

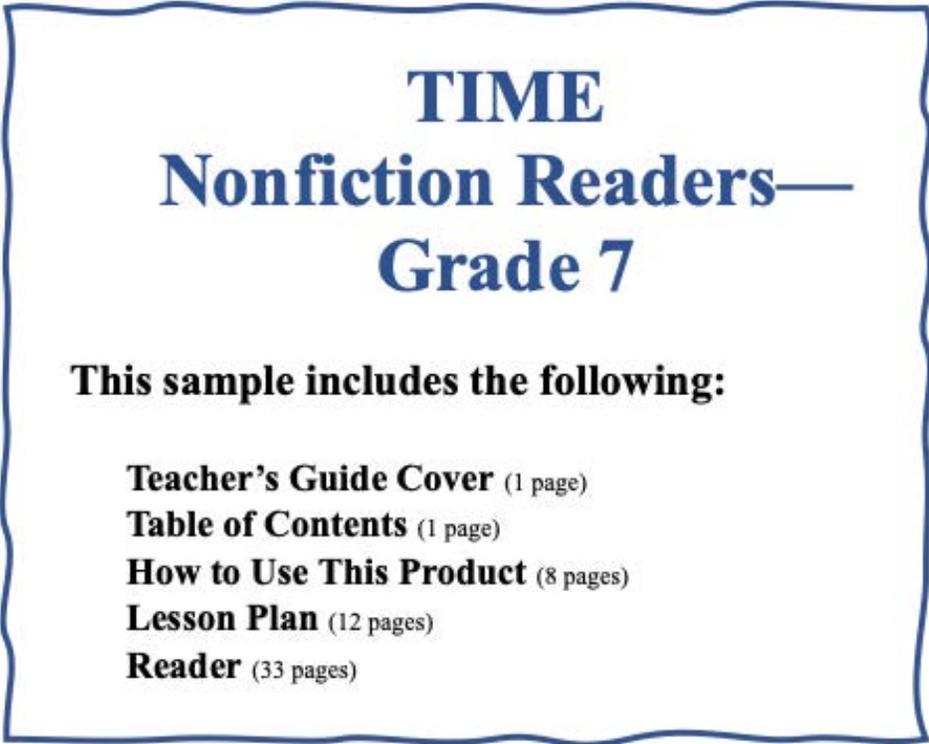
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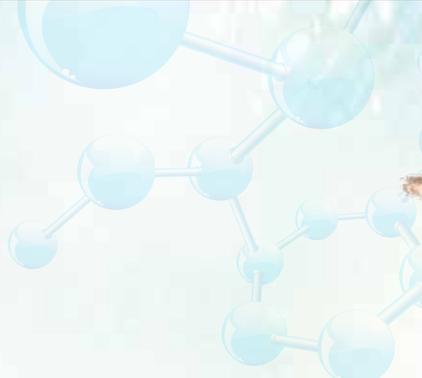
A blue hand-drawn rectangular border with wavy edges surrounds the product title and list of contents. The title is centered and reads: **TIME  
Nonfiction Readers—  
Grade 7**

**This sample includes the following:**

- Teacher's Guide Cover** (1 page)
- Table of Contents** (1 page)
- How to Use This Product** (8 pages)
- Lesson Plan** (12 pages)
- Reader** (33 pages)

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TIME  
**Nonfiction**  
Readers



**Grade 7**  
**Teacher's Guide**



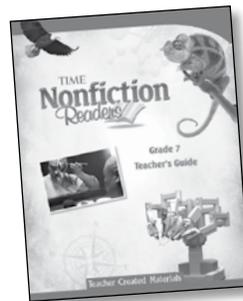
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# How to Use This Product

## Kit Components

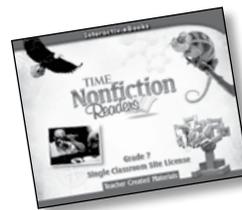
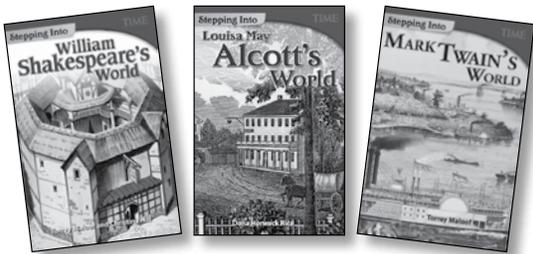
**Trio 1**



### Teacher's Guide

Easy-to-use standards-based lesson plans

**Trio 2**



### Digital Resources

- PDFs of books for whiteboard use
- teacher resources
- student activity sheets and assessments
- professional audio recordings of books
- Interactiv-eBooks with comprehension activities, close-reading activities, embedded audio and videos, and digital assessments

**Trio 3**



**Trio 4**



**Trio 5**



### Assessment Guide

- Comprehension Pre-assessment
- individual reader assessments with multiple-choice, constructed-response, and close-reading questions

**Trio 6**



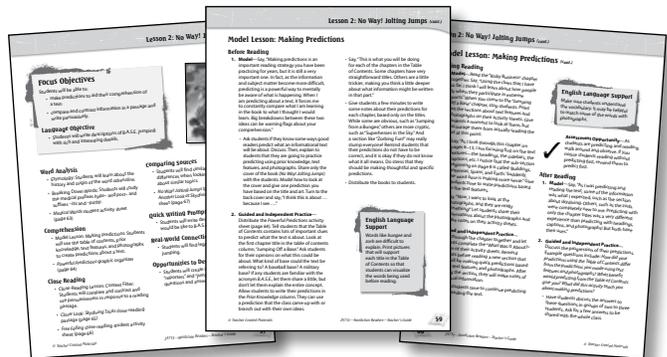
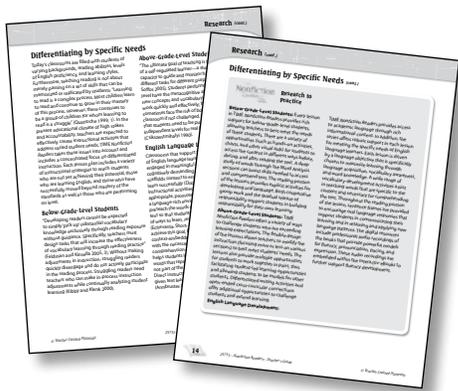
# Getting Started

## 1. Use the Comprehension Assessment.

Diagnose which comprehension skills your students will need to focus on. For a complete overview of the comprehension assessment and directions for test administration, see page 6 of the *Assessment Guide*.

## 4. Prepare assessment resources.

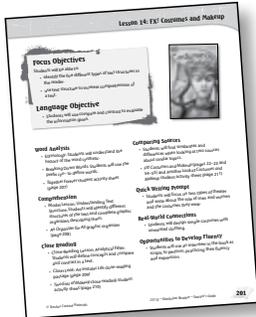
Depending on how you plan to conduct your assessment, you may wish to create an assessment folder for each student. These folders can hold the student's Comprehension Assessment, individual-reader assessments, activity pages, and anecdotal records taken during the reading lessons.



- 2. Create reading groups.** If desired, place students in reading groups based on their reading levels or other instructional needs. For students reading below grade level, the *grades K–5 Nonfiction Readers Series Placement Test* is included as a digital resource only. This is an individual oral reading test that can be used to determine general reading levels or to measure growth and aid in selecting books for students. See pages 30–31 for tips on using *TIME Nonfiction Readers* in a balanced literacy classroom.
- 3. Prepare student resources.** As an option, organize student resources such as dictionaries and writing folders.

# Teaching a Lesson

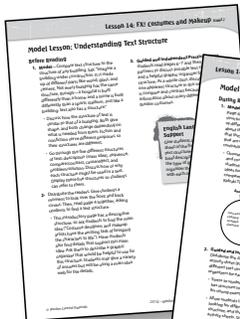
Each 11-page lesson is organized in a consistent format for ease of use. Teachers may choose to complete some or all of the lesson activities to best meet the needs of their students.



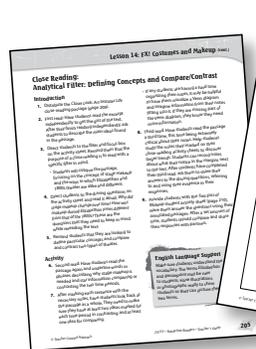
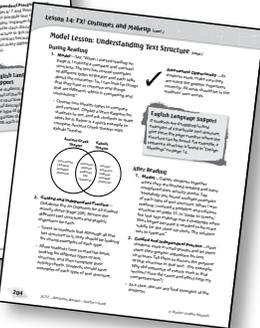
**Lesson Overview** provides lesson objectives and key information for planning purposes.



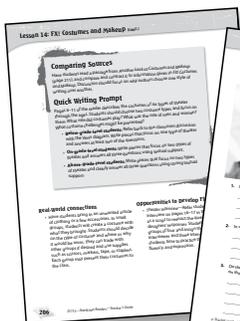
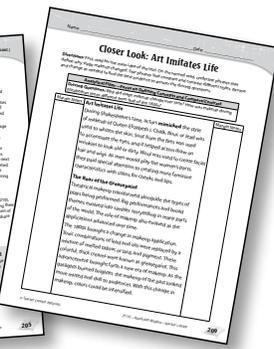
**Word Analysis** section includes activities and suggestions for teaching word patterns, parts of speech, Greek and Latin roots, and etymology of words.



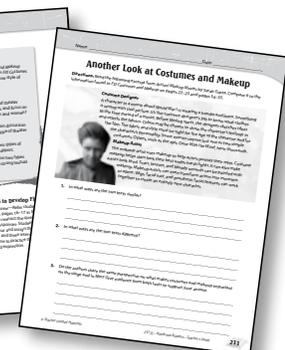
**Comprehension Model Lesson and Practice Opportunities** provide teachers with simple and engaging activities that reinforce the comprehension skill addressed in the lesson. Each lesson includes a graphic organizer to help students organize the material being taught.



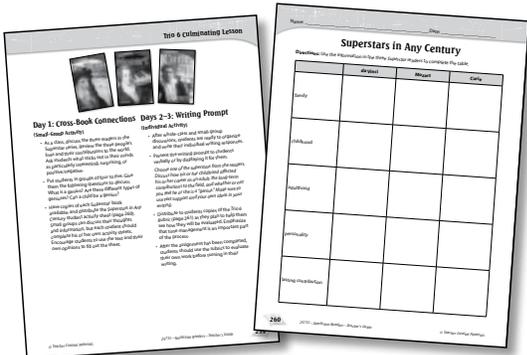
**Close-Reading Lesson and Activity Sheet** provide students with an opportunity to practice close reading a short passage of text from the reader for a very specific purpose. Each trio of books has a close-reading “filter” in common, but each individual lesson uses the filter in a different way. See page 21 for more information on the close-reading filters. Each lesson includes a step-by-step close-reading lesson, a student passage for annotating, and an activity sheet to extend the lesson.



**Comparing Sources, Quick Writing Prompts, Real-World Connections, and Opportunities to Develop Fluency** sections offer additional activities for building comprehension and making connections.



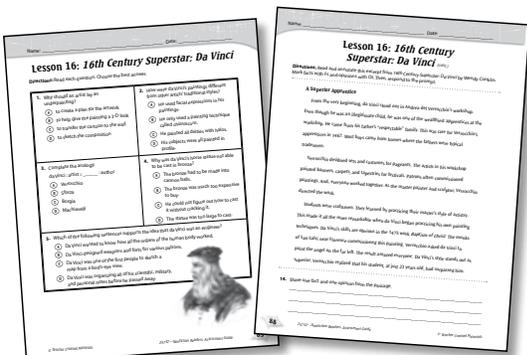
## Using the Trio Resources



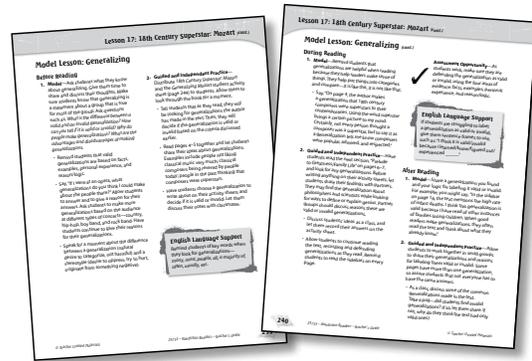
Each trio has a culminating lesson that combines small-group work with an individual assignment designed to allow students to look across the books in the trio to find similarities and differences among the books. Each trio lesson is designed to be given over multiple days and includes an activity sheet as well as a rubric to help evaluate student work.

