientific artists, as well as classes being taught at local colleges and museums. Just ask my best friend, the Internet!

What advice do you have for filmmakers looking for science animators?

If you are looking for science animators, my advice would be similar. Check with schools and museums, and there are now quite a few commercial studios specializing in scientific and educational animation. Again, the Internet is a terrific resource. Learn more about Keren's work or inquire about working with her at kerenalbala.com.

Blender

Blender is an open source 3D content creation suite that is available for most operating systems. The best thing about Blender is that it's free. If you're new to 3D animation, this program allows you to hop in and try it without the expense.

Vue

If you're looking to create mostly landscapes, Vue is the program for you. It can produce photo-realistic environments very quickly. Many of Avatar's scenes were created in Vue.

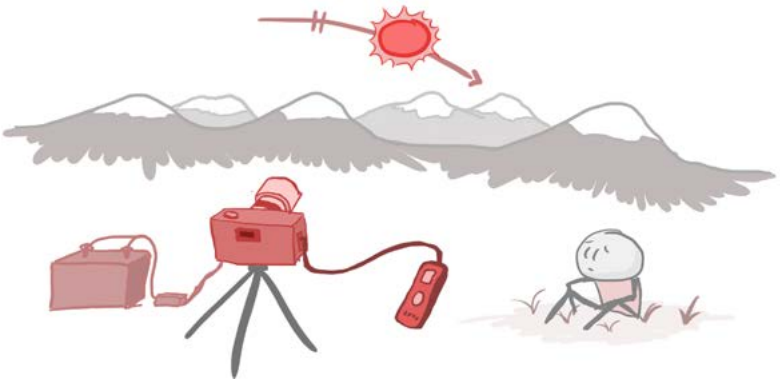
Maya

Maya is by far the gorilla of 3D animation software. It is the program of choice for animators in many big production houses. Many colleges teach courses in Maya (including one that I took). There is a trial version to test it out. It's not difficult to learn, but from experience, it might take a good month of tutorials to get to where you want to be when producing basic science animations. Most Untamed Science animators, in-house and contracted, use this program

Google Sketchup

For quick animation work Google has an easy to use program called Sketchup. It's a program that architects have been using for a long time. Building static houses and moving around them is really easy. Plus, a simple Google search will pull up free, premade 3D graphics from thousands of users around the web.

R.5 Time-Lapse



Time-lapse photography is the opposite of slow-motion; you capture a bunch of photos of the same thing over a period of time then play them back in sequence in a shorter amount of time. It is a favorite technique here at Untamed Science; if done properly, it can look beautiful and tell a great story. We've taken well over 500 time-lapses and made a lot of mistakes. Here are techniques to avoid the pitfalls we've run into over the years.

Find a Camera with Interval Recording

The first camera we used to take time-lapses was a standard video camera with interval recording. Many camcorders today have the ability to change the rate of recording. When you're shooting a time-lapse you are doing what's called **under-cranking** (the term comes from when film cameras were hand-cranked). The camera we've used most is the Panasonic HVX200. This fully digital video camera helped revolutionize the way video media was captured. With this camera you can change the frame rate in the menu to take a single frame anywhere from once every 16 frames to once every 10 minutes. This

method worked amazingly well for short time-lapses. The only problems came when the length of the time-lapses exceeded the length of battery life. If you don't have a power source for the camera and lose power even briefly, you can lose the entire sequence. This can be problematic with longer time-lapses like growing plants, so, for long sequences, we use digital still cameras.

Digital SLRs

Our favorite method of shooting time-lapses is with a digital SLR hooked up a remote trigger. We currently have a Canon 5D Mark III hooked up with a matching Canon Remote.

Point-and-Shoot Cameras

There are several point-and-shoot cameras on the market today that have intervalometers built in which count intervals for you and simplify the process. But you'll need to become familiar with manipulating the camera's manual functions.

Our suggestion for point-and-shoot time-lapse cameras is the Canon SD4000. It is a compact camera that shoots HD video (which you don't use for time-lapses) and has a built-in intervalometer.

Web Cameras

Believe it or not, you can actually take a decent time-lapse with a simple desktop web camera. Classroom teachers will love this setup. Using a program like Boinx iStopMotion, which allows you to plug in a huge variety of cameras into your computer and program them, you could

time-lapse a plant on the desk next to your computer or do claymations.