## Using Assessment Options

1. **Use individual reader assessments at the end of each lesson.** Each lesson is accompanied by an assessment designed to be given out at the end of the lesson. It contains multiple-choice, constructed-response, and close-reading components. The assessments mirror the skills being taught in the lessons and reinforce classroom learning.



2. **Use informal assessments during each lesson.** Refer to the assessment tips embedded throughout the lessons to gather information about students' reading skills. Record anecdotal records as they meet the needs of your classroom.



## Using Technology Options

1. **Use the audio recordings of the readers as models of fluent reading.** The digital resources include professional audio recordings of the books. Play the audio files of the books to support students as a prereading activity, during fluency practice, or in a center.
2. **Use the Interactiv-eBooks to enhance the reading experience.** This kit includes interactiv-eBooks that guide students toward independent reading and engage them in fully interactive experiences. Students can hear the texts read aloud, view video clips and book trailers, record their own readings, and complete interactive activities to build academic skills—from close reading to comprehension and writing. The interactiv-eBooks can be used in a variety of instructional settings and help support numerous literacy and learning goals. For a detailed overview of how to use the interactiv-eBooks in the classroom, see pages 41–43.

## About the Books

TIME *Nonfiction Readers* is designed to enhance any reading program. Each book motivates students to want to read due to its high-interest content and engaging visuals. The authentic reading experiences help students develop vocabulary, comprehension, and fluency skills.

## Leveling Components

Each book offers a variety of specialized features, including the following:

- detailed and descriptive text with sentences of varying lengths
- frequent use of sophisticated fonts in sidebars and chapter headings
- a bibliography, which includes fiction titles, to keep students reading
- a Try It! section to extend and support the content
- a glossary, an index, and a table of contents as key nonfiction text features
- increased use of illustrations, graphics, primary sources, and photographs
- interactive spreads to prompt critical thinking
- between 100 and 250 words per page spread for robust reading experiences

## Special Features in the Books

Each reader includes the following special features to enhance the reading experience:

### Think Link



- Introduces main concepts
- Poses critical-thinking questions or key points to encourage reading with a purpose

### Dig Deeper!



- Provides background knowledge to access a deeper understanding
- Offers a variety of text types, including instructions, maps, diagrams, and interviews
- Provides high-interest graphics and interaction

### Stop! Think...



- Poses additional critical-thinking questions
- Guides students in expanding their visual literacy and comprehension using information from charts, graphs, and more

## Word Counts and Level Correlations

Grade 7 Title	Pages	Word Count	TCM Level	Guided Reading Level	DRA Level	Lexile® Measure
<i>No Way! Spectacular Sports Stories</i>	48	2,899	7.7	U	70	1000L
<i>No Way! Jolting Jumps</i>	48	3,096	7.3	Y	70	1010L
<i>No Way! Amazing Acrobatics</i>	48	3,083	7.8	Y	70	950L
<i>Stepping Into William Shakespeare's World</i>	48	3,324	7.5	Y	70	920L
<i>Stepping Into Louisa May Alcott's World</i>	48	3,543	7.5	W	70	940L
<i>Stepping Into Mark Twain's World</i>	48	3,370	7.6	X	70	940L
<i>STEM Careers: Metamorphosis of Medicine</i>	48	3,817	7.8	Y	70	940L
<i>STEM Careers: Enhancing Engineering</i>	48	3,205	7.9	W	70	890L
<i>STEM Careers: Reinventing Robotics</i>	48	2,668	7.8	W	70	890L
<i>You Are There! Pompeii 79</i>	32	2,021	7.0	Y	70	1000L
<i>You Are There! London 1666</i>	32	2,152	7.5	X	70	970L
<i>You Are There! San Francisco 1906</i>	32	1,585	7.8	V	70	880L
<i>FX! Lighting and Sound</i>	64	4,476	7.9	X	70	940L
<i>FX! Costumes and Makeup</i>	64	4,691	7.6	W	70	980L
<i>FX! Computer-Generated Imagery</i>	64	3,994	7.8	W	70	950L
<i>16th Century Superstar: Da Vinci</i>	32	2,156	7.5	X	70	970L
<i>18th Century Superstar: Mozart</i>	32	1,926	7.9	W	70	950L
<i>20th Century Superstar: Curie</i>	32	2,027	7.5	Y	70	920L

### Using This Program in a Balanced Literacy Model

*TIME Nonfiction Readers* is a supplemental leveled reading program that can be flexibly implemented in a balanced literacy model. The high-interest books provide an engaging reading experience while supporting the development of important reading skills that include comprehension, fluency, vocabulary, and word study. The comprehensive Teacher's Guide with step-by-step, scaffolded model lessons and student activities can be easily incorporated into any block of a balanced literacy model, including large group, guided reading groups, literature circles, and independent work time. Multiple assessment opportunities will diagnose students' needs and help direct teachers as they plan for differentiation and inform their instruction as they move students toward mastery of key reading and writing skills.

#### Guided Reading

Two key features of *TIME Nonfiction Readers* allow it to be effectively used within a guided reading program. First, it can serve to target specific word-analysis skills. Second, the high-interest leveled books make them ideal selections for use with groups that need practice at certain reading levels and with general reading skills.

The readers are ideal to use with small teacher-led guided reading groups. The high-interest leveled books in this kit make them ideal selections to use with readers who read at levels 6.0–6.9. The chart on page 29 indicates the reading levels of the books included within this kit.

The easy-to-follow lesson plans offer a carefully scaffolded format that provides explicit teacher modeling through think-alouds as well as guided practice to use with peers and independently. Teachers may use the readers in a variety of small-group settings, including guided reading groups and as an intervention with struggling readers.

**Lesson Plan Structure:** The core of the guided reading lesson is organized around before-, during-, and after-reading activities and suggestions. Each book targets two main strategies or skills: one comprehension and one close reading. (Refer to page 271 for a complete list of the skills addressed in this kit.) Each comprehension strategy lesson is carefully scaffolded using teacher modeling, guided practice, and independent practice. The lessons are designed to provide a rich menu for teachers to pick and choose from as they differentiate instruction for students. If needed, the lessons can also be used as quick reviews or mini-lessons.

#### Leveled Practice and Other Reading Skills:

Each reader included in the program has been leveled for use in small groups of students with similar reading levels. In addition to teaching the specific comprehension skills that students need to read nonfiction, the lesson plans for the readers also include carefully crafted instruction in the following areas of literacy:

- **Word Analysis:** Word analysis is broken into two sections: Etymology and Breaking Down Words. The Etymology sections look at the history of certain words and how they have developed over time. Breaking Down Words looks at how words are put together and how words are built. Each word-analysis activity is accompanied by a student activity sheet to extend the learning beyond the lesson.
- **Academic Vocabulary:** Students study key academic vocabulary through the use of dictionaries, graphic organizers, drama, sketching, and glossary use. Many of the activities are appropriate for whole-class work in a vocabulary session focusing on activities suggested in the lesson plans for vocabulary development or for word-knowledge practice.

## Using This Program in a Balanced Literacy Model (cont.)

### Guided Reading (cont.)

- **Fluency:** Fluency activities focus on reading text aloud while also focusing on stress, phrasing, pausing, pace, and intonation. These activities are designed to be highly engaging for students.
- **Progress Monitoring:** Assessment options are found directly in each lesson so that teachers can keep ongoing formative assessment records and adjust instruction accordingly. During the lessons, frequent assessment checks and suggestions for observing students while reading offer concrete ways to inform instruction and chart student progress in the program. The activity sheets that accompany each lesson also provide assessment checks for the teacher. The informal and formal assessments are included in easy-to-use formats.

### Other Blocks of Balanced Literacy

**Writing:** The lesson plan for each book includes an engaging writing activity. Additionally, further writing tasks are integrated into the student activity sheets. The writing activities vary in style but are all designed to be completed in single writing sessions to allow teachers to fit this important practice into class time.

#### **Learning Centers and Independent Practice:**

One of the challenges of a balanced literacy classroom is making sure that students who are not in the small instructional group with which the teacher is currently working are constructively engaged. *TIME Nonfiction Readers* lesson plans provide ample suggestions and materials for independent student use and for the development of centers. For example, three high-interest activity sheets are included for each book. Students may complete these practice pages independently after reading the book.

**Independent Reading:** Students who spend more time reading independently outperform their peers on standardized tests and other measures. Time spent reading independently is the best predictor of reading achievement (Anderson, Wilson, & Fielding 1988). The books from the *TIME Nonfiction Readers* series provide easy-to-read, high-interest content. They can be added to classroom libraries for independent reading selections.

## Lesson 15: FX! Computer-Generated Imagery

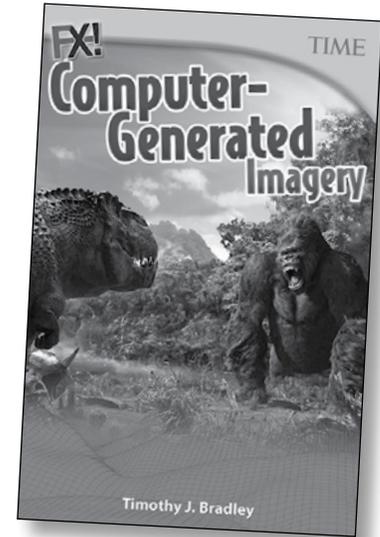
### Focus Objectives

Students will be able to:

- use information and prior knowledge to infer from the text.
- support a claim with evidence.

### Language Objective

- Students will use formal introductions and conclusions in writing.



### Word Analysis

- Etymology: Students will understand the meaning and origin of the word *polygon*.
- Breaking Down Words: Students will use the prefix *poly-* to define and use words in context.
- *So Many Words* student activity sheet (page 218)

### Comprehension

- Model Lesson: Inferring: Students will make inferences about the text based on the author's clues and their own prior knowledge and text connections.
- *CGI Inferring* graphic organizer (page 219)

### Close Reading

- Close-Reading Lesson: Analytical Filter: Claims/Arguments and Evidence: Students will find claims in a passage and find evidence and arguments to support them.
- *Closer Look: The Pixar Revolution* close-reading passage (page 220)
- *Pixar's Claim* close-reading student activity sheet (page 221)

### Comparing Sources

- Students will find similarities and differences when looking at two sources about similar topics.
- *FX! Computer-Generated Imagery* (pages 20–21) and *Another Look at CGI* student activity sheet (page 222)

### Quick Writing Prompt

- Students will write expository paragraphs discussing the new CGI technique used in animated films.

### Real-World Connections

- Students will create posters based on the CGI scenes from recent movies.

### Opportunities to Develop Fluency

- Students will script and perform movie trailers highlighting CGI.

### Reader's Guide Reminder

The Reader's Guide questions in each book encourage students to think critically and can serve as class discussion starters. Suggested answers are provided in the Digital Resources.

## Word Analysis

- 1. Etymology**—Remind students that language is something that is alive and always changing. New words are created and added to languages when they are needed. Understanding where a word came from and what all its parts are can help us to better know and understand words.
  - Display the word *polygon* for students to see. Ask students in which subject they would normally see the word (math). Ask them also to define and give examples of the word. Make sure students understand that *polygon* refers to a 2-D shape with three or more sides. Examples include triangles, squares, pentagons, hexagons, and octagons.
  - Say, “*Polygon* is a word originating in the 1570s. It comes from the Greek word *polygonos*, made up of *polys* (many) and *gonos* (angled). In modern times, the prefix *poly-* means ‘many.’” Call students’ attention to the fact that although the definition states it, and people usually think of polygons as having multiple sides, the true etymology of the word refers to a shape having many angles.
- 2. Breaking Down Words**—Have students brainstorm words beginning with the prefix *poly-*. Display the words and add the words *polygraph* and *polychromatic* if no students suggest them. Encourage students to look for the meaning within the words. Now that they know the prefix, have them use prior knowledge of other words and suffix definitions to define the words on the list.
  - Point out the word *polygraph*, and ask students what *-graph* means. They could also think of other words with that suffix (autograph, telegraph, etc.). The suffix *-graph* means “to write,” so have students think about what the word might mean. The polygraph was originally a machine used to record and print out results of several bodily functions. Over time, it came to be associated with a lie detector test.
  - In a similar way, ask students to find a word chunk in *polychromatic* that they know. Some students may point out *chrome* in the word and know that it means “color.” So something polychromatic has many colors.
  - For further practice, have students complete the *So Many Words* student activity sheet (page 218).