Things to Think About

Use a Tripod

The fact that you need a solid, stable tripod might seem obvious, but it's often overlooked. Flimsy tripods tend to shake slightly, even with a small amount of wind, causing a jitter in the final video. To secure the camera, weigh the tripod down by hanging a backpack under the main head. This small amount of weight goes a long way in stabilizing the shots.

If you don't have a tripod, you can set the camera on the ground or on a camera bean bag. It's a bit trickier to get the right framing, but it can work. Generally, hand-holding a camera does not lead to great results.

Set the interval according to your subject

Clouds look great in time-lapse. I like to shoot clouds at either one frame every two seconds or one frame every 5 seconds. The two second interval is great for fast-moving cumulus clouds. I use the longer frame-rate for cirrus clouds, but even that is often not fast enough. Fortunately, you can speed it up in post-production.

Plants can really come to life when you use time-lapse to capture their growth. I use one frame every 10 minutes for most plants. This seems to work well for growing seedlings.

Stars are fun to shoot but require more advanced time-lapse skills. First, you need to have a camera that will let you keep the aperture open as long as possible. I set

my camera manually to stay open for about 45 seconds (I do this on the intervalometer while the camera is set to bulb mode). Too much longer blurs the stars and shorter doesn't allow for enough light. Then, I set the interval at three to five seconds longer than the camera is open, maybe 50-second intervals. The camera is basically only taking very short breaks in a much longer time-lapse. The results are fantastic if you're patient!

Pregnancy is one of the longest time-lapses I've taken. It was about an 8-month project and required keeping the camera as still as possible. My problem was that I travel a lot, and my camera had to come with me. I found a way to mount the camera on the wall so that my wife and I could get pictures once a day for the entire pregnancy. Sometimes we missed days, but it didn't matter so much.

The other thing I love taking in time-lapse are **people in motion**. You might even consider this a form of stop-motion. I set the camera so that I can move between intervals, about two seconds. If you go longer, it makes the process extremely tedious. If you're close enough to hear the camera taking pictures, you can move in-between shots.

Exposure and ISO

For the most part you want to lock the ISO and exposure settings on the camera. If your camera is automatically determining the exposure at any given time, it may cause noticeable differences in each frame, creating an unwanted flicker effect.

The only time you need the camera to automatically adjust exposure (and other manual settings) is if you're trying to capture the transition from day to night on a clear

day. This should be a fairly smooth transition for the camera to make.

Fancy Stuff

The Panning/Dolly Time-lapse

There are few things cooler than a moving time-lapse. The BBC employed this technique in their *Planet Earth* series with stunning results. It requires a bit of fancy machinery. Basically, you need a long dolly hooked up to an intervalometer. We've attempted to build this myself and failed miserably, but Dynamic Perception sells great time-lapse dollies.

Tilt-shift: Making your scene look like a miniature

A new, artsy technique in time-lapse is tilt shift, which makes the scene look miniature. It basically adds a blur to the video so that it seems as though there is a shallow depth of field. This effect happens naturally when you shoot small things because its hard for large lenses to get everything in focus. While you can achieve it with several programs, Boinx software's iStopMotion allows you to quickly add this filter to your time-lapses.

Putting it all together

Using Quicktime player

One of the easiest ways we've found to create time-lapse sequences out of still photos is in Quicktime 7 Pro. Use the "Open Image Sequence" command under "File." It ends up being really easy to do, and you can export video as large as you like. We generally choose Apple ProRes 1080p and save the raw files to make larger quality movies in the future.

Using After Effects

Creating a time-lapse using After Effects (AE) allows you to have more control over the final output. You can apply filters, pan across a large picture, and manipulate individual frames, if needed.

R.6 Macro Video

Macro filmmaking is the art of taking video of very small things. Filmmakers that come from a photography background will quickly learn the basics if they've spent any time studying or shooting macro photographs; macro video is basically an extension of macro photography with only a few differences. The main difference is in light acquisition. You need a lot of light to take a macro photograph, with big strobes. It's extremely difficult to get the same amount of light constantly on a small subject. You also have to be very steady. A photograph can be taken hand-held, but a video cannot.

Purists will explain that you can't shoot macro unless you're able to reproduce the image 1:1. But thanks to new technology, the resolution of photographs and video are high enough to work around that.

In our search for reference material, we found that the Internet is full of very bad information on how to shoot

macro video. There is spectacular video footage, but few that have summarized the best cameras and techniques for the job. This is where we come in.

Things to think about

Depth of Field

The first major obstacle in shooting macro video is that the depth of field becomes extremely small. For example, you may get only part of an insect's eye in focus. While this can be a great effect, it may not be your intended result. The aim is to get the largest depth of field possible at a small scale. To keep the animal in focus you have to be creative with light and composition.

How do you increase the depth of field? Decrease the aperture (the size of the opening in the lens) by increasing the f value as seen on your camera. For example, f22 is more desirable than f1.4. Small apertures mean you're shooting through a pinhole. This increases the depth of field but means you'll need a lot of light!

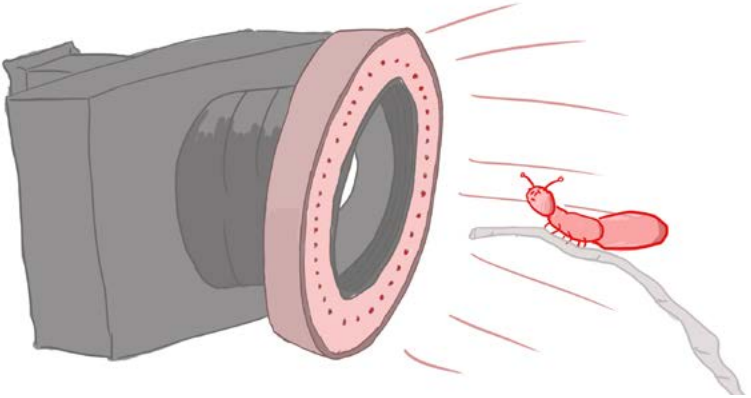
Lighting

Light is extremely important in macro video work when you're trying to get the largest depth of field.

Amount of light: The subject should have as much light as possible on it. It's not always possible to get the maximum intensity. We did a shoot once on tiny, endangered snails that couldn't be exposed to the heat produced by intense halogen light. We had to get creative with that shoot by changing our light type to a cooler LED.

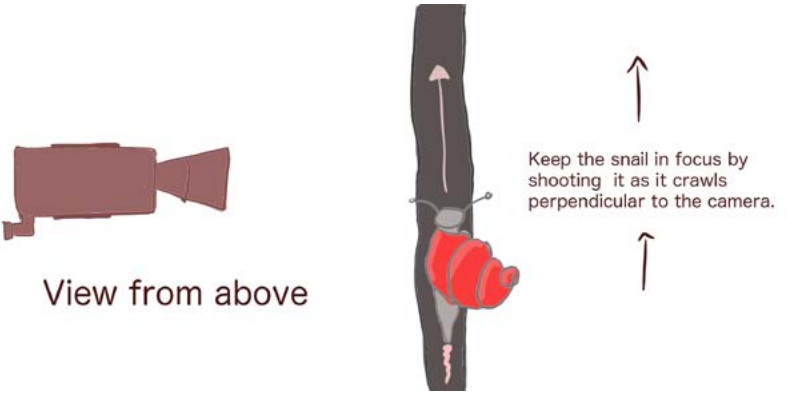
Type of light: While many shots might demand direct, contrasty light, we like diffuse lighting. A great way to get diffuse lighting is to construct a paper cone around your subject and direct the light evenly toward the paper. Doing this will decrease the glare that shiny objects might reflect.

Direction of light: Macro video is taken extremely close to the subject, so much so that the camera may get in the way of the incoming light. To get around this we suggest using a ring of LED lights around the lens.



Composition

The composition of your macro video is extremely important when you are working against your shallow focus and trying to angle the animal to maximize the area in focus. For example, you might choose to shoot a snail as it's crawling perpendicular to the camera. so that it always remains in focus. If it was crawling toward you, chances are that only part of the snail would be in focus at any given time.



Backgrounds

For the most part when you shoot macro video, the background will be blurred. However, the color of your background will be seen, so try to choose a color that offsets or compliments the color of your composition.

Using a Tripod

While it isn't necessary to use a tripod when you're doing macro-photography stills, you will need a tripod for video to stabilize your shot and make it look professional.

Focus

Most of the time, you should focus on the eyes of the organism, because the eyes are what humans tend to look at first when we look at an animal. When you're shooting flowers, you'll probably want the center of the flower in focus, but then again, it all depends on what you're highlighting.

Finding a Camera

By the time you read this, these camera choices may already be outdated. However, we present a few to help you get started in your research. Often, camera companies pride themselves on particular line of camera models that shoots great macro (like COOLPIX).

Point and Shoot Cameras

There are several cameras on the market that shoot great macro photographs and HD video. The quality of the macro video on many of these models is mind-blowing, considering what you needed 10 years ago for the same shots. Here are our top four picks.