## Model Lesson: Inferring

### Before Reading

- 1. Model**—Tell students you are going to play a simple game. You will tell them about fictional items found in a locker. (Items could actually be displayed if time permits.) Students will tell you something they believe might be true about the owner of the locker and why they think that.
  - Say, “I found a French textbook.” Students might guess the person is taking French because he or she would be unlikely to have extra books in his or her locker. Say, “I found a basketball jersey.” Students may guess the person is on a basketball team because all the players have jerseys. Say, “I found pictures from after-school activities hanging inside.”
  - Ask students if they remember what this comprehension strategy is called (inferring or making an inference). Have students turn to partners and explain what inferring is. (Readers get information, think about what they already know, and make their inferences. It is not making a guess or a prediction; it is figuring out something that the author does not tell the reader explicitly.)
- 2. Guided and Independent Practice**—Distribute the reader. Give students a moment to look over the book. Read through pages 4–7 together. Ask students, “What might matte painters think of computer-generated imagery?”
  - Before they answer, have them go through a thought process. First, they need to ask themselves what they read about the topic. (They create realistic backgrounds. The backgrounds cannot have actors moving around in them.) Then, ask students to think about what they already know. (Actors often have to interact with backgrounds. CGI has become very popular.)
  - Then, have students discuss their inferences in small groups. Perhaps matte painters might be threatened by CGI because it could replace their jobs.

### English Language Support

To help give students something concrete to work with, share the sentence frames “I read \_\_\_\_\_.” and “I know \_\_\_\_\_, so I think \_\_\_\_\_.” Have them partner with a student who can guide the discussion if needed.

## Model Lesson: Inferring (cont.)

### During Reading

**1. Model**—Distribute the *CGI Inferring* student activity sheet (page 219). Have students turn to page 7 in the reader.

- Say, “As I’m reading this page, I’m asking myself, ‘Why weren’t the practical effects enough for filmmakers?’ And I am reading information in the text about backgrounds that are not interactive, sets that take too much time and money to make, and prosthetics that do not change a person’s size. I know the audience is not easily fooled and that filmmakers want to deliver the best possible product to audiences. So, I can infer that the practical effects were not enough for the filmmakers because they did not look realistic enough to impress audiences.”
- Have students share their thoughts or inferences.

**2. Guided and Independent Practice**—Have students read through page 9. Ask students to infer why audiences were expecting more from films. As a whole class, discuss the information given explicitly about the topic. Students can write that in the first column on their activity sheets.

- Have students write what they already know in the second column and make their inferences on their sheets. Then, allow students to share their thoughts with the class.
- Have students continue reading the text, making inferences on the activity sheet.

**Assessment Opportunity**—As students work, make sure they are not writing predictions but using the text and their prior knowledge to make inferences.



### English Language Support

Have students discuss movies they’ve seen with stronger students. The focus should be on the different special effects used to make these movies. They can make comparisons with movies in the book that use practical effects.

### After Reading

**1. Model**—Say, “Following the three steps on the activity sheet helps me make inferences with text support. If I just make an inference based on what I think, it can turn into a guess or be too slanted by my prior knowledge. But when I make note of what the text says and add my prior knowledge, then I can make a strong inference. And the inference gives me more information than just the text alone. For example, I can infer that people connect with the *Star Trek* characters in some way because it was popular in the 1960s and still is today.”

**2. Guided and Independent Practice**—Allow students to share their notes for the second inferring question from page 23. If students share conflicting thoughts, let them defend their notes. Remind students that inferences are not necessarily right or wrong answers—more than one inference can often be supported by the text.

- In groups of two to three, let students share their notes for the inferring questions on the activity sheets. Students should focus on the thought process of making the inferences, not just the inferring itself. When they are finished, conduct a brief whole-class discussion so students can share their inferences.

## Close Reading: Analytical Filter: Claims/Arguments and Evidence

### Introduction

1. Distribute *Closer Look: The Pixar Revolution* close-reading passage (page 220).
2. First read: Have students read the excerpt independently to get the gist of the text. After they finish reading independently, ask students to describe the main ideas found in the passage.
3. Direct students to the filter and focus box on the activity sheet. Remind them that the purpose of a close reading is to read with a specific filter in mind.
  - Students will critique the passage, focusing on the claim made in the passage and the arguments and evidence in support of it.
4. Direct students to the driving questions on the activity sheet and read them aloud: *What claim is made in this passage? What arguments and evidence support it?* These are the questions that they need to keep in mind while rereading the text.
5. Remind students that to find Pixar's claim, they may need to infer.
  - If any students are having a hard time organizing their notes, it may be helpful to have students take a second look at their claim. If it is only "Pixar wanted to be the first to..." it will not be a strong enough claim to have several pieces of evidence.
8. Third read: Have students read the passage a third time, this time being extremely critical about their notes. Help students study the notes they marked on their close-reading activity sheets to discover larger trends. Students can record notes about what they notice in the margins next to the text. After students have completed their third read, ask them to share their answers to the driving questions, referring to and using their evidence in their responses.
9. Provide students with the *Pixar's Claim* student activity sheet (page 221). Using their annotated passages to help them, have them answer the questions. After a set amount of time, students should compare and share their responses with partners.

### Activity

6. Second read: Have students read the passage again. When they find information pertaining to Pixar's claim, students should mark it with Cs. Have them underline any evidence supporting the claim or arguments for it.
7. After marking each sentence with the necessary notes, have students look back at the passage as a whole. They need at least three pieces of evidence or arguments in support of the claim.

#### English Language Support

If students are having trouble finding a claim, encourage them to infer. Ask them *why* they think Pixar wanted to be the first to create an animated movie made only on computers.

### Comparing Sources

Have students read a passage from TIME FOR KIDS, *Another Look at CGI* (page 222), and compare and contrast it to information given in *FX! Computer-Generated Imagery*. Discussion should focus on why authors choose one style of writing over another.

### Quick Writing Prompt

Have students write about the new animation technique used in the 1999 film *The Iron Giant*. The writing should describe traditional cel animation, the difficulty with using it on *The Iron Giant*, and how computers and CGI were used to make the movie a success. Students' writing should include introductions and conclusions.

- **Below-grade-level students:** Help students create a chart to organize ideas with the following categories: introduction, traditional cel animation, *The Iron Giant* difficulties, computer help, and conclusion. Ask them to create pieces in chronological order.
- **On-grade-level students:** Encourage students to create pieces with introductions and conclusions. Have them address the different animation techniques used in making *The Iron Giant* with text support.
- **Above-grade-level students:** Challenge students to push themselves beyond the prompt. Have them write pieces with clear introductions and conclusions. Within their pieces, they can compare and contrast the techniques used in *The Iron Giant* with other movies.

### Real-World Connections

- In small groups, have students brainstorm movies they have seen recently and choose one. Have them discuss different ways CGI might have been used. Students will create posters using illustrations of photos of the CGI scenes from the movie. Then, display the posters for the class to see.

### Opportunities to Develop Fluency

- *CGI Trailers*—Have students work in small groups and choose one of the movies on pages 31–36 that were groundbreaking or important in the development of CGI. Using information about the movies (from the text or outside sources), have students create movie trailers highlighting the film's use of CGI. Give students time to write the script and practice fluency, tone, and expression. Then, have them record their trailers to share with the class.

# Closer Look: The Pixar Revolution

**Directions:** First, read for the main idea of the text. On the second read, mark information pertaining to a claim with Cs. Underline textual evidence and/or arguments for the claim. Review and change as needed to find the best evidence to answer the driving questions.

## Analytical Filter—Focus on Claims, Arguments, and Evidence

**Driving Questions:** What claim is made in this passage? What arguments and evidence support it?

Margin Notes	<b>The Pixar Revolution</b>	Margin Notes
	<p>Pixar started as a small group of digital artists. Their goal was to make the first animated film created solely with computers.</p> <p>At first, the Pixar staff worked for Lucasfilm Ltd., the company that produced the Star Wars movies. They worked on special effects for a division called Industrial Light &amp; Magic (ILM). This division was started in the 1970s to create practical and digital special effects for films. Pixar grew and soon became a separate company. In addition to creating special effects, Pixar also built its own line of computers. Some of those machines were sold to the Walt Disney Company. Pixar later developed a partnership with Disney to distribute its films. In 2006, Disney announced its plan to buy Pixar.</p> <p><b>Toy Story</b></p> <p>Pixar created the first fully CGI animated film. <i>Toy Story</i> debuted in 1995 to huge excitement. It is visually a different kind of film than had been seen before. The world of <i>Toy Story</i> is highly stylized. Toys are the main characters, but they are even more colorful and inviting than in real life.</p> <p><b>The Incredibles</b></p> <p>Pixar's 2004 film <i>The Incredibles</i> is also computer generated. The characters and settings are stylized, too, but in a very different way from those in <i>Toy Story</i>. There is an authenticity to the graphics. The story follows a family of superheroes who have given up using their powers. Audiences went wild over the action, humor, and heart in the story.</p>	

# Pixar's Claim

**Directions:** Use your notes from *The Pixar Revolution* passage to answer the following questions. Make sure to include evidence from the text in your responses.

1. What claim is the author making about Pixar?

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2. What evidence does he give to support that claim?

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3. What is the strongest, most relevant evidence in this section? Explain your reasoning.

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4. How were movies like *Toy Story* visually different from other films made up to that point?

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# Lesson 15: FX! Computer-Generated Imagery

**Directions:** Read each question. Choose the best answer.

<p>1. What is the problem with traditional cel animation?</p> <ul style="list-style-type: none"><li>(A) Humans and animals are difficult to animate.</li><li>(B) It uses too many drawings.</li><li>(C) Cars and robots are difficult to animate.</li><li>(D) It cannot show smooth, lifelike animation.</li></ul>	<p>2. What is the meaning of the underlined word in the sentences from the text?</p> <p>“A radio teleplay of the story was broadcast in 1938. Many listeners tuned in late, missing the <u>disclaimer</u> that it was not a real invasion.”</p> <ul style="list-style-type: none"><li>(A) electronically controlled robot</li><li>(B) a statement to avoid misunderstanding</li><li>(C) special effects handled over radio</li><li>(D) radio broadcaster</li></ul>
<p>3. What effect could 3-D printers have on costumes?</p> <ul style="list-style-type: none"><li>(A) Designs will be limited to certain materials.</li><li>(B) Costumes will last longer.</li><li>(C) Making costumes can be simplified.</li><li>(D) Costume design will be more detailed.</li></ul>	<p>4. Prosthetics, models, and painted backgrounds are examples of what?</p> <ul style="list-style-type: none"><li>(A) CGI effects</li><li>(B) special effects</li><li>(C) anime effects</li><li>(D) practical effects</li></ul>
<p>5. Complete the following analogy.</p> <p><i>King Kong</i> : Peter Jackson :: <i>Inception</i> : _____</p> <ul style="list-style-type: none"><li>(A) Christopher Nolan</li><li>(B) James Cameron</li><li>(C) Ed Catmull</li><li>(D) Kerry Conran</li></ul>	



## Lesson 15: *FX! Computer-Generated Imagery* (cont.)

**Directions:** Read each question. Choose the best answer.

<p><b>6.</b> Ray Harryhausen’s dream in the comic <i>Dreams of a CGI Future</i> is about what?</p> <ul style="list-style-type: none"> <li><input type="radio"/> (A) prosthetics</li> <li><input type="radio"/> (B) motion capture</li> <li><input type="radio"/> (C) cel animation</li> <li><input type="radio"/> (D) green screen</li> </ul>	<p><b>7.</b> Which of the following is a faulty generalization about filmmaking?</p> <ul style="list-style-type: none"> <li><input type="radio"/> (A) <i>Tron</i> was one of the first movies made that used CGI.</li> <li><input type="radio"/> (B) George Lucas is one of the most innovative filmmakers of all time.</li> <li><input type="radio"/> (C) Some movies are made with CGI along with other special effects.</li> <li><input type="radio"/> (D) All movies made with CGI are blockbusters.</li> </ul>
<p><b>8.</b> What inference can you make based on these sentences from the text?</p> <p>“CGI characters started to appear on movie and television screens more often. The more believable these characters were as humans, the more audiences forgot that CGI isn’t real.”</p> <ul style="list-style-type: none"> <li><input type="radio"/> (A) Films get audiences to suspend their disbelief.</li> <li><input type="radio"/> (B) The human characters are convincing actors.</li> <li><input type="radio"/> (C) Audiences are not intelligent.</li> <li><input type="radio"/> (D) Non-CGI effects should not be used anymore.</li> </ul>	<p><b>9.</b> What are the steps, in sequential order, in creating animation?</p> <ul style="list-style-type: none"> <li><input type="radio"/> (A) draw, build armature, cover armature, sculpt, digitize</li> <li><input type="radio"/> (B) draw, sculpt, digitize, build armature, cover armature</li> <li><input type="radio"/> (C) draw, digitize, sculpt, build armature, cover armature</li> <li><input type="radio"/> (D) draw, sculpt, build armature, cover armature, digitize</li> </ul>
<p><b>10.</b> Which movie uses the most computer-generated imagery?</p> <ul style="list-style-type: none"> <li><input type="radio"/> (A) <i>Jurassic Park</i></li> <li><input type="radio"/> (B) <i>Tron</i></li> <li><input type="radio"/> (C) <i>Avatar</i></li> <li><input type="radio"/> (D) <i>Alien</i></li> </ul>	

# Lesson 15: *FX! Computer-Generated Imagery* (cont.)

**Directions:** Read and respond to each question. Provide evidence from the text in your responses.

11. The book states some people worry that CGI will make actors obsolete. Do you agree or disagree? Give at least two reasons to support your opinion.