- **Nikon COOLPIX L120:** The COOLPIX has always had a stellar macro function. It used to hook up to microscope eyepieces. You are able to focus on subjects one centimeter away with this small little camera.
- **Panasonic Lumix DMC-LX3 with Raynox MSN-202 lens**: The addition of the Raynox is what makes this package appealing for macro.
- **Canon SX20 IS with Raynox 150 lens** Again the addition of the Raynox lens is the key.
- **Panasonic Lumix FZ38 with LC55 Close-up lens**: This is a stellar combination.

Note that I added specific camera models here to give you a starting point. These cameras will be well outdated by the release of this book. A simple search will help you figure out the most updated model of each of these.

DSLR Cameras

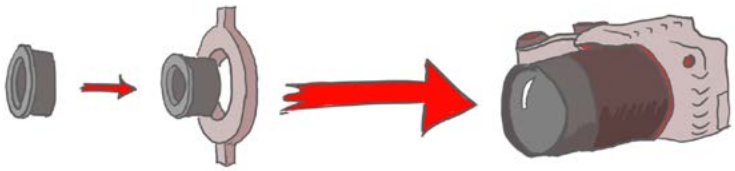
A digital SLR camera with a great macro lens is another option to consider. For Canon users, these are our favorite three lenses:

- 180 mm macro
- 100 mm macro
- 65 mm MP-E

Alternatively, you can add an extension tube, which essentially halves the focal distance and doubles the size of your image. The downside, though, is that it decreases the depth of field.

Extra lenses

There are lots of great cameras that can take macro video if you get a macro lens adapter. The Raynox DCR-250, for example, can be added to many cameras.



Camcorders

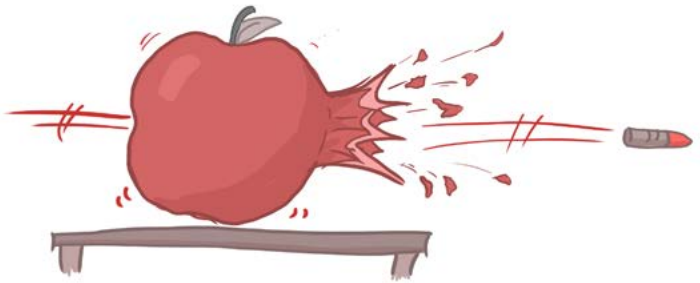
Traditionally, camcorders have the ability to do macro video as well. Here is a selection:

- Panasonic sells the TM700 for around 1000 USD.
- The Panasonic 2100, is a high-end, shoulder-mounted camera that can be used to shoot macro video.

Underwater macro

This type of macro video is tricky because you have to protect the housing from the conditions; you can attach an extra wet-mount lens (which you can do while in the water). We've seen success with the INON UFL-MR130 EFS60 Underwater Micro Semi-Fisheye Relay Lens.

R.7 High-speed/Slow Motion



The filmmaking term for shooting slow-motion video (or high-speed video) is over-cranking. You're basically shooting at a high frame rate. Playing it back at 30 frames per second makes it look like it's in slow motion. Technology has progressed a lot since the days of film, and the realm of high-speed filmmaking has taken on new dimensions; there are a wide range of options for everyone from the broadcast professional to the hobbyist.

An Example

One of my favorite shows that use high-speed filmmaking is the Discovery channel show "Time-Warp." The show often takes a behind-the-scenes look at some of the many things you can slow down. For an episode on water, they used the setup of still photographer Martin Waugh of

Liquid Sculpture (liquidsculpture.com) and showed him what they can do with high-speed video. The results are amazing!

Professional High-end Equipment

The key to getting amazing high-speed video is using a high-quality camera that can take extremely fast pictures. Just as in macro video, you'll also need a lot of light. However, while macro video needed increased light so that it could decrease the aperture size (giving a high depth of field), now we need to decrease the shutter speed so that we can take thousands of frames per second.

There are two major groups of high-speed cameras. The first are those designed for industrial purposes. Vision Research (visionresearch.com) has a wide range of models that can be used for all sorts of applications, such as analyzing automotive crashes and examining NASA launches. The second application of high-speed cameras is for broadcast purposes. Unless you plan to use these cameras every day, you'll probably want to rent one. Plan to budget anywhere from 1000 to 3000 USD per day, including a technician to help operate it.