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12. Explain what was new and different about Kerry Conran’s idea for a movie.

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13. Choose one visionary from the book who you believe has made the biggest contribution to CGI. Use details from the text to support your answer.

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## Lesson 15: *FX! Computer-Generated Imagery* (cont.)

**Directions:** Read and annotate this excerpt from *FX! Computer-Generated Imagery* by Timothy Bradley. Put a C by the passage’s claim. Underline evidence to support the claim. Then, answer the question.

.....

### Motion Capture in Action

The most difficult task for a director may be to create realistic fantasy creatures that audiences will believe exist. Part of the director’s challenge is to make unique shapes and textures for these beings. The other more difficult part is to animate the character in a realistic way.

Motion capture does this. The major skeletal joints of an actor are marked with reflectors. The actor then performs a scene while a digital camera records it. The recording is then run through software. The computer identifies the movements of the markers on the actor. Then it applies those movements to a CGI character. The animated character takes the place of the live-motion performer.

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14. What evidence supports the claim you noted?

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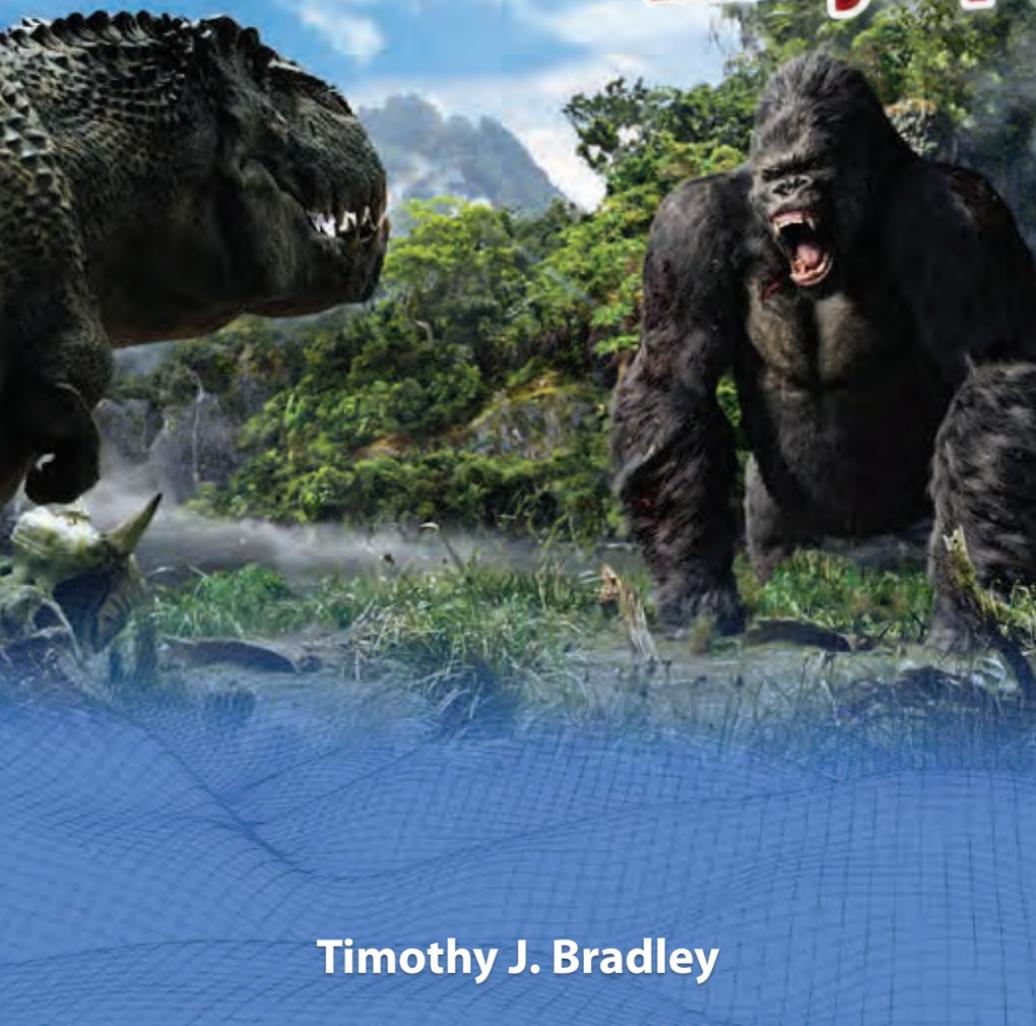
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**FX!**

TIME

# Computer- Generated Imagery



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# Crafting a Blockbuster

Imagine you're a film director, and you've just been handed a script for a blockbuster film. The script calls for giant spaceships, creepy alien invaders, and fierce space battles. How can you possibly create all those **special effects**, and *more*, in time for a summer **release**?

*Computers!* Whatever a story needs, computers can deliver eye-popping visuals to make your movie look awesome. Magical creatures? No problem. Huge, detailed space battle? Of course! Robot invasion of planet Earth? You've got it! With the right **hardware**, **software**, and artists, filmmakers can create dazzling visual effects for their movies. They do this through computer-generated imagery, or CGI. This gives directors the freedom to bring to life anything they can imagine.

It all starts with amazing computer technology. The first "computer" was invented in the second century BC in Greece and was used to calculate planetary movements through the **cosmos**. Little did anyone know that computers would evolve to become an integral part of our everyday lives.

Computers help operate cars, phones, and homes. They allow us to play games, explore the world and the universe, and create astounding film effects that keep audiences enthralled and lining up for more.



Antikythera Mechanism, believed to be the first "computer"

## Blockbuster

The word *blockbuster* has been used since the 1920s. But it wasn't until the 1970s, when films such as *Jaws* and *Star Wars* were released, that it became a popular way to describe hit movies.



- © How many computers do you see or use in the course of a typical day?
- © What might be a worthwhile new use for a computer?
- © If you could build your own computer to do anything, what would you want it to do?

## “Old School” Special Effects

Until about thirty years ago, special effects in film and television were created using **practical effects**. Models of spacecrafts and cities with puppets are examples of practical effects. Giant props that make actors look extra small are also examples. The effect is then captured by the camera.

Computers were initially used in films to create motion-control effects. Mounting a camera on a track and controlling it with a computer helped filmmakers create certain effects. For example, if the camera were to move past a model vehicle, this would create the illusion on film that the vehicle is moving past the viewer. This process is considered a practical effect because a physical model is used.

Practical effects are great, but they do have drawbacks:

- A skilled **matte painter** could create a realistic background for a scene. But it would not be possible to move around in that background.
- Masks and **prosthetics** can be used to make a human look like a monster, but the human’s proportions couldn’t really change. So the effect sometimes doesn’t look real enough to an audience. All they see is a person in a monster suit.
- Realistic **sets** of space stations or spacecrafts can be built. But such sets require huge sound stages, hundreds of construction experts, and the time to build them.



This effects artist creates a realistic miniature set.

### Blink and Miss It

Live-action movies made before the 1980s did not contain more than a few seconds of **computer graphics** or **animation**.

## The Need for a New Approach

Filmmaking became more advanced over time. Audiences expected more spectacular effects and visuals in films. Practical effects were becoming too expensive to create, and their limitations held back directors' visions.

Filmmakers searched for new ways to achieve their goals. They needed methods to create amazing effects without busting their budgets. Computers became more and more appealing.

Computer graphics started to be used in a few science fiction films in the 1970s. Movies such as *Star Wars*, *Alien*, and *Westworld* each contained a few seconds of CGI. CGI made fantastical things real—such as showing the world through a robotic character's machine eyes.

There was a revolution taking place behind the scenes in the film industry. Filmmakers, artists, and animators were testing computers to see what they could do to enhance films. What they created blew the minds of theater audiences.

### Renaissance Geek

Dan O'Bannon, one of the screenwriters of *Alien*, was hired to produce graphics for the interior sets of the *Nostromo*, which is the spacecraft where all the movie's action takes place.

creature from *Alien*

## Brave New World

Modern computers were originally built to solve complex math problems. At first, punch cards were used to **input** information. As technology advanced, computers could handle new and different tasks. They also became easier for people to use.

In 1972, computer scientists Ed Catmull and Fred Parke produced the first computer animation. They turned a cast of Catmull's hand into a series of polygons. The endpoints of the polygons were **digitized** by a computer to form the hand shape. Catmull and Parke wrote software that allowed the polygons to be bent and moved. The result was an animated hand that looked and moved like a real hand. By today's standards, this first animation was **crude**. But it was an important breakthrough that led to the field of computer graphics.

Soon after, short animations were created by universities around the world. They wanted to test the limits and capabilities of computers. Artists eagerly explored the new possibilities.



1972 digitized hand made by Catmull and Parke

### From Pixels to Pixar

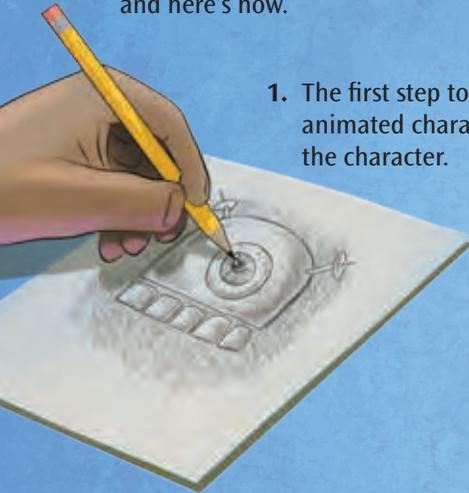
Ed Catmull went on to cofound Pixar, a company that specializes in computer-animated films such as *Toy Story* and *The Incredibles*.



## Characters 101

Catmull and Parke's hand animation inspired artists and computer programmers everywhere. Is it possible to create characters and animations so realistic that they can pass for living things? It is—and here's how.

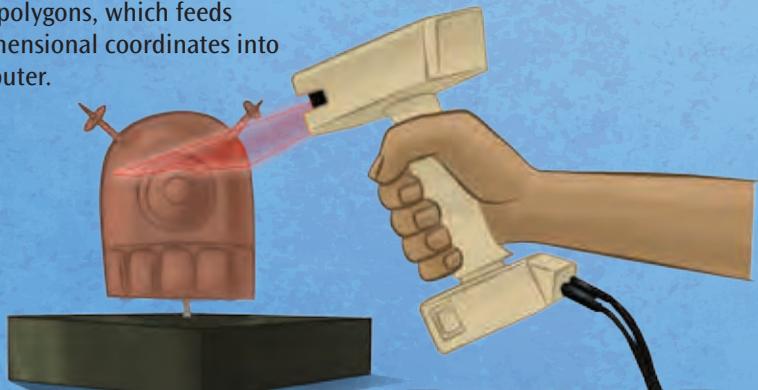
1. The first step to creating a realistic animated character is to draw the character.