Here are some options:

Photron cameras SA1, SA3 and Fastcam BC2

Photron makes several cameras, such as the SA1 (used for Timewarp), SA3, SA5, and the Fastcam BC2. They are about 1000 to 2000 USD to rent by the day and about 100,000 USD to buy. These cameras are capable of filming a bullet coming out of a gun or a water balloon popping at 20,000

frames per second (fps). The exact specs on these sorts of cameras change from year to year, so we'll leave finding out the specifics to your Google searches.

Phantom Flex

The Phantom Flex is Vision Research's top-of-the-line camera. It seems to have slightly slower high-speed shooting than the Photron cameras but are still a top of the line slow-motion camera manufacturer.

Entry-level Equipment

For those that would like to add a high-speed shot into their films without the expense, there are a few entry-level high-speed cameras that we've found many YouTube filmmakers using. For example:

Casio High-Speed EX-f1

This camera is fairly prosumer with a price tag of around 2800 USD. The real benefit of this camera is quality high-speed recording on a tiny camera. Users can select a recording speed of 300 fps, 600 fps, or 1200 fps. Resolution drops with the highest frame rates as follows: 512 x 384 (300 fps), 432 x 192 (600 fps), 336 x 96 (1200 fps).

Casio High-Speed Exilim EX-FC100

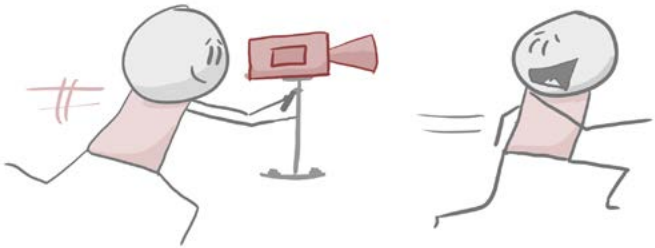
On the affordable end of the spectrum is the Casio High-Speed Exilim EX-FC100. The image quality isn't great, but at less than 300 USD you can hardly beat it. The best features are that it shoots

210 fps and one-second 30 fps (at 6 megapix) burst mode. In very low resolution, it will shoot 1000 fps.

Sony FS700 series

With a purchase price of about 8000 USD, the Sony FS700 is a bit more of a prosumer slow-motion camera. It shoots up to 900 fps at 1920x1080 HD though. It's a great camera for mixed shooting as it can also serve as your main camera on a shoot.

R.8 Moving Shots: Cranes and Dollies



Though most viewers don't notice, one of the techniques that sets high-budget films apart from the rest is that many of the shots are moving. The movement isn't just panning on a tripod; it is a steady physical movement of the camera up, down, or through the action being recorded. Even lower budget films can simulate the look of high-priced features by including these dynamic shots.

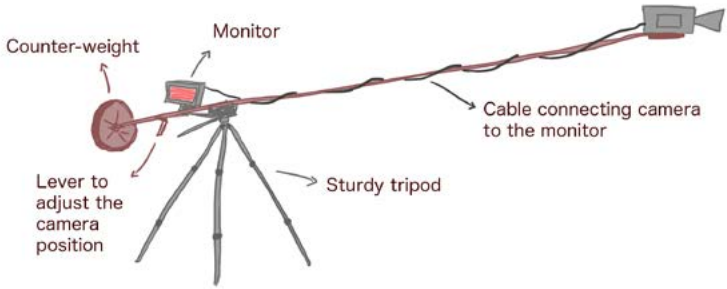
In filmmaking, camera movements are often referred to as dollies or dollying the camera. Dolly shots can be set up on rails or cables. Sometimes similar movement is accomplished through the use of cranes or jibs. Filmmak-

ers can also use simple steady cams to stabilize handheld camera movement.

Here we'll show you some very basic setups that can make a low-budget film look like a multi-million dollar feature.

Cranes

A crane extends a camera on the end of a long pole with a counterweight on the opposite side. This setup allow smooth movement of the camera up, down, left, and right.



Very small cranes can be attached to a tripod head and moved freely in all directions. The simplest crane we've found is the CobraCrane setup. For around 350 USD you can get a stellar rig that you mount to your tripod for some amazing shots! They use standard weight-set weights and can be broken down to fit inside your luggage or car. Like most camera-movement gear, you'll need some practice to get dynamic shots.