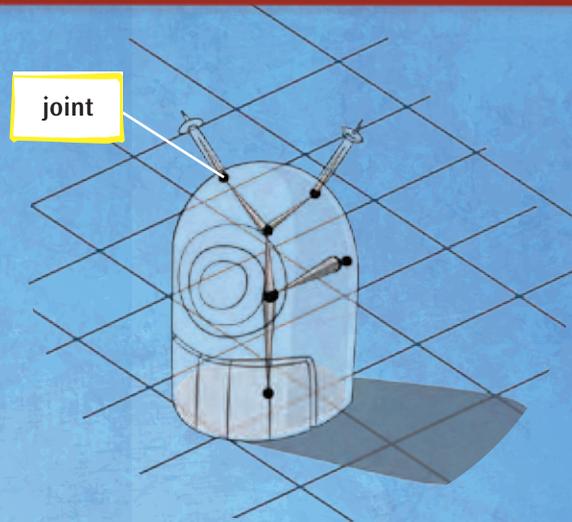
2. Next, make a sculpture, or **maquette**. The character can now be seen in three dimensions.



3. Then, digitize the sculpture as a series of polygons, which feeds three-dimensional coordinates into the computer.



4. The character can be built around a virtual **armature** so that its joints can bend and flex.



5. The armature can be covered with a texture. For example, a monster eye might need a glossy texture.



### Fun with Polygons

Very complicated shapes can be created by joining polygons together. Once the shape is created, the polygon edges can be smoothed, resulting in a realistic object, such as an adventure setting in a video game.

## A Breakthrough in Special Effects

In 1982, the Walt Disney film *Tron* was one of the first films to use CGI and animation as a setting for a story. *Tron* is the story of a video game designer who is transported into one of his games. He becomes trapped in battles against other programs. He must cross a digital desert to return to the real world. Sleek lightcycles, battle tanks, and solar ships carry programs over polygon landscapes.

The film only contains about twenty minutes of computer animation. And that was plenty! Audiences went wild for the crazy shapes and colors of *Tron*'s world. *Tron* showed that CGI effects could add new excitement to movies, and it paved the way for even more exciting things to come.

### Designing the Future

Artist Syd Mead was an industrial designer on the film *Tron*. Mead designed awesome lightcycles and game grids where the digital warriors in *Tron* competed against one another. Part of Mead's career has been designing what future technology will look like. His futuristic concepts can also be seen in the films *Blade Runner*, *Aliens*, and *2010: The Year We Make Contact*.

### "Rapid Fire"

The amazing "bullet time" effects in *The Matrix*, which show time and motion dramatically slowed, were accomplished through computers. A rapid series of photos were taken on cameras placed around the actor. A computer stitched together the photos to make an exciting, mind-bending effect.

## Man of Iron

The film *The Iron Giant* is based on a 1968 book by Ted Hughes called *The Iron Man*. To keep it from being confused with the Marvel® superhero Iron Man®, the name of the movie was changed to *The Iron Giant*.

## Blurring the Lines

Film directors began to see that computers could be effective tools to create amazing effects. They could help take movies to new levels of excitement and artistry.

The 1999 animated film *The Iron Giant* was made with traditional **cel animation**. Cel animation involves creating thousands of drawings of the characters by hand. Those drawings are hand-painted onto clear plastic sheets and then photographed. The brain sees a smooth, lifelike motion when the drawings are shown rapidly in order. Cel animation works well for human and animal characters. Objects such as cars or robots are more difficult to animate. Any wrong proportions on them are easy to spot.

The robot character in *The Iron Giant* was created with a computer. But the computer graphics copied the look of the film's cel animation. The result is that the robot fits well with the look of the film. Also, the robot's proportions are always correct.

## It Began with a Mouse

Walt Disney and his studio are often credited with advancing the art of cel animation. In 1937, the studio released the first full-length animated cartoon, *Snow White and the Seven Dwarfs*. The film's realistic animation set the standard for cel animation, and it is considered a masterpiece, even by today's standards.



## Advancing the Art

*The Iron Giant* certainly wasn't the first huge metal man to appear on film, nor will he be the last. Giant robots have long been seen in movies and on television. There are also other movies that use both computer graphics and hand-drawn animation. In *Neon Genesis Evangelion*, robots defend Earth as alien monsters try to wipe out life. Humans control the robots.

This show first appeared as a television series in Japan in 1995. In 2008, several *Evangelion* films were made. The visuals were created using computer graphics. The animation in the films matches the style of the series. More detail and interest were added to the robots and effects through CGI.

### Anime

*Neon Genesis Evangelion* is an example of anime, a popular style of animation from Japan that is meant for children and adults. It is often characterized by colorful, highly stylized, and futuristic images.

### Taking the World by Storm

The genre of animated giant robot films and television series had begun to lose its following in Japan. But the *Evangelion* series reignited the interest in giant robots not only in Japan but throughout the world.



## The Pixar Revolution

Pixar started as a small group of digital artists. Their goal was to make the first animated film created solely with computers.

At first, the Pixar staff worked for Lucasfilm Ltd., the company that produced the Star Wars movies. They worked on special effects for a division called Industrial Light & Magic (ILM). This division was started in the 1970s to create practical and digital special effects for films. Pixar grew and soon became a separate company. In addition to creating special effects, Pixar also built its own line of computers. Some of those machines were sold to the Walt Disney Company. Pixar later developed a partnership with Disney to distribute its films. In 2006, Disney announced its plan to buy Pixar.

## Toy Story

Pixar created the first fully CGI animated film. *Toy Story* debuted in 1995 to huge excitement. It is visually a different kind of film than had been seen before. The world of *Toy Story* is highly stylized. Toys are the main characters, but they are even more colorful and inviting than in real life.

## The Incredibles

Pixar's 2004 film *The Incredibles* is also computer generated. The characters and settings are stylized, too, but in a very different way from those in *Toy Story*. There is an authenticity to the graphics. The story follows a family of superheroes who have given up using their powers. Audiences went wild over the action, humor, and heart in the story.



- © Why was *Toy Story* a good choice for a CGI film?
- © Would *Toy Story* have been as successful if animated in the traditional way with hand-drawn cels?
- © Pixar is known for bringing unusual creatures to life. What type of creatures should Pixar feature next?

## The Race into Space

Depicting convincing special effects for science fiction films was a problem before computers. Spacecraft models were hung from wires in front of painted backgrounds or black curtains pierced with tiny holes like stars. The spacecraft might fly on a slightly visible wire. Those old effects couldn't meet audience demands for realism.

When a new crop of creative artists armed with computers got to work, they blasted sci-fi fans into space and beyond with out-of-this-world visuals.

## A New Frontier

The original *Star Trek* television series ran from 1966 to 1969. The series follows the captain and crew of the U.S.S. *Enterprise* as they explore the galaxy. The show was popular with viewers and continues in reruns today.

Fans remained excited about *Star Trek* after it was cancelled. So, Paramount Pictures made several feature films based on the series. The 1982 film *Star Trek II: The Wrath of Khan* features an impactful visual scene, made possible through CGI. In it, Admiral James T. Kirk watches a video which shows a machine that can rapidly remake a planet, creating life. But it also destroys any creatures already there. The **cutting-edge** scene was created by a small group at ILM. It was the same group that would later become Pixar.

**KHAAAAAAAAAAAAAN!**

Khan was first seen in the original *Star Trek* television series in 1967. This series used practical effects. In the 1982 film *Star Trek II: The Wrath of Khan*, growing animation technology created the effects. In the reboot film, *Star Trek: Into Darkness*, Khan returns with a huge space battleship, and an epic space battle ensues—only possible through today's CGI.

3:58 / 11:24

## Pods and Bugs and Soldiers, Oh My!

The Star Wars films are known for creating cutting-edge special effects. These effects have been imitated throughout the film industry. ILM was founded by the creator of the Star Wars empire, George Lucas. He started the company to create the effects he wanted for his series.

In 1999, *Star Wars: Episode I—The Phantom Menace* features a desert race. The racers drive an array of pods powered by huge rocket engines. The pod-race scene combines live characters with CGI characters and vehicles. The high-speed race through canyons and over rock-filled plains is a fan favorite from the film and considered a masterwork of CGI.

### Dinosaur Input Device

To create its impressive dinosaurs, the makers of *Jurassic Park* developed the Dinosaur (or Direct) Input Device (DID). The DID uses an armature covered in sensors to monitor the movements of the joints. The data is sent to a computer to create the animation.

The 1997 film *Starship Troopers* is based on the 1959 science fiction novel of the same name. In both, space soldiers battle a deadly army of alien insects attacking Earth.

Tippett Studios created and animated the alien bugs in *Starship Troopers*. Phil Tippett, the studio's founder, began his career as a stop-motion animator. But for *Starship Troopers*, his studio created a new method. Tippett animated the bugs to swarm the soldiers' base. First, a metal armature was made. Then, the armature was connected to a computer that recorded its movements. Those motions could then be applied to the swarming bugs.

scene from *Starship Troopers*

# Power to the People

Advancements in computers happen very quickly. Computer hardware and software can do much more today than they could do a few years ago. Today's computers are much smaller and faster than they used to be just a decade ago. (The first modern computers filled entire rooms!)

## Home Computer Revolution

Today, the power to produce amazing images and animations is available to everyone. Directors and animators have pushed the limits of creativity. They can now create feature films using only personal computers. You may be doing your homework on one of the same machines that made your favorite movie!

In 1994, director Kerry Conran began working on a film. He made it entirely on his home computer. Four years later, he was able to put human actors into completely CGI backgrounds. The six-minute piece was enough for Conran to receive funding to make the entire film. The sets and backgrounds of the finished movie were as strong as those created in studios.

Conran developed a unique approach for moviemaking. He used technology to achieve his vision. His 2004 film *Sky Captain and the World of Tomorrow* is filled with giant robots, airships, and a mad scientist. Conran created a fantastic futuristic adventure.

robot from *Sky Captain and the World of Tomorrow*

### Do-It-Yourself

Many of the first workable home computers were delivered in kit form. Buyers had to build the computers.

Gareth Edwards used a slightly different approach when he wrote and directed the 2010 film *Monsters*. The story follows a reporter who accompanies his boss's daughter home through an "infected" zone. The zone is an area in Mexico that has been taken over by alien creatures. The aliens were brought to Earth by a NASA space **probe**. Huge creatures are everywhere as the pair crosses the infected zone. But are the aliens *really* dangerous bloodthirsty creatures? Or are they just misunderstood beings stranded on Earth?

The film was relatively inexpensive to make but was a surprise hit at theaters. Edwards produced all the special effects himself on his home computer. His do-it-yourself special effects allowed him enormous amounts of creativity. It also helped open the door for other filmmakers to take the same approach.

### Then and Now

Edwards claimed, "You can go in the shop now and you can buy a laptop that's faster than the computers they made *Jurassic Park* on."

illustration inspired by  
2010 movie *Monsters*



**STOP!**  
**THINK...**

- © Compare and contrast the sizes of the monster, the humans, and the landscape.
- © If this were a live-action movie, what CGI might be used to create this scene?
- © How might you use CGI to change the landscape?

# Virtually Real

As computers advanced, digital effects enabled filmmakers to make giant leaps forward in realism. Backgrounds could be more highly detailed, and hair and fur could look realistic. CGI characters started to appear on movie and television screens more often. The more believable these characters were as humans, the more audiences forgot that CGI wasn't real.

Examples of great CGI are easy to find. Here's a walk through some of the best and most significant examples of CGI magic.

## Jurassic World

The fourth film in the Jurassic Park series, *Jurassic World* (2015), has CGI in almost every scene. The CGI creatures in the film interact with the live actors in realistic ways. The virtual dinosaurs show more personality than ever before, due to the increased skills of the artists and animators as well as advanced computer capabilities.

## Deadly Puppets

For extreme close-ups of the dinosaurs in *Jurassic Park*, lifelike animatronic puppets were created by Stan Winston Studios and operated by teams of puppeteers.

## Jurassic Park (1993)

The most frustrating thing about dinosaurs is that they aren't around anymore. However, computer advances have made it seem as if they are. In 1993, the film *Jurassic Park* showed audiences why it's better that dinosaurs *aren't* around! *Jurassic Park* is an amusement theme park filled with live dinosaurs that were bred from ancient DNA. As often happens in adventure movies, *things go horribly wrong*. An employee shuts down the park's security system. The dinosaurs escape and cause panic and chaos for the staff.

There is actually a very small amount of CGI footage in *Jurassic Park*. But it was enough to pave the way for future films to bring the nonexistent to life.





### ***The Abyss* (1989)**

James Cameron wrote and directed an undersea science fiction film called *The Abyss*. The crew of a deep-sea oil platform finds an alien colony on the ocean floor. One CGI effect shows an alien water tentacle reaching inside the platform. That one sequence, containing just over a minute of CGI, took seven special effects groups six months to complete!

### ***Terminator 2: Judgment Day***

Cameron used the water tentacle effect again in a dramatic way in his 1991 film *Terminator 2: Judgment Day*. A robot is made from material called "liquid metal." Through CGI, the metal can reshape itself into almost any form and repair itself after severe damage.

5:58 / 11:24

### **Original Alien Invasion**

*War of the Worlds* by H. G. Wells was published as a novel in 1898. The story centers on a character who finds himself in the midst of an alien invasion in London. A radio teleplay of the story was broadcast in 1938. Many listeners tuned in late, missing the **disclaimer** that it was not a real invasion. Some people began to panic, believing the story was real!



### ***War of the Worlds* (2005)**

A remake of the classic 1953 movie *War of the Worlds* has the benefit of modern special effects. Scenes of an Earth invasion, walking machines, and creepy Martians were made believable through CGI. The earlier version of the film used cutting-edge models to portray the Martians. It was hailed as a great film in its time. But the comparison between the two versions shows just how far technology has advanced.



### ***Star Trek* (2009) and *Star Trek: Into Darkness* (2013)**

Director J. J. Abrams launched a reboot of the original *Star Trek*. He made full use of modern CGI to update *Star Trek* for a new audience. The stories in the newer films have the humor and action the original show is known for. But they also include eye-popping space battles, alien creatures, and wonders in space.

### **Star Trek**

An updated version of the 1960s *Star Trek* series was released on DVD in 2007. New special effects were added that enhanced the original shows. All the spacecraft and alien planet scenes were redone to make them more realistic. More color and motion were added to painted backgrounds. Even stains in the uniforms worn on the show were hidden!

### **CGI on a Big Scale**

James Cameron's movie *Avatar* was done with about 70 percent CGI. It also used a breakthrough technique called image-based facial performance capture. For *Avatar*, this technique was used mainly on the actors' faces. For this to work, an actor wears a custom-fit helmet with a small boom pole attached. At the end of the pole is a camera that is set directly in front of the actor's face. This camera records every facial and eye movement and sends the information to a computer. The result is a character with more realistic human expressions.



### ***Inception* (2010)**

It makes sense to think that as technology links the planet, criminals will find weaknesses in that technology. The film *Inception* follows a crew of high-tech thieves who break into their targets' dreams. One of the thieves finds out the hard way that sometimes dreams can turn on you.

Director Christopher Nolan used CGI to show how the dream world is manipulated. City blocks fold over on themselves, bridges rise from the ground, and staircases lead back to themselves. *Inception* is a twisted mystery with layers of dream imagery that take audiences on a dizzying chase.



### ***Interstellar* (2014)**

While *Inception* journeys into the human mind, Nolan's *Interstellar* journeys deep into space. The film follows the crew of a space mission to find a new home for humans stuck on a dying Earth. Livable planets are seen through a wormhole. Among the CGI effects are planets with massive tidal waves and frozen clouds. An astronaut even gets trapped in 5-D space!

### **What Does a Black Hole Look Like?**

Nolan was advised by a Caltech physicist on how a black hole might appear if you were able to get close enough to take a good look.

▶ ◀ 3:58 / 11:24 ⚙️ 🔊

### **An Artist and Director**

Director Ridley Scott is also a talented artist. He generates hundreds of sketches and **storyboards** to help the crew understand what he envisions for his films.



### ***Gravity* (2013)**

Director Alfonso Cuarón's film *Gravity* is about astronauts stranded in space after a debris storm severely damages their shuttle. A unique combination of filming and CGI was used to recreate the setting of outer space.

Many of the scenes are entirely CGI except for the actors' faces. For other scenes, the challenge of the film was achieving the look of a zero gravity environment. To do this, Cuarón worked with a talented special effects team and collaborated with NASA. Their hard work paid off—the film won an Academy Award® for Best Achievement in Visual Effects.



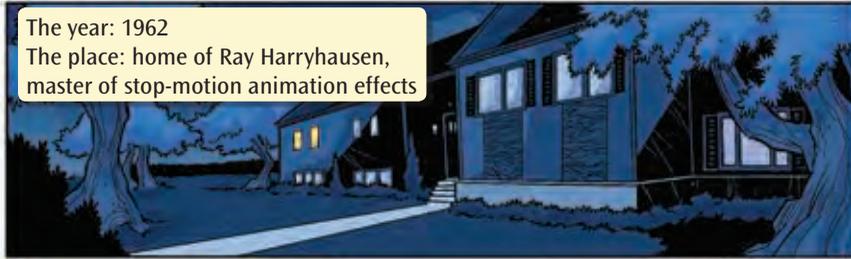
## Green-Screen Effects

Using the green-screen technique allows filmmakers to create scenes without building sets. A stage is painted green or draped in green fabric, and live actors are filmed against the green color. Separately, a “virtual” set is made with CGI. The virtual set is combined digitally with the live-actor footage, with the green color replaced by the virtual sets.

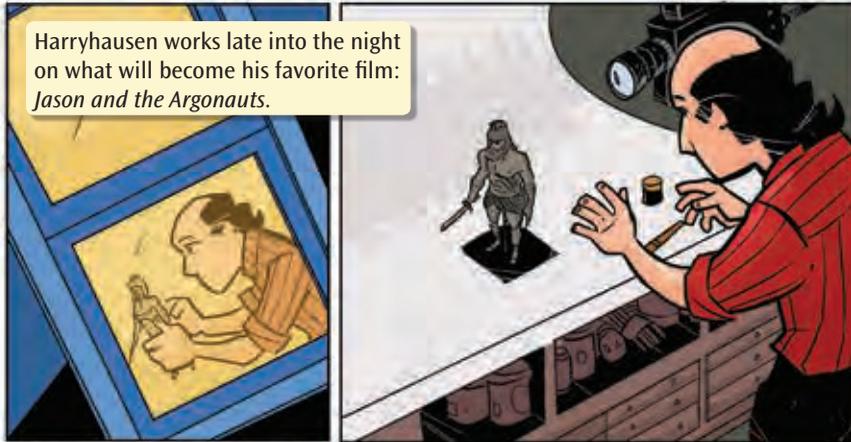


# Dreams of a CGI Future

The year: 1962  
The place: home of Ray Harryhausen, master of stop-motion animation effects



Harryhausen works late into the night on what will become his favorite film: *Jason and the Argonauts*.



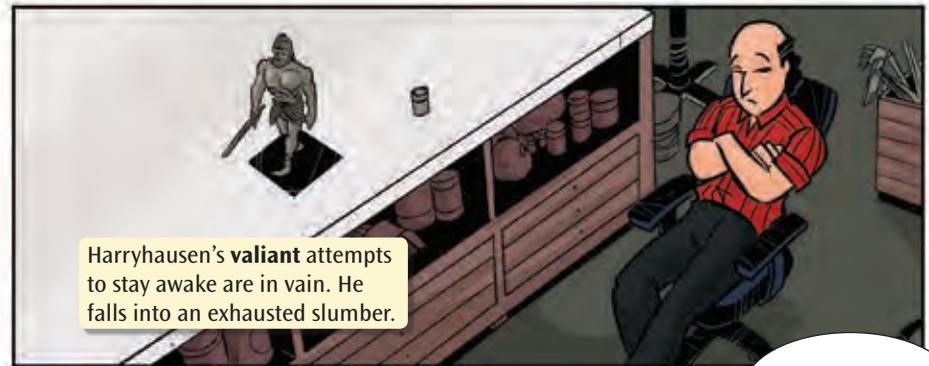
Stop-motion animation involves tiny movements of a model. The viewer's brain perceives the separate movements as a continuous motion!



yawn...  
There has to be an easier way to do this!

Harryhausen grows fatigued from the Herculean task.

Harryhausen's valiant attempts to stay awake are in vain. He falls into an exhausted slumber.



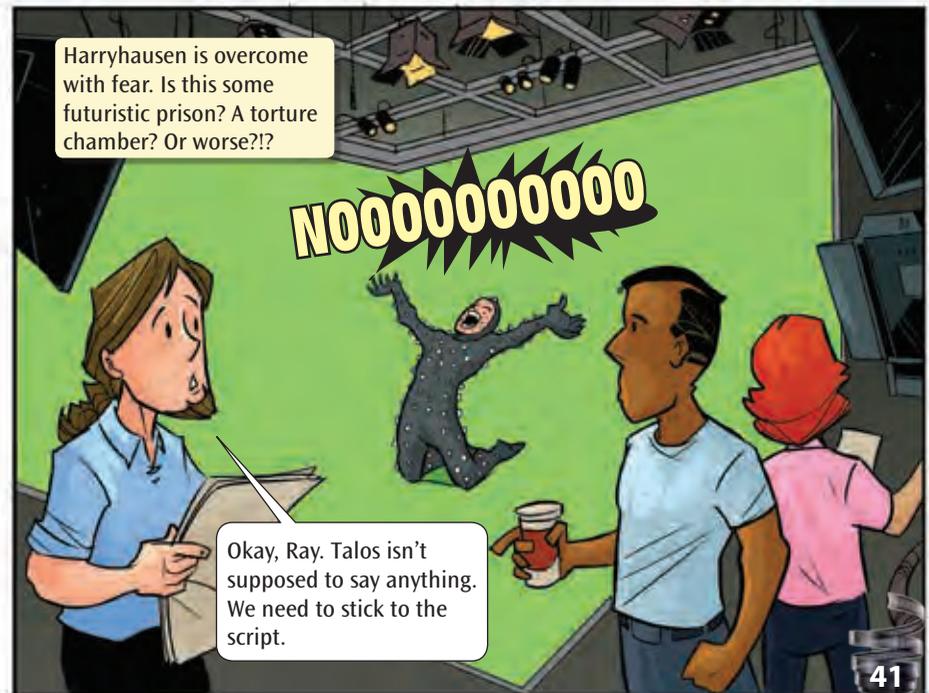
When he awakes, he has a camera on his head.



It's a madhouse!  
A madhouse!

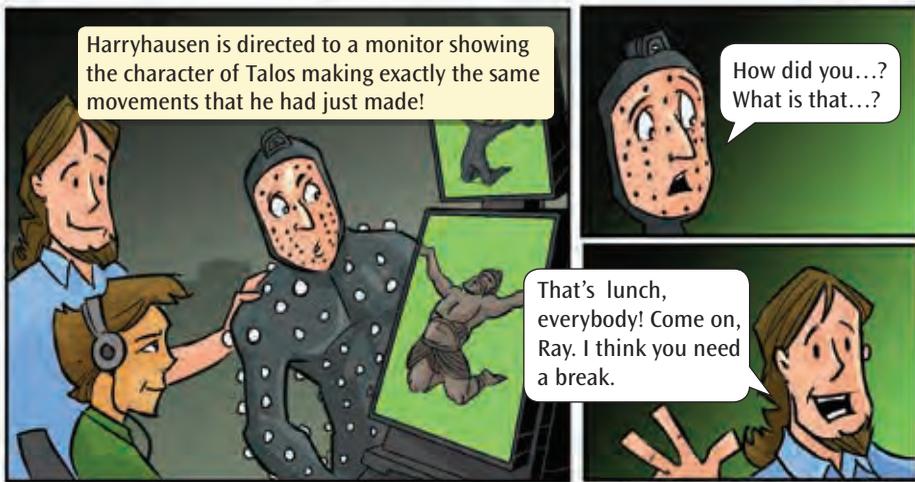
He sees giant green curtains and is wearing an odd bodysuit with strange spherical markers on it.

Harryhausen is overcome with fear. Is this some futuristic prison? A torture chamber? Or worse?!?



NOOOOOOOOOOO

Okay, Ray. Talos isn't supposed to say anything. We need to stick to the script.



Harryhausen is directed to a monitor showing the character of Talos making exactly the same movements that he had just made!

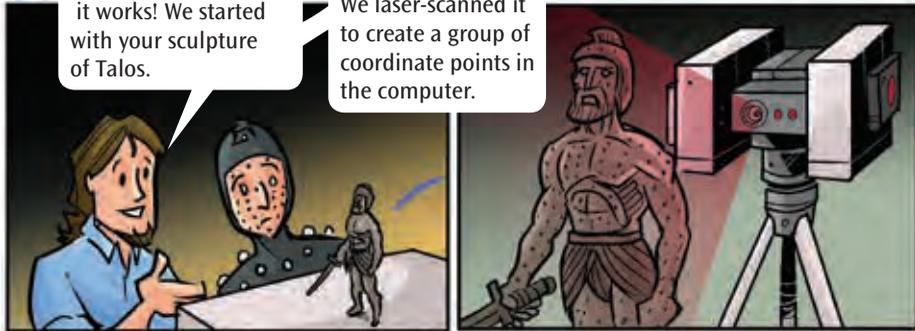
How did you...? What is that...?

That's lunch, everybody! Come on, Ray. I think you need a break.



Let's get some lunch, and I'll show you the progress we're making on the digital effects.

What are digital effects?

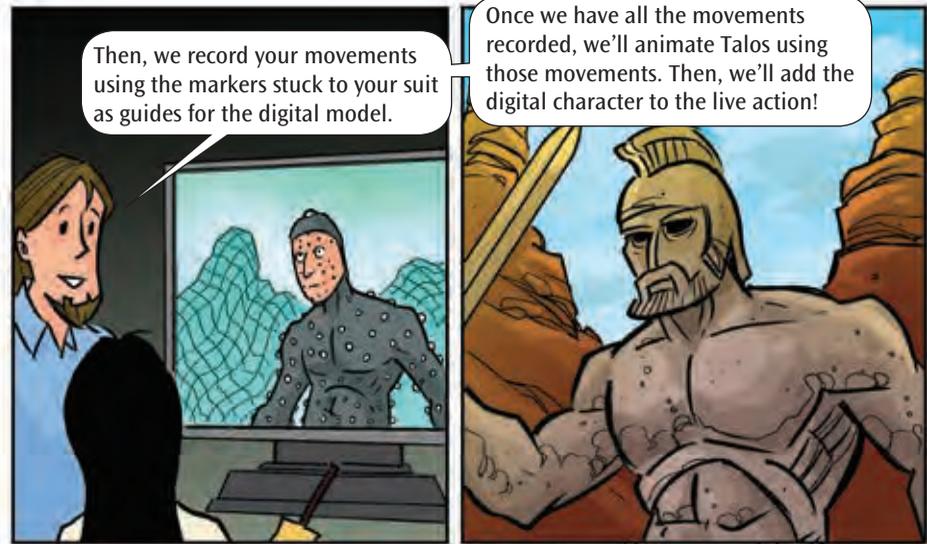


You know how it works! We started with your sculpture of Talos.

We laser-scanned it to create a group of coordinate points in the computer.

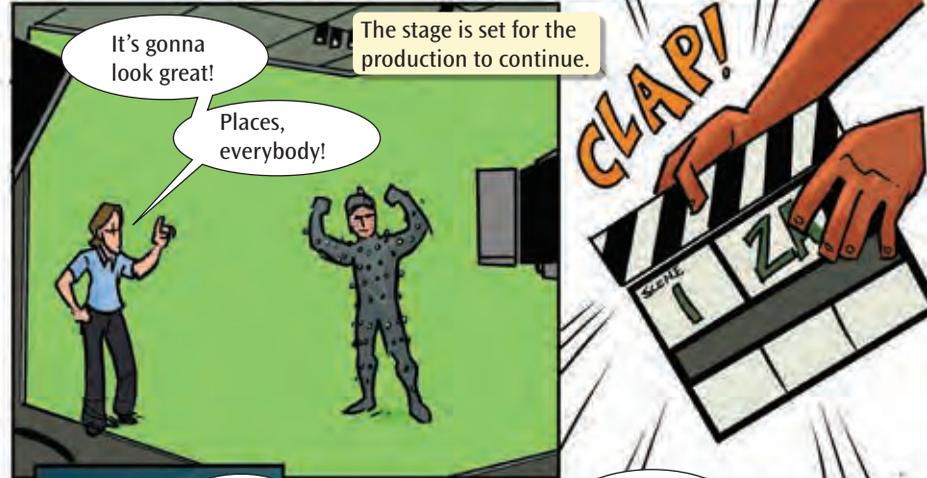


We added joints to the digital model. Now, it can move so that Talos looks real.



Then, we record your movements using the markers stuck to your suit as guides for the digital model.

Once we have all the movements recorded, we'll animate Talos using those movements. Then, we'll add the digital character to the live action!



It's gonna look great!

The stage is set for the production to continue.

Places, everybody!



Huh?

Wouldn't it be great if it were that easy?

Harryhausen awakens. He's been dreaming in his studio the whole time!

Ray Harryhausen gets back to work in the depths of the night, alone once again.

# Motion Capture in Action

The most difficult task for a director may be to create realistic fantasy creatures that audiences will believe exist. Part of the director's challenge is to make unique shapes and textures for these beings. The other more difficult part is to animate the character in a realistic way.

Motion capture does this. The major skeletal joints of an actor are marked with reflectors. The actor then performs a scene while a digital camera records it. The recording is then run through software. The computer identifies the movements of the markers on the actor. Then it applies those movements to a CGI character. The animated character takes the place of the live-motion performer.

a full body suit designed specifically for human motion capture



## Gollum

Actor Andy Serkis played the completely computer-generated character Gollum from *The Hobbit: An Unexpected Journey* and the Lord of the Rings trilogy films, directed by Peter Jackson. Motion capture made it possible. For close-ups of Gollum's face, a small video camera recorded Serkis's facial expressions to introduce the amazingly subtle and realistic character to audiences.

## Sonny from *I, Robot*

In 2004, a film based loosely on Isaac Asimov's classic book *I, Robot* debuted. In it, a police detective works to discover who (or what) is guilty of murder. The film's success centers on presenting a realistic robot. Motion capture proved to be the ideal technique to create Sonny, the accused robot. Actor Alan Tudyk makes Sonny a complex and sympathetic character. The film strongly portrays a world full of humanoid robots.



- © What are some computer-generated things that exist in films that could one day be real?
- © Who is your favorite CGI character? What qualities make that character your favorite?
- © What CGI character do you think you could portray well by wearing a motion-capture suit?

## King Kong (1933)

*King Kong* has been redone many times since the original stop-motion masterpiece. The challenge for each film has been to create a convincing giant ape. Oversized puppets, men in ape suits, or other giant props have never been realistic enough for audiences to accept.

In 2005, director Peter Jackson tackled a modern retelling of the Kong story. He used cutting-edge CGI to help audiences **suspend their disbelief**. Jackson worked with actor Andy Serkis to create the ape. Computer-graphic artists were able to take his work and apply it to the realistic Kong character. The ape seems almost human.

### Andy Serkis: The Future of Acting

Actor and voiceover artist Andy Serkis is one of the most experienced motion-capture actors working today. He has founded his own motion-capture studio, The Imaginarium Studios.

1933 *King Kong*

2005 *King Kong*

## Rise of the Planet of the Apes (2011)

The original Planet of the Apes films of the late 1960s and '70s feature a planet where apes are intelligent and humans are wild. The apes are actors with makeup and prosthetics. This approach was realistic for the time. Audiences flocked to see each film.

In 2011, this franchise was rebooted. Peter Jackson's visual effects company helped create this movie. More realistic apes were made by using the visual effects techniques from 2005's *King Kong*. Andy Serkis portrays the lead ape character. The apes are not only lifelike but also sympathetic. After watching the film for a few moments, it is easy to forget that the apes began as a series of **pixels** on a computer.



## Motion Capture DIY

With the right software and hardware, anyone can create a spine-tingling digital monster. It's as easy as one, two, three!

1. Get a great actor to wear a motion-capture suit.
2. Apply the motion-capture performance to the digital character.
3. Enjoy the finished result with a digital character in your film!



# Virtual Visionaries

Computers weren't designed for the purpose of making art. A few creative visionaries have explored and tested the ways computers can be used. They have set the stage for dynamic CGI and animation.



**Walt Disney**

Walt Disney encouraged new ways to think about hand-drawn animation. Disney and his animators created the first cel-animated feature-length film in 1937. *Snow White and the Seven Dwarfs* was a huge hit.



**Ed Catmull**

Ed Catmull is a computer expert who saw that computers could be used in creating animations. He developed new approaches in computer graphics and digital filmmaking. In 1972, his CGI hand animation was a leap forward.



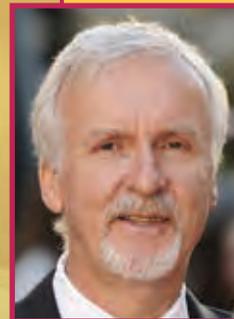
**George Lucas**

George Lucas made the first *Star Wars* film in 1977. He knew that he would need new approaches to create the right effects for his films. He founded Industrial Light & Magic to create the effects and to pioneer the use of CGI.



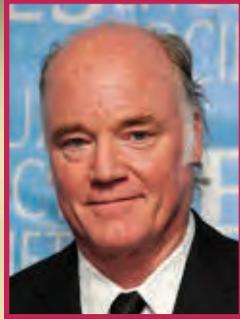
**Stephen Lisberger**

Stephen Lisberger's use of computer graphics started in the late 1970s. He created a studio to make films that used computer graphics. His short film of the character Tron led to innovative ways of making movies.



**James Cameron**

James Cameron wanted to find new technologies to create realistic special effects. One scene in his 1989 film *The Abyss* called for a "tentacle" of water to reach into an undersea base. It took Cameron six months to produce the final sequence. The scene ran for just over a minute!



**Phil Tippett**

Phil Tippett followed in the footsteps of Ray Harryhausen in creating stop motion. *Jurassic Park* director Steven Spielberg decided to create dinosaurs through CGI. Tippett was the right artist to merge stop motion with digital animation.



**Peter Jackson**

Peter Jackson's *Lord of the Rings* trilogy features the first use of motion capture. Actor Andy Serkis wore a costume that allowed his movements to be recorded. Those movements were then used to animate the CGI character of Gollum.



**John Lasseter**

John Lasseter was an animator for the Walt Disney Company. He preferred to use CGI instead of cel animation and got hired at Lucasfilm. He managed a department that would ultimately become Pixar.



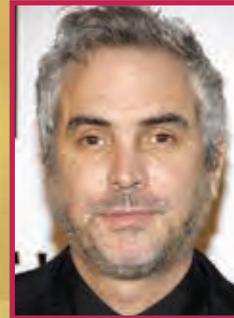
**Kerry Conran**

Kerry Conran devised a technique for using live actors but with completely CGI sets and backgrounds. *Sky Captain and the World of Tomorrow* was the first film to be created in this new way.



**The Wachowskis**

For their film *The Matrix*, the Wachowskis needed an effect that froze time. To create it, cameras were arranged around an actor as he moved. A computer blended the photos into an animation.



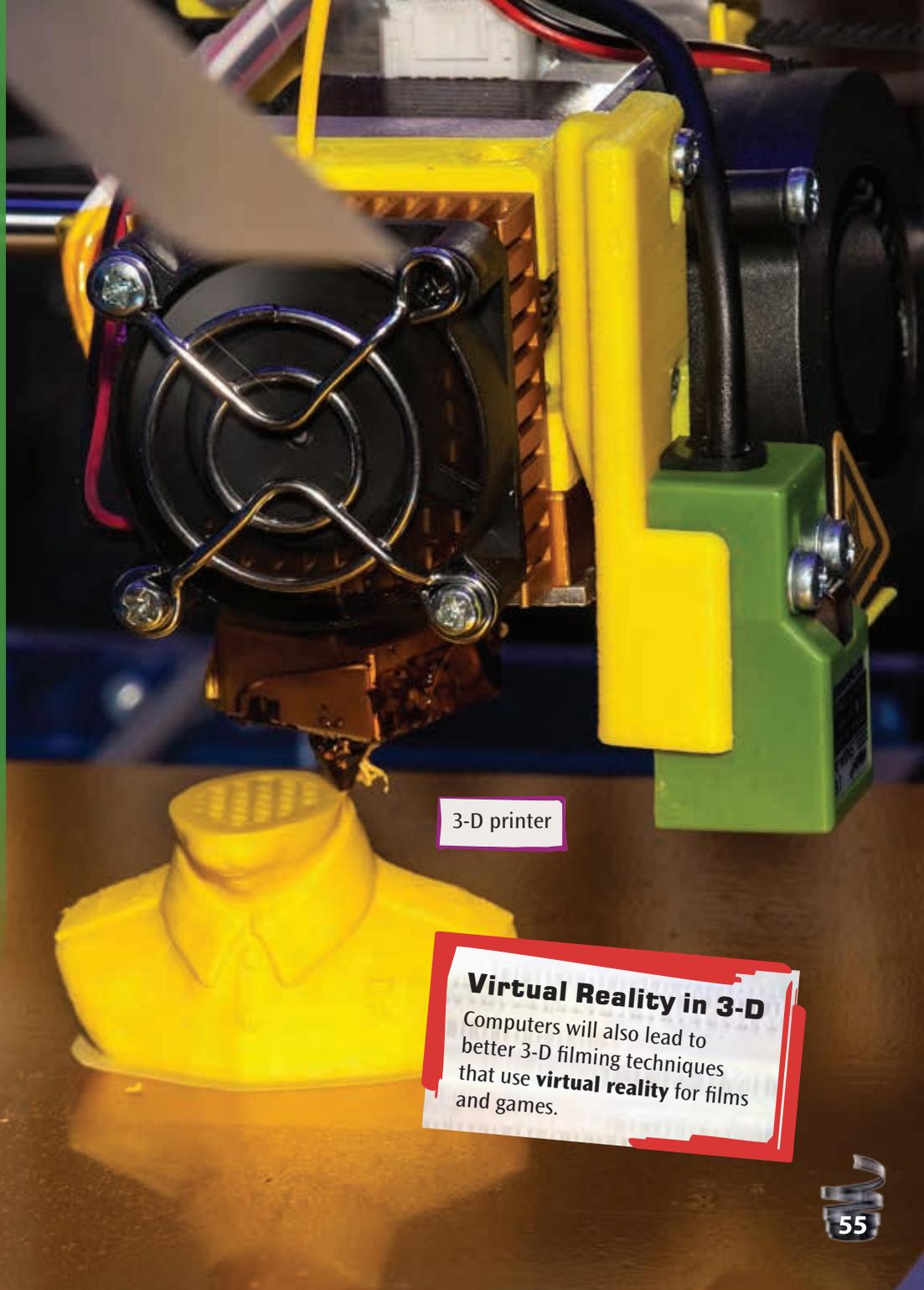
**Alfonso Cuarón**

In Alfonso Cuarón's film *Gravity*, nearly all the scenes were computer generated. The live actors were filmed separately. Computers were used to create the effects. They were also used to join together the individual effect shots.

## What's Coming Next?

We have seen some remarkable advances in the special effects used in film and television over the last few decades. Film directors are at a point where their most wild and creative visions can be captured and projected onto screens in convincing ways. What will they do next? What's the next step after realism has been achieved?

You can bet that computer technology will continue to advance and introduce faster and less-expensive shortcuts for CGI. For example, 3-D printers are making it possible to craft suits of "armor" and other costume pieces. First, a body scan of an actor can be recorded on a computer. Then, a computer-generated costume can be sent to a 3-D printer for fabrication. This method simplifies the traditional process. At one time, actors had to have full-body plaster casts made to make armor. This was an arduous process for the actors. It was also quite a challenge for the artists and animators who made the prosthetics from the casts.



3-D printer

### The End of Actors?

As advances are made in CGI, some actors worry that computerized characters will replace human actors. The art of acting has been around since ancient times and is enjoyed in many formats. It seems unlikely that actors will ever be replaced. In fact, they're at the heart of some of the best CGI!

### Virtual Reality in 3-D

Computers will also lead to better 3-D filming techniques that use **virtual reality** for films and games.

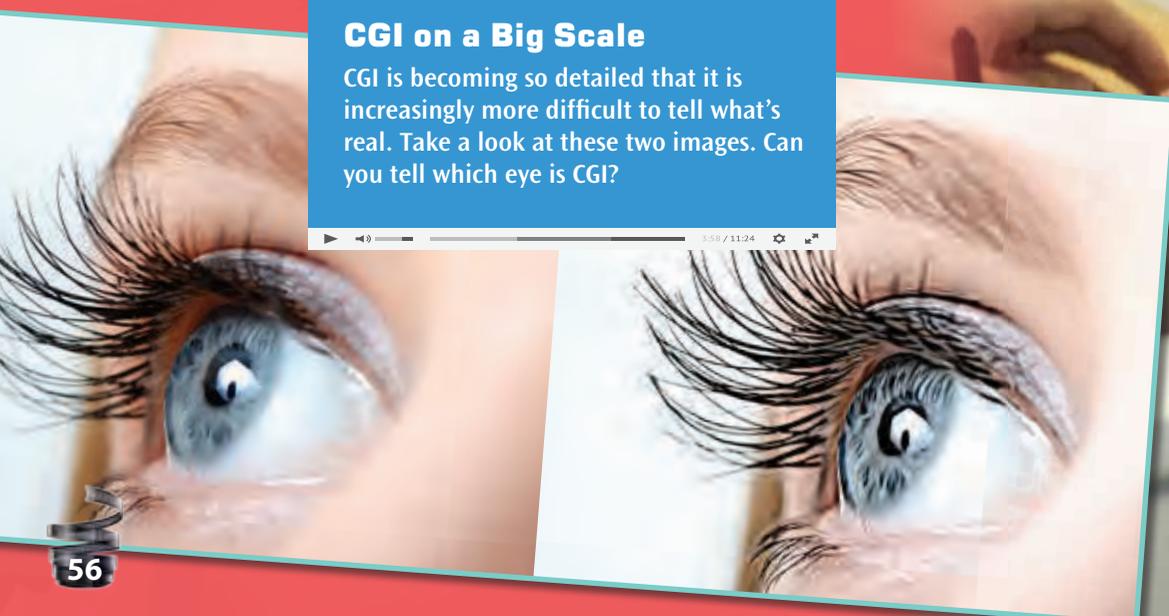
Advances in computer technology will also enable new generations to create stunning visuals. All they'll need are modest computers to produce amazing effects. And it'll cost a fraction of what it costs now. Experts keep squeezing more capabilities into smaller chips and machines. Lower prices have a way of freeing creativity! They allow a forum for the seemingly impossible to become real.

The next breakthroughs in CGI may be as unknown to us as the motion capture used in the newest *King Kong* would have been back in 1933. Perhaps the most important part of the next advances in special effects will be how they make possible a renewed focus on the script and characters. The best visuals support the film rather than steal the spotlight from the characters and the story. Audiences may no longer go to the movies to check out its special effects—they will be there to watch a great story unfold!



### CGI on a Big Scale

CGI is becoming so detailed that it is increasingly more difficult to tell what's real. Take a look at these two images. Can you tell which eye is CGI?



### Living Forever

CGI has made it possible to include actors who have died during the production of new films. When actor Paul Walker died during the filming of his last movie, CGI as well as a body double were combined to include him in new scenes.

# Glossary

**animation**—a way of making movies with a series of drawings, constructed figures, or computer-generated images

**animatronic**—electronically controlled robot

**anime**—a style of animation created in Japan that uses bold colors and stylized characters

**armature**—an internal “skeleton” inside a sculpture or robot

**cel animation**—an art technique where paintings on separate sheets of clear acetate (cels) are shown rapidly one after another, creating the illusion of movement

**computer graphics**—pictures, shapes, and words produced by a computer

**cosmos**—the universe and all the astronomical bodies within it

**crude**—very simple and basic, showing minimal skill and craftsmanship

**cutting-edge**—the most advanced; the newest thing

**digitized**—turned a shape into computer coordinates

**disclaimer**—a statement made to avoid misunderstanding

**hardware**—computer equipment

**Herculean**—related to extraordinary intensity

**input**—to feed information into a computer

**live-action movies**—movies made with real people and places

**maquette**—a small sculpture, used to digitize a character into a computer

**matte painter**—an artist who specializes in painting backgrounds used in practical effects shots in films

**pixels**—very small dots that form a picture on a screen

**practical effects**—effects filmed using models or other figures and then filmed by a camera

**probe**—a spaceship sent into space to explore and collect data

**prosthetics**—artificial body parts or features used to change an actor’s face or body

**release**—the launch of a movie for the public to see

**sets**—constructed environments where movie scenes are filmed

**software**—the programs that run on computers to perform specific functions

**special effects**—images or sounds created for a movie to suggest something real

**storyboards**—side-by-side drawings that show the events of stories in sequence

**stylized**—having exaggerated features or proportions

**suspend their disbelief**—let go of the reality people think they know

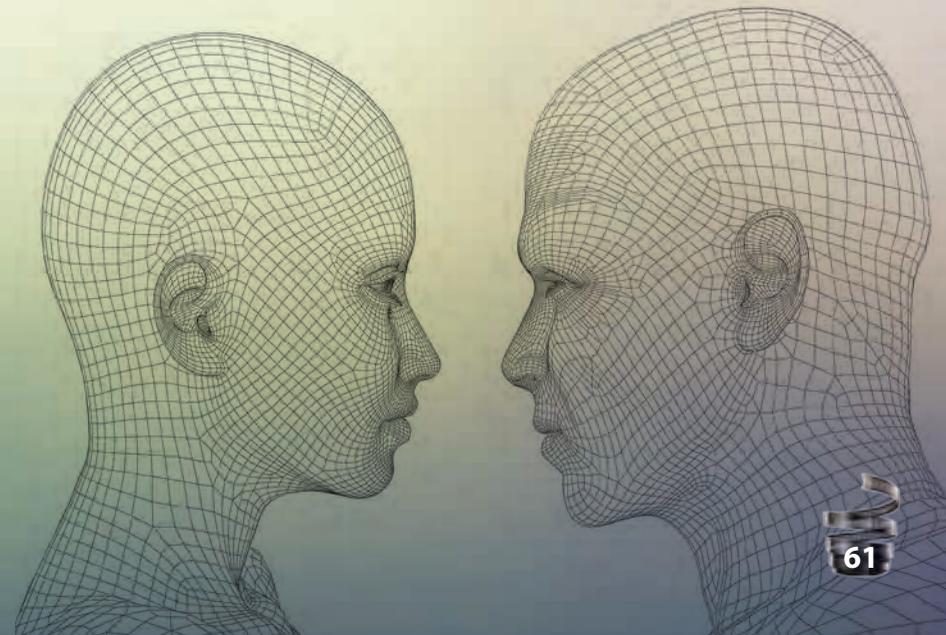
**valiant**—very brave

**virtual reality**—false images created to suggest reality, often seen through special headsets, glasses, or on screen



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## Books

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- Byrne, Bill. 2009. *Movie Maker: The Visual Effects Arsenal: VFX Solutions for the Independent Filmmaker*. Focal Press.
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## Videos

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- War of the Worlds*. Steven Spielberg. 2005. Paramount Pictures.

## Websites

- Pixar. <http://www.pixar.com>.

# Try It!

For an upcoming interview with a prestigious film studio, you must make a short film (3 to 5 minutes) to display your work. It can be an animated film, one using people (friends or family), or other objects (building blocks, clay figures, etc.).

- ⦿ First, draw a storyboard.
- ⦿ Write a script if characters will be speaking.
- ⦿ Gather all the materials necessary for the film.
- ⦿ Create or design the set depending on what type of movie you're producing. You may also need costumes.
- ⦿ Rehearse the story several times, making sure everyone involved knows what to do and say.
- ⦿ Record your movie. Invite others to watch your production.



## About the Author



Tim Bradley grew up watching films loaded with special effects. He would constantly draw spaceships and aliens, and had so much fun that he decided to do it for a living! As a professional artist and author, Tim writes about the wild stuff of science and science fiction. Tim lives in sunny Southern California with his wife and son.

## Reader's Guide

1. Some people believe that the old ways of making movies—using practical effects and stop motion—are more of an art form than CGI. What is art in moviemaking? Use details and examples to support your view.
2. How do science, math, and art work together in CGI to create today's movies?
3. Compare and contrast two movies from this book that you've seen. Focus on the use of CGI and how it helped or hindered the movies.
4. Look back at pages 50–53. Which three people do you think made the most important innovations in the area of movie special effects? Explain your choices.