One thing that will help you capture quality crane shots is being able to clearly see what the camera is shooting. You can either watch the LCD screen on your camera or rig up a small LCD monitor on your tripod that's wired to your camera. A separate LCD monitor allows you to stay focused

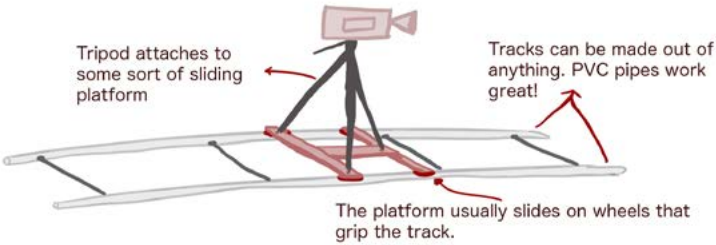
on your camera movement relative to the action that you're trying to capture. You may also want to consider some of the tripod-mounted wired camera control devices that allow you to focus, record, and zoom remotely for greater control. VariZoom offers various options. The cheaper solution is to mount your camera remote control with Velcro to your tripod so you are able to start and stop recording without dashing up to the camera on the other end of the crane.

What makes crane shots grab your attention is the camera moving past objects that are both near and far from the camera. It greatly increases the feeling of motion and perspective.

Dollies

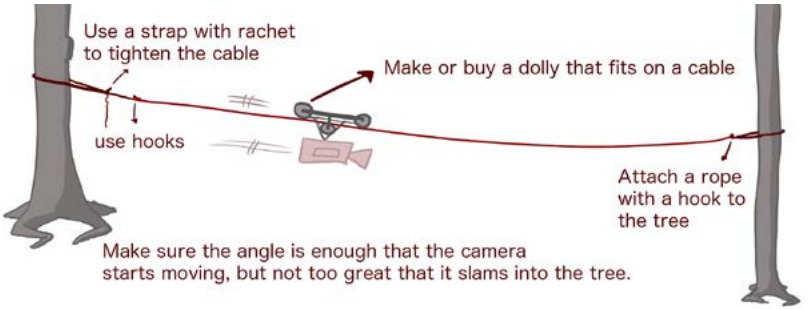
A dolly shot is where the camera is mounted to wheels on a platform and tracks movement left to right or forward to backward. Here a few ways to make a beautiful and steady dolly move for your videos.

Standard dollies



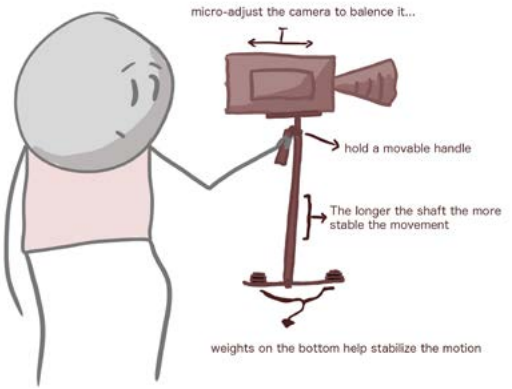
The simplest dolly shot can be created on flat, level floors with someone pushing the camera person in a wheeled chair. Skateboards work for the same purpose. However, if you want to increase the steadiness, you're going to need some sort of dolly setup. Again, we like CobraCrane's stock.

Cable dollies



Cable dollies consist of a single rope or wire connected by two points. The camera is then mounted to a device that can move along the dolly. (Just don't make the angle of the cable too steep or your camera will fly at dangerous speeds and end up destroyed at the far end! Make sure to test your setup with one person at each end of the cable.)

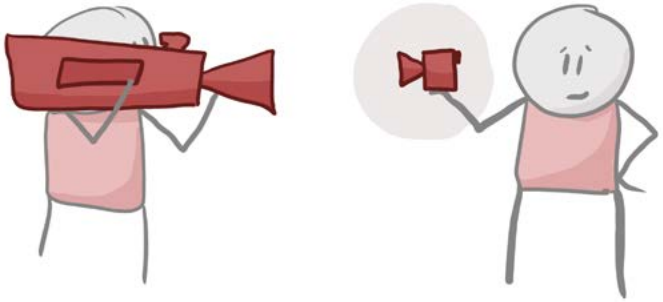
Camera-stabilization systems



"Steadicam" is a brand name that has come to refer to any number of camera-stabilization systems (like calling all facial tissues "Kleenex"). There are several ways to stabilize handheld camera movements. Most of them require

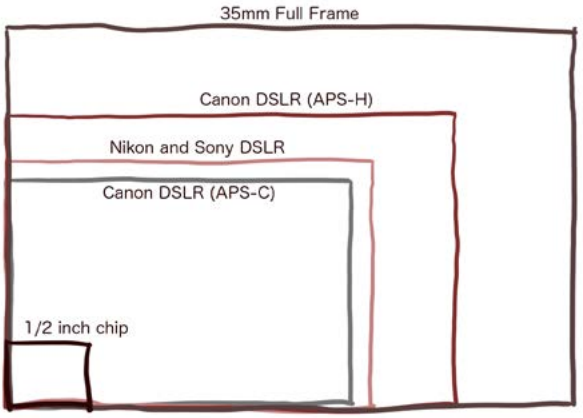
adding a small bit of weight to the camera, usually off of an extension below the camera.

R.9 DSLRs



Why DSLR's are Revolutionary

Filmmakers often say DSLR filmmaking is as revolutionary as the invention of color or 16mm film because it represents a huge leap forward in the quality of the image. Basically, a DSLR has a monstrous image sensor compared to the cameras filmmakers were using previously, about 20 to 30 times larger than that of the standard prosumer camcorder. Here is a relative size comparison:



(We included the 1/2 inch sensor size of the $9000 Sony EX1 so that you can get a feel for how much larger it really is.)

So what does this achieve? These are the main benefits.

- **Shallow Depth of Field:** For a professional-looking shot, the goal is to get the subject in focus while the background objects are blurred. This draws attention to the primary subject.
- **Greater Dynamic Range:** When shooting in high-contrast light conditions, such as a sunny day under a half-shaded forest, you'll want the bright spots and the shady spots to have resolution and clarity. The greater the dynamic range, the more detail you'll be able to see in all brightness levels. 35mm film has always had one of the greatest dynamic ranges; DSLR cameras are catching up.
- **Great Low-light Sensitivity:** If the sensor is larger, it's going to register the incoming light better. After using an older camera to shoot indoors, filmmakers are amazed at how little light you need to shoot quality video with a DSLR. Most of the time you don't even need extra light in indoor situations.

Making a Film with DSLR

Again, while a DSLR was never intended to be a movie-making device, the revolutionary quality of its video at an affordable price make it worthwhile for filmmakers to use them with some creative workarounds, mainly in the audio department. For those filmmakers that use separate audio recorders, like Zooms, Tascam's or Marantz's, the workflow is much the same. Here are a few points to think about when shooting with a DSLR.

Get an external microphone that can plug into your camera (using a mini-plug) or make sure to use an external audio recorder with a high-quality microphone.

Bring a set of quality lenses for the camera. Prime lenses are the best quality for video. Image-stabilized lenses also greatly increase quality.

Bring tripods, shoulder-mounts, or dollies to help stabilize the shots. These cameras are small and prone to jiggle.

Try not to shoot while rapidly moving the camera. Because of the way the images are scanned, moving the camera quickly could make it look like the shot is wobbling.

The Benefits to Wildlife Filmmakers

When shooting wildlife, you may not always be in an ideal scenario. Perhaps you're in a dark and shady forest or you're far off in the arctic where the conditions make it challenging to stay alive, let alone lug around a heavy camera. Sometimes you're in a third-world country where pulling out a giant camera brings a lot of unwanted attention your way. In these scenarios, a small, inconspicuous, lightweight, light-sensitive DSLR is the way to go.

Getting shots in the understory of a rainforest is one of our new favorite things. Before, we needed to bring lights with us to shoot frogs or millipedes that were crawling on the forest floor. Now, as long as there is some small amount of light, there is absolutely no problem shooting these shots *au naturale*. It saves us from carrying a lot of extra weight into the jungle.

The lightweight factor can't be emphasized enough. It's a breeze to bring the camera on exploratory walks. If you see something that is worthy of a good video shot, you can pull out the camera and capture it.

Finally, it is great to have diverse lens options. You can put on a fisheye lens to get a point of view shot or you can attach an extreme telephoto lens to capture some amazing animal behavior.

The Negatives of DSLR Filmmaking

The ultimate negative of the DSLR is a lack of audio functionality. The audio inputs on the camera are substandard for a broadcast. But we've mentioned ways to overcome this. Plus, the industry is slowly coming out with great hybrid cameras - a DSLR sensor with the full audio capabilities of normal filmmaking cameras.

To see sample videos demonstrating these advanced techniques, visit:

untamedscience.com/advanced-filmmaking

A Farewell Message

We've shared the knowledge we have in a way that we hope gets you started on your filmmaking path. Maybe you picked up a thing or two. We also want this book to help advance the field of science and natural history filmmaking.

As a final note (and shameless plug for our site), remember that we keep the most up-to-date, specific filmmaking information on our website, UntamedScience.com. If you worry that any of the information seems outdated, visit us online for the newest stuff.

Thanks for sharing in this journey. Have fun making your films!

About the Authors

Rob Nelson

Dan Bertalan

Rob and Dan currently help run Untamed Science, a non-profit company dedicated to creating short science videos. Combined they have created more than 500 short films. Dan started his career as a geologist and turned to filmmaking 15 years ago. Rob started as a marine biologist and decided to also pursue an academic degree in science filmmaking. He holds an MFA from Montana State University specializing in creating effective science videos for the classroom. They're both family men and always find time to balance their filmmaking passion with loved ones. Rob has mixed both through his Youtube channel The Curious Parent. Read more about Rob and Dan at UntamedScience.com

Keep it Legit

Legal Docs

As a filmmaker, you need to make sure you're covered legally to distribute the film, which usually means providing written documentation to a client, a TV network, or YouTube, that shows the necessary permissions needed for broadcasting. Without them you could get into a heap of trouble that will cost time and money. Here are two standard releases that you can photocopy, modify, or fill it out right here in the book. One is a model or performer release; the other is a location release. Make sure you have a signature from everyone who will appear on camera. If you're in a location that you think might come back and have an issue with your film (maybe a power plant, a city center, or a high-tech lab), make sure you get a location release, too. Happy filmmaking!

PERFORMANCE RELEASE FORM

_____ (the "Company") wants to make audio, video or motion picture recordings and/or take photographs (the "Recordings") of [PERFORMER] _____ (the "Performer") for possible use in a program tentatively entitled _____ (the "Program").

The Performer hereby grants to the Company, their respective successors, assigns, assignees, grantees and licensees, permission to make the Recordings and edit them as desired. The Company shall own all right, title and interest, including the copyright, in the Recordings and the Program, and may use, re-use, license, transfer or dispose of them, without limitation, for the above Program, related materials and/or for any and all other purposes, in perpetuity and throughout the world, in any and all languages, formats and media, including, without limitation, electronic versions, print publications and audio and video recordings and versions in any media prepared for use by the handicapped or disabled. The Performer's name, voice, likeness, picture and biographical data may be used to publicize, promote and advertise the Program, or other materials, without limitation, containing the Recordings, and in any materials that derive from, supplement or relate thereto. Nothing herein requires the Company to use the Recordings.

The Company shall pay the Performer the amount of $ -0- in full consideration of the grant the Performer makes under this Release. The Performer acknowledges that the Company bears the responsibility for making such payments and the Performer will not look to or make any claim against the Company in connection therewith.

The rights the Performer has granted herein will not conflict with or violate any commitment, agreement, or understanding the Performer has or will have to or with, nor infringe upon any rights of, any person or entity.

The Performer agrees to indemnify and hold the Company and its officers, representatives, agents, employees, assignees, grantees and licenses, harmless from and against all claims, losses, costs, expenses, settlements, demands and liabilities of every kind, including reasonable attorneys' fees and expenses, arising out of or incurred by reason of the use of the above Recordings as set forth above, or the inaccuracy, alleged or actual breach of any representation, warranty, covenant, agreement, or undertaking the Performer has made herein.

The Company:	Performer
Signature:	Signature:
Print Name:	Print Name:
Date:	Date:
	Address:
	Tel #:

Any PERFORMER who is under the age of eighteen requires parent or guardian signature below:

I am the parent or guardian of the person whose signature appears above and who is less than eighteen years old. I permit the performance or appearance of that person, referred to above, to be used by the Supplier and the Company, their respective assignees, licensees and grantees, according to the provisions set forth above. These provisions shall carry the same force as if I had agreed to them on my own behalf.

Parent/Guardian signature:

Address / Tel # :

Parent/Guardian (print name):

Date:

LOCATION RELEASE

_____ (Company) wants to make a video recording of the property located at (location) _____ _____ for possible use in a program to be copyrighted by Untamed Science. _____ is either the owner or authorized manager of the Location (Owner), and wants the Supplier to make such Recordings for the Company's use.

The Owner hereby grants to the Company, and their respective licensees, grantees and assigns, permission to use the Location for videotaping scenes for their programs. The Company shall own all right, title and interest, including the copyright, in the Recordings.

The Company shall pay the Owner the amount of $ 0 in full consideration of the grant the Owner makes under this agreement.

Company Signature:

Print Name:

Owner Signature:

Print Name:

Date:

Address:

Tel #: