2D & 3D Animation

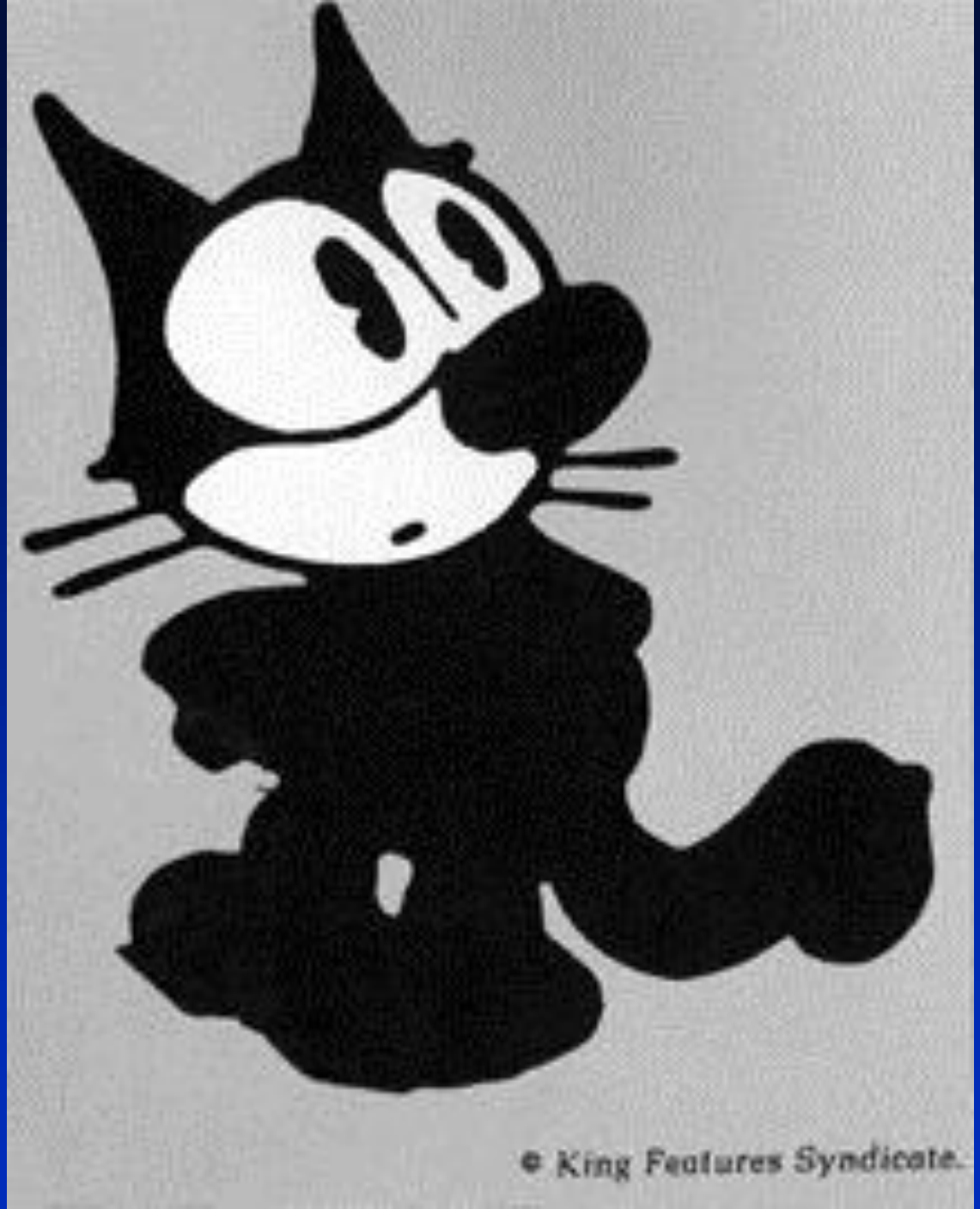
NBAY 6120

Donald P. Greenberg

March 21, 2016

Lecture 7

2D Cel Animation


© King Features Syndicate.

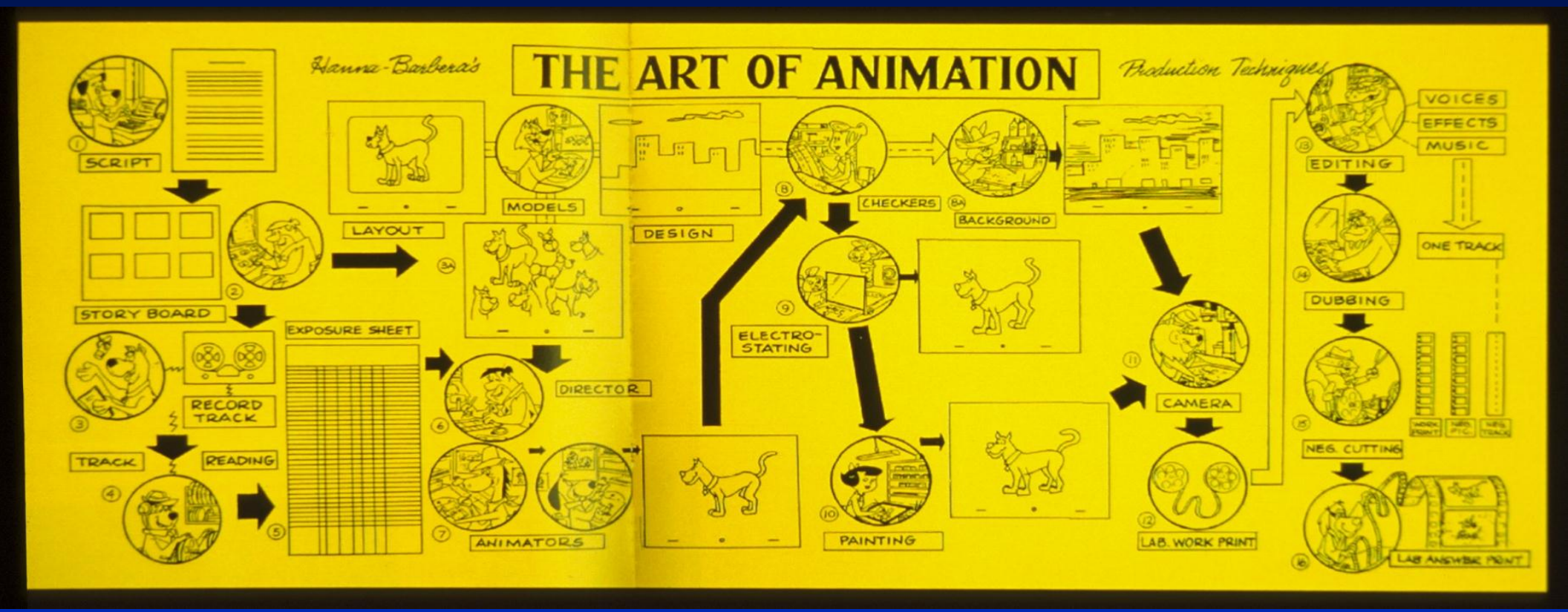
Cartoon Animation

- **What is cartoon animation?**
  - A sequence of drawings which, when viewed in rapid succession, create an illusion of continuous life-like movement.
- **Cel animation**
  - Process in which background and action are drawn separately
  - Background and action are placed together when ready to film

Steps for creating cel-animated films

- ✓ Background is drawn and colored
- ✓ Key animator draws the most important, or key, frames of character
- ✓ In-betweener fills in the key frames with all the action required of the character
- ✓ Cels are inked and painted
- ✓ Checker places each cel on the background and checks the quality of art and movement
- ✓ Each cel is filmed

Cel-animation



HANNA-BARBERA PRODUCTIONS

SONG
"MY FAVORITE TIME OF THE YEAR"
PROD. #110-1

FOLDS SC. #110 P.-35

SC. 111

FRED: MERRY CHRISTMAS, MISTER SLATE!

PAGE 3½ PROD.

(FX: DOOR SLAM!)

REG-1

1

OCT 21 1977

REVISED 10/13/77

L.O. CHECK BG'S FOUND SC. # 86 FOR CONSISTENCY

FINAL PRODUCTION BOARD

CUT

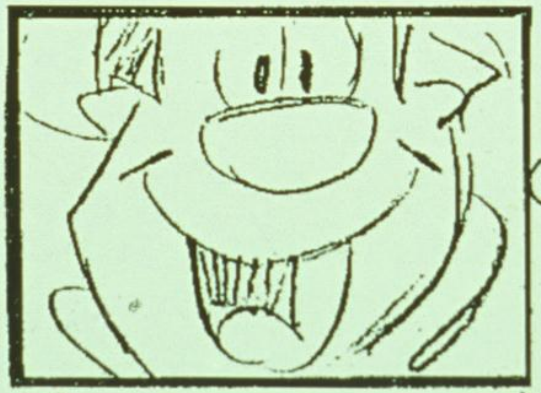
111A

(FRED SAGS)

FRED: (RELIEVED) WHEW!

CUT

111B



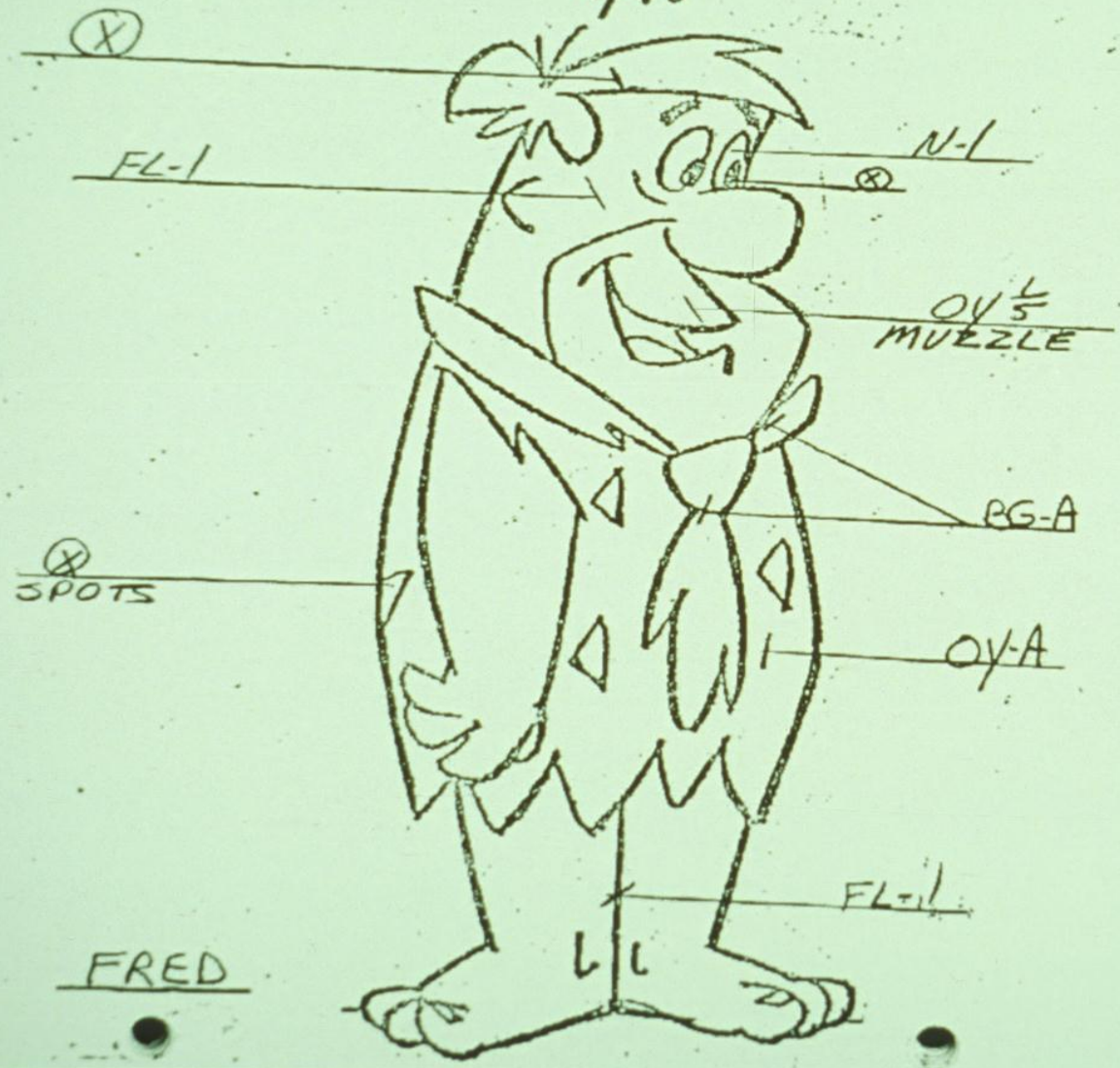
(INTO HAPPY REALIZATION)

OH BOY! OH BOY! OH BOY! OH BOY!

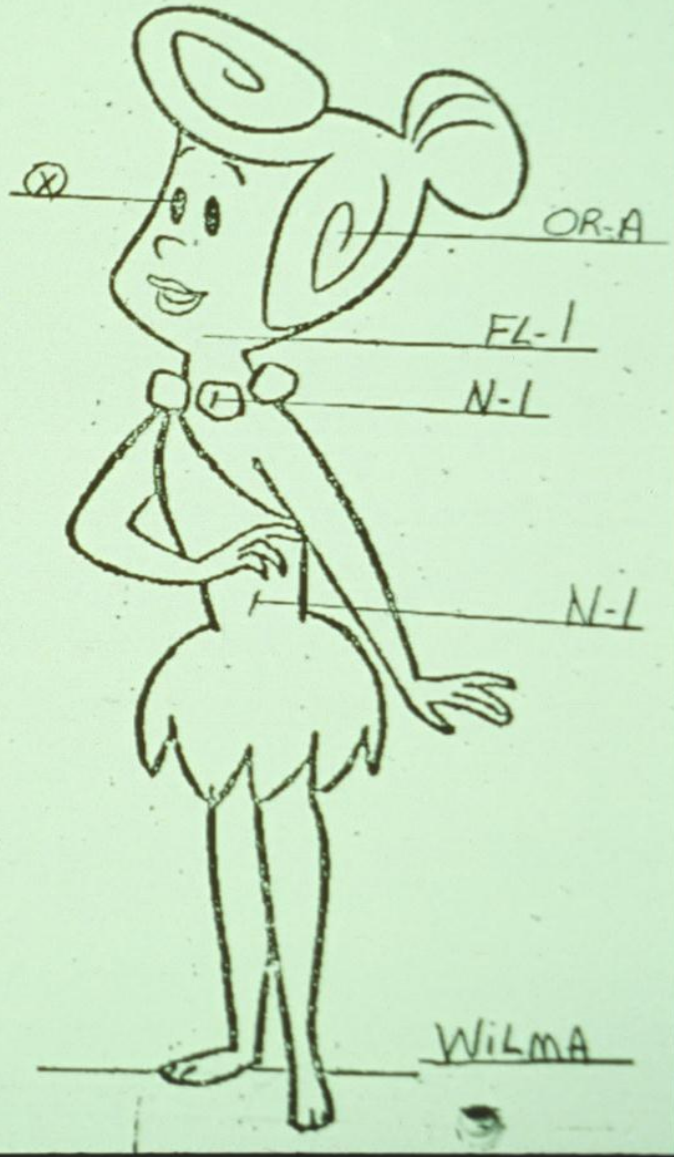
FRED: YABBA DABBA DOO ——!

154 SERIES THE FLINTSTONES

11/78



FRED



WILMA

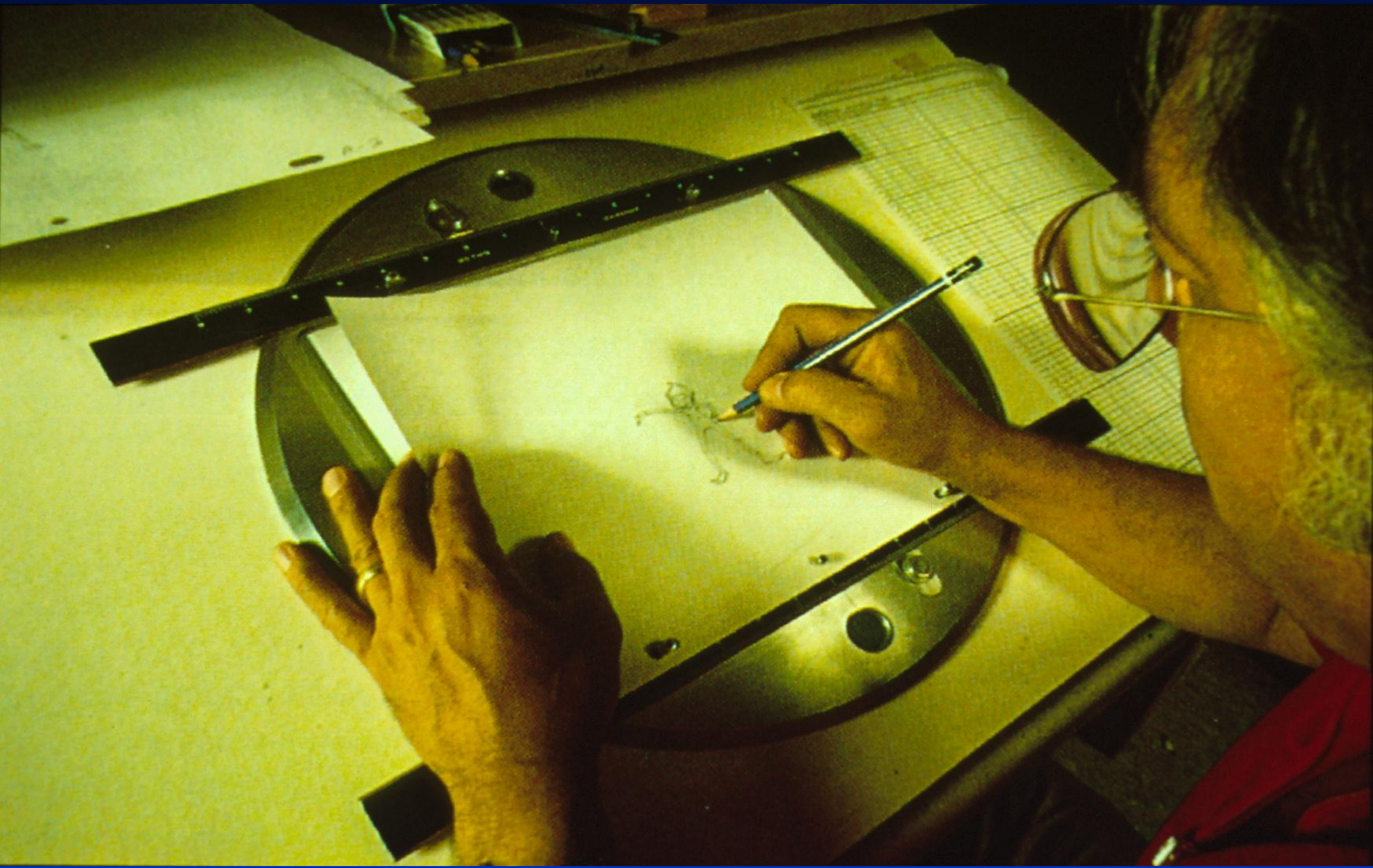


Figure 2a: Walt Disney's multiplane camera stand

Automating the production process with computers for keyframe animation

- **Almost the entire process of creating an animated film can be automated with a computer**
  - Backgrounds can be drawn and colored on a computer
  - Key frames should still be drawn by key animator
  - In-between frames can be interpolated with a computer
  - Cels can be inked and painted on a computer
  - Cel and background can be put together and checked with a computer and then filmed

Approximate Employee Distribution

• Storyboard/Screen Writers	5
• Background	10
• Animators (140)	
– Key	25
– Ass't	40
– In-betweeners	75
• Checkers	10
• Inking/Painting	220
• Sound/Music	5
• Editing	10
Total	400

Automating the production process with computers for keyframe animation

- Backgrounds can be drawn and colored on a computer
- **Key frames are still drawn by key animator**
- **All in-between frames are still drawn by animators**
- Cels can be inked and painted on a computer
- Cel and background can be put together and checked with a computer and then filmed

Advantages of Partial Animation

- All artistic control stays with the animators
- The cost of the most expensive part of the production process (inking and painting) is vastly reduced ($1/10^{th}$)
- Can still take advantage of special features
  - > Zooming
  - > Color changes
  - > Multi-Plane camera simulation
  - > Reduction in scale

Three-Dimensional Computer Animation

Why do we need an animation production pipeline?

- Animated full-length features are huge endeavors
  - Up to 5 years from conception to final (2 years in production)
  - > 500 people involved
- Currently requires big budgets and big organizations
  - $ 100 M - $150M per movie
- Needs a very organized structure to bring the creative process from conception to final product

What is the animation production pipeline?

- Logical organization of the steps required to produce an animated feature film
  - Every company has its own pipeline
  - Every movie changes the pipeline
    - Requirements are changing
    - Save money
    - Increase the quality of the movie

Toy Story 3
Building a Single Frame

1 / SKETCHES There are 49,516 of these sketches in the movie's story reel.

John Lehrer. "How It's Done," Wired 18.06. http://www.wired.com/magazine/18-06

Building a single frame

5 / FINALE Surfaces—walls, clothing, faces—are fed through rendering software that simulates light and shadow. An average frame takes more than seven hours of computing time to render. This one required eleven hours.

John Lehrer. "How It's Done," Wired 18.06. http://www.wired.com/magazine/18-06

John Lehrer. “How It’s Done,” Wired 18.06. http://www.wired.com/magazine/18-06

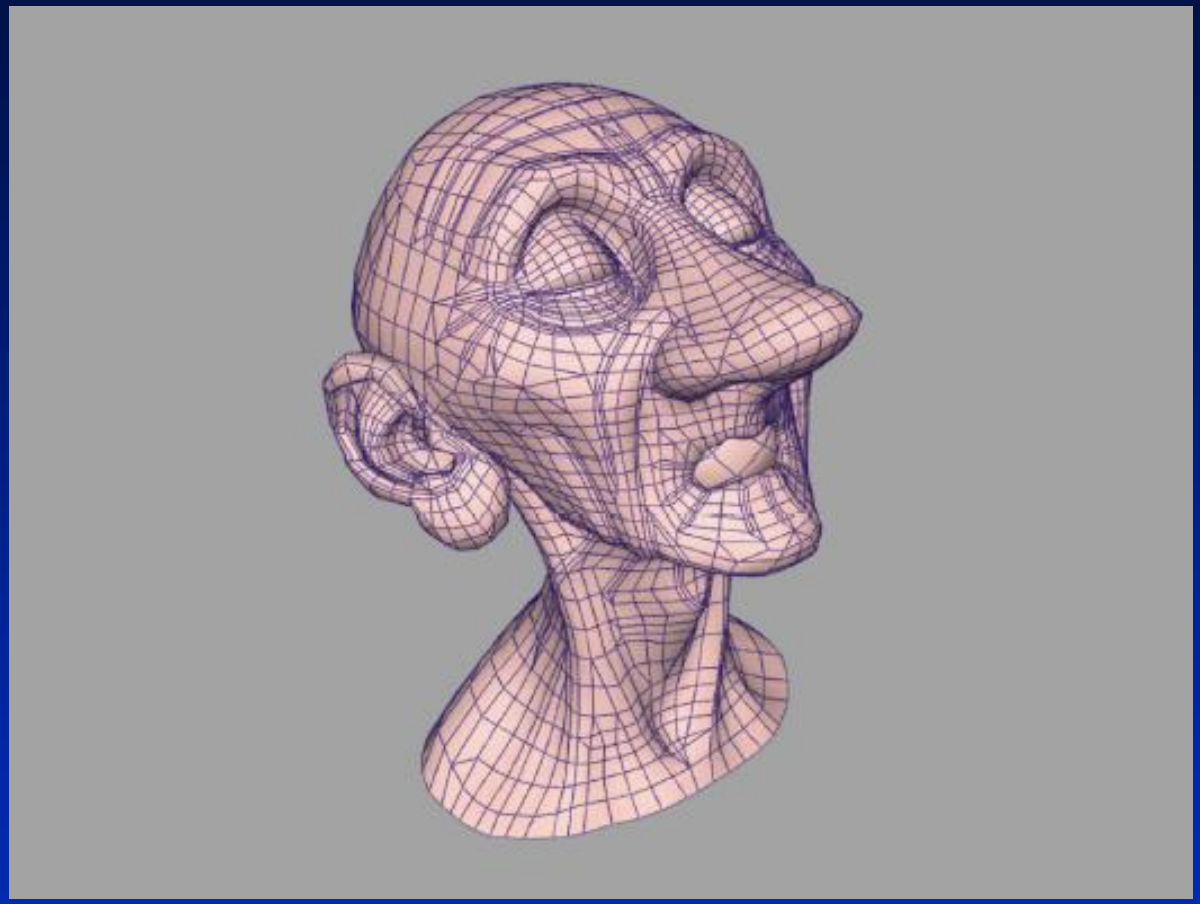
The simplified pipeline

- Many departments

Story	Art	Casting	Editorial
Modeling	Shading Texturing	Rigging	Backgrounds
Layout	Animation	Simulation	Effects
	Lighting	Rendering	

Jan Pinkava – *Storyboard*,

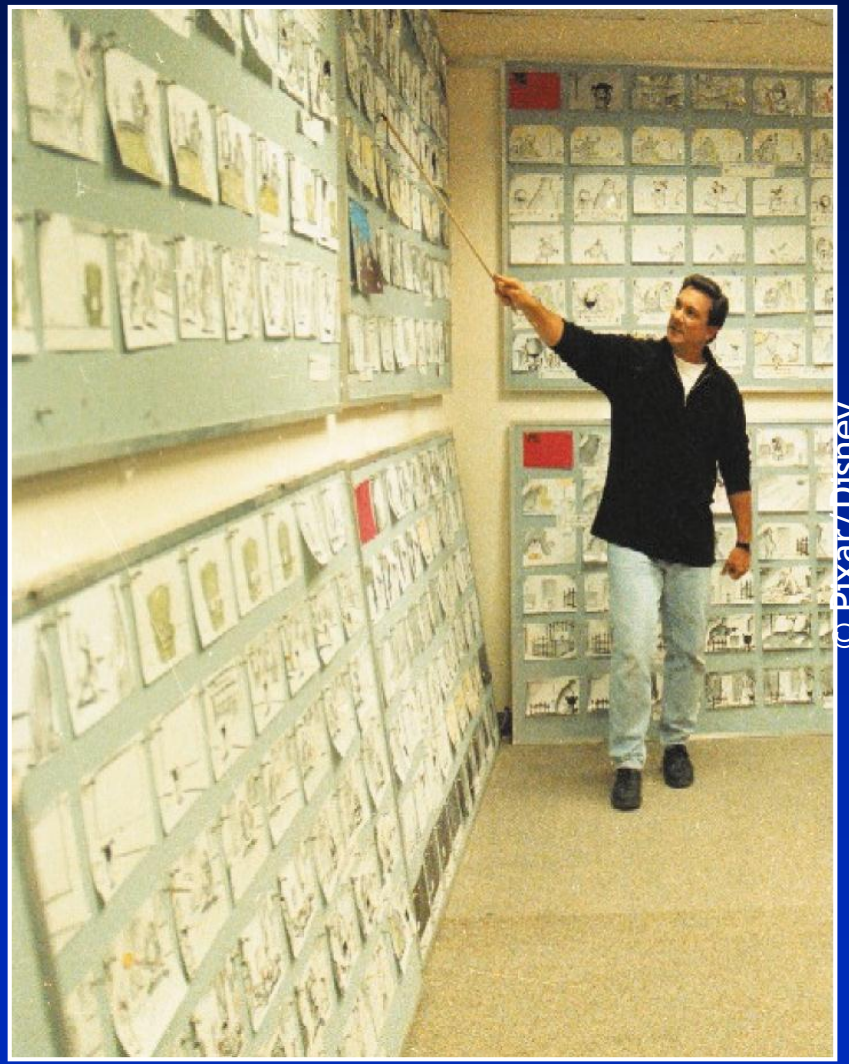
GERI'S GAME (Pencil)



The control mesh for Geri’s head, created by digitizing a full-scale model sculpted out of clay.

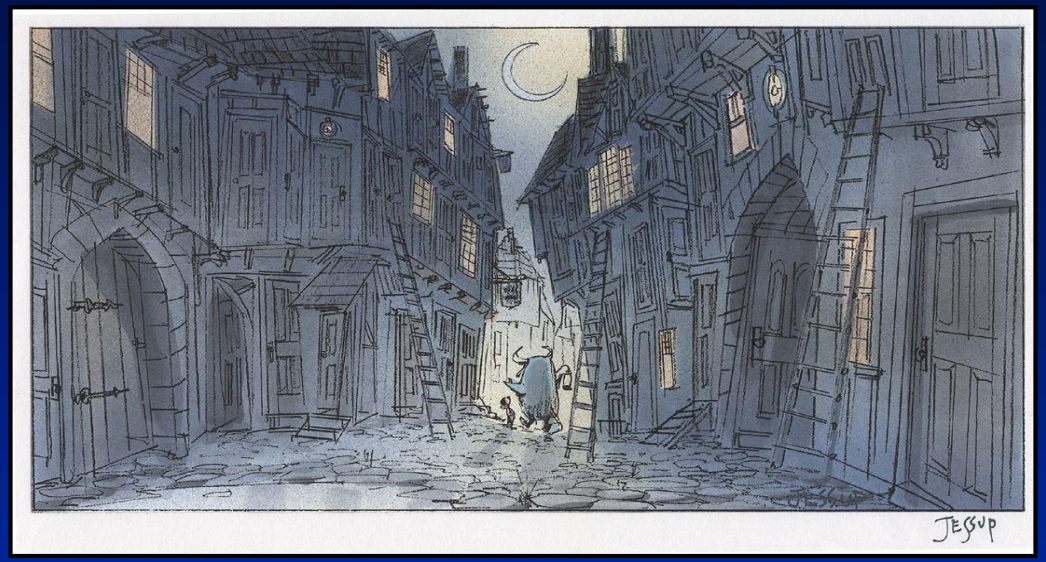
Subdivision surfaces

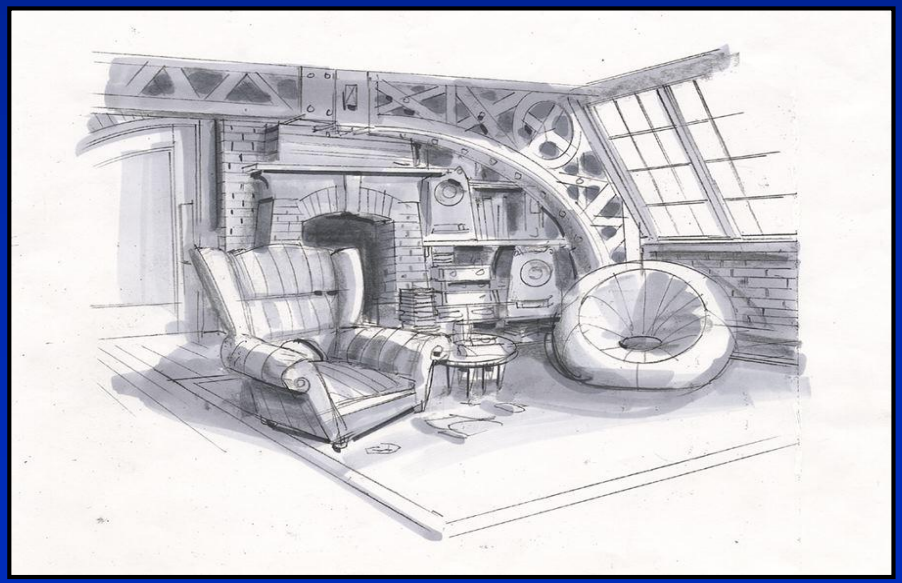
Story Development

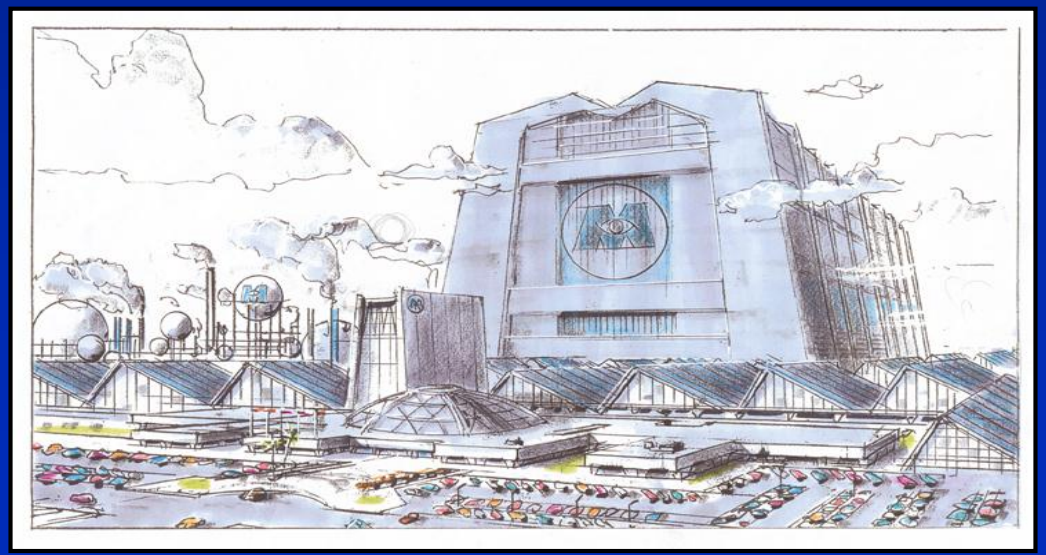


Art Development - Characters

Art Development - Environments

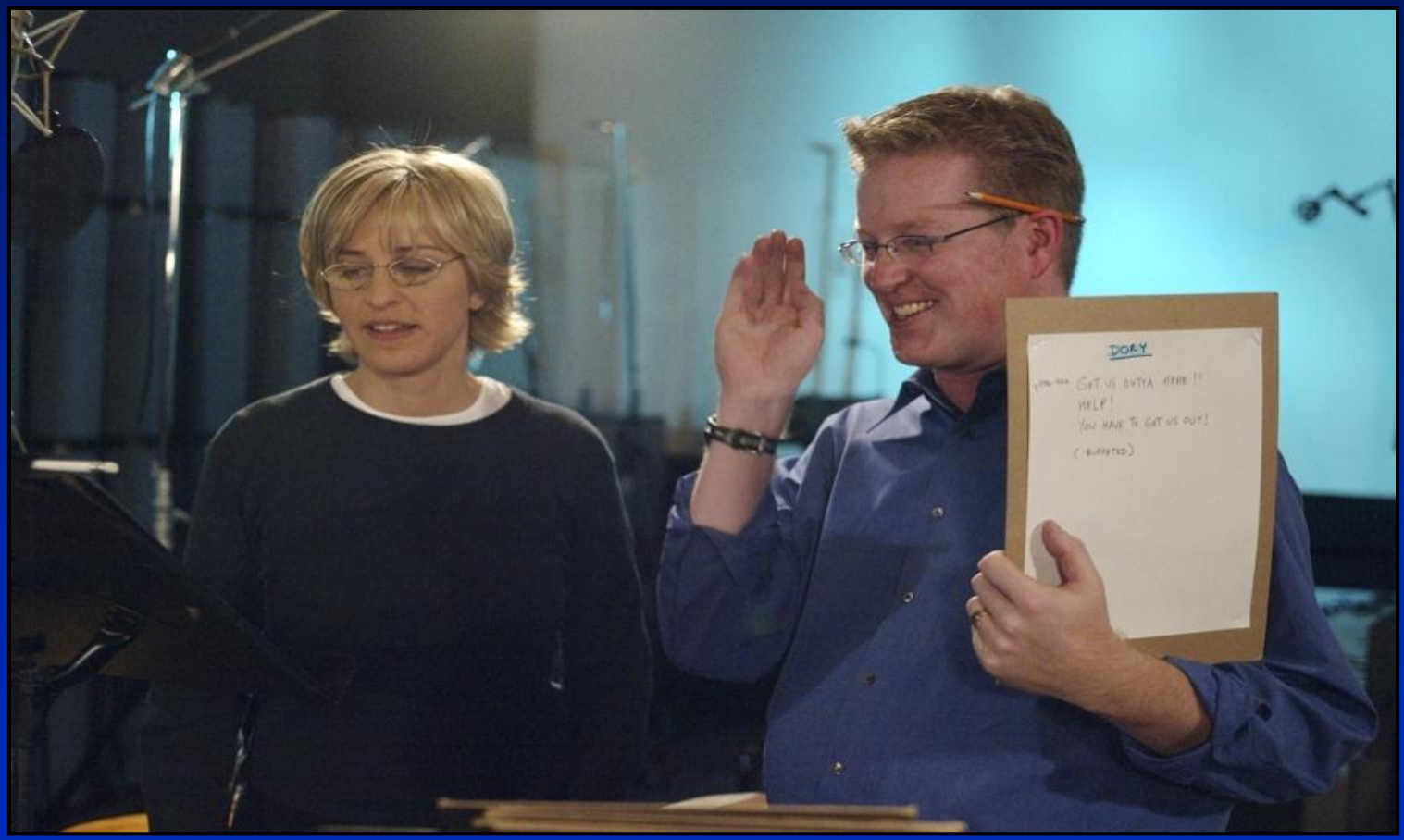






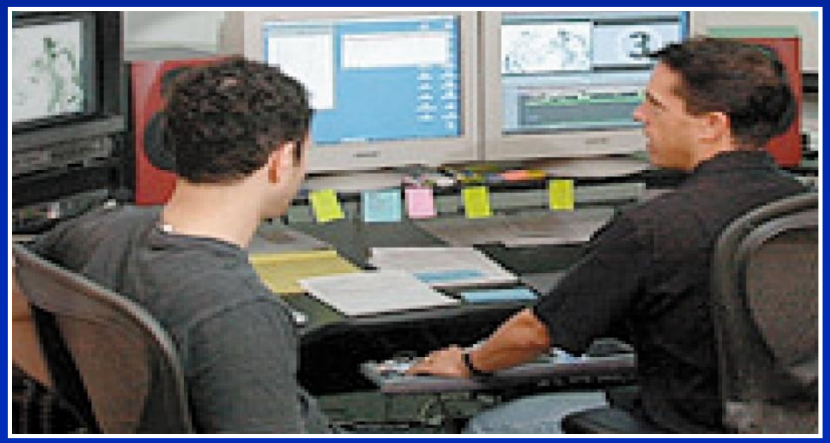
Dialogue Recording

- Useful for animation reference



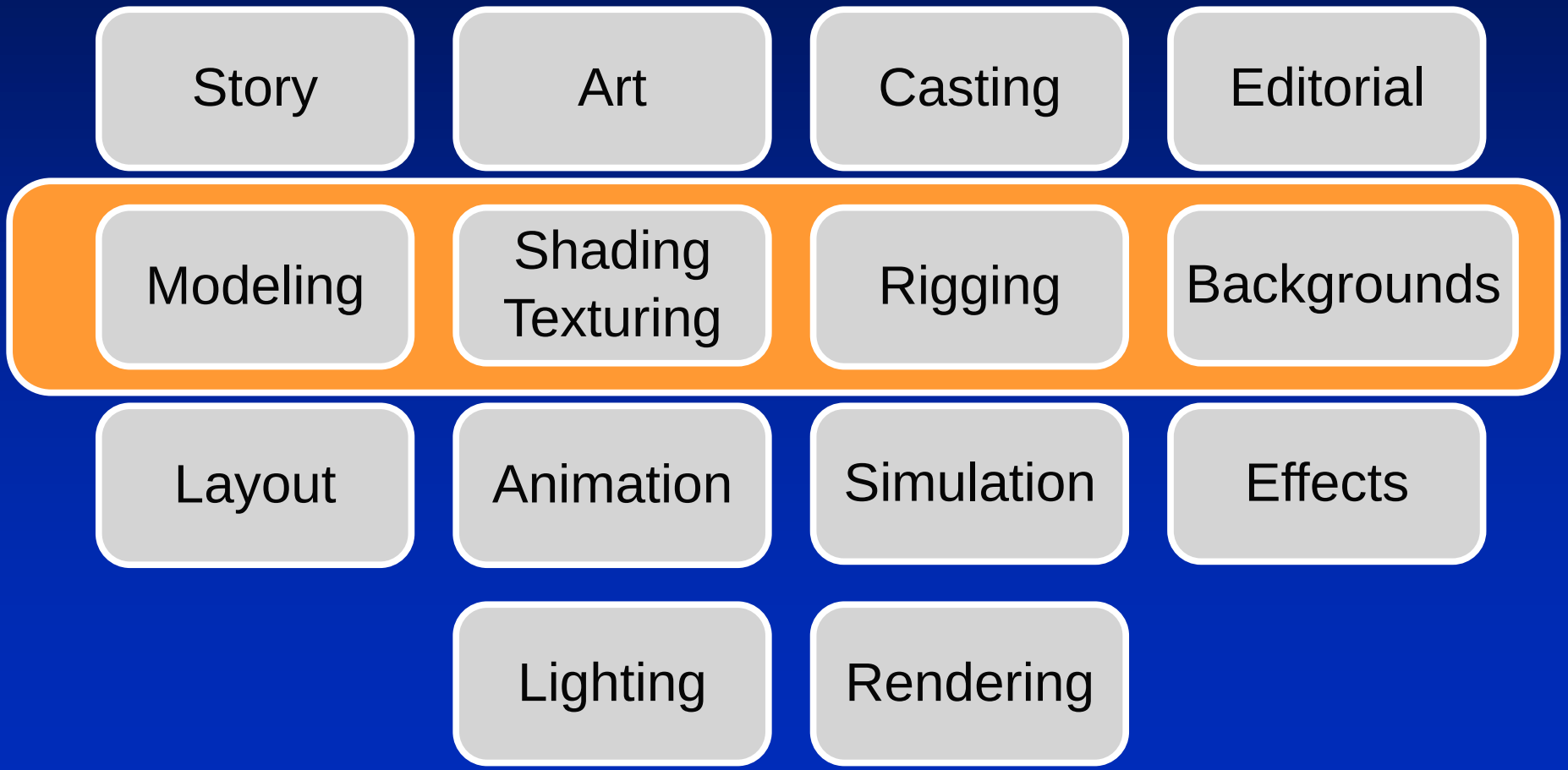
Editorial

- The keeper of the flow
  - Study the timing of actions in the movie
- Manage the editing of the movie
  - Prepare the various releases
- Similar to a traditional studio



The Simplified Pipeline

- Characters and Sets

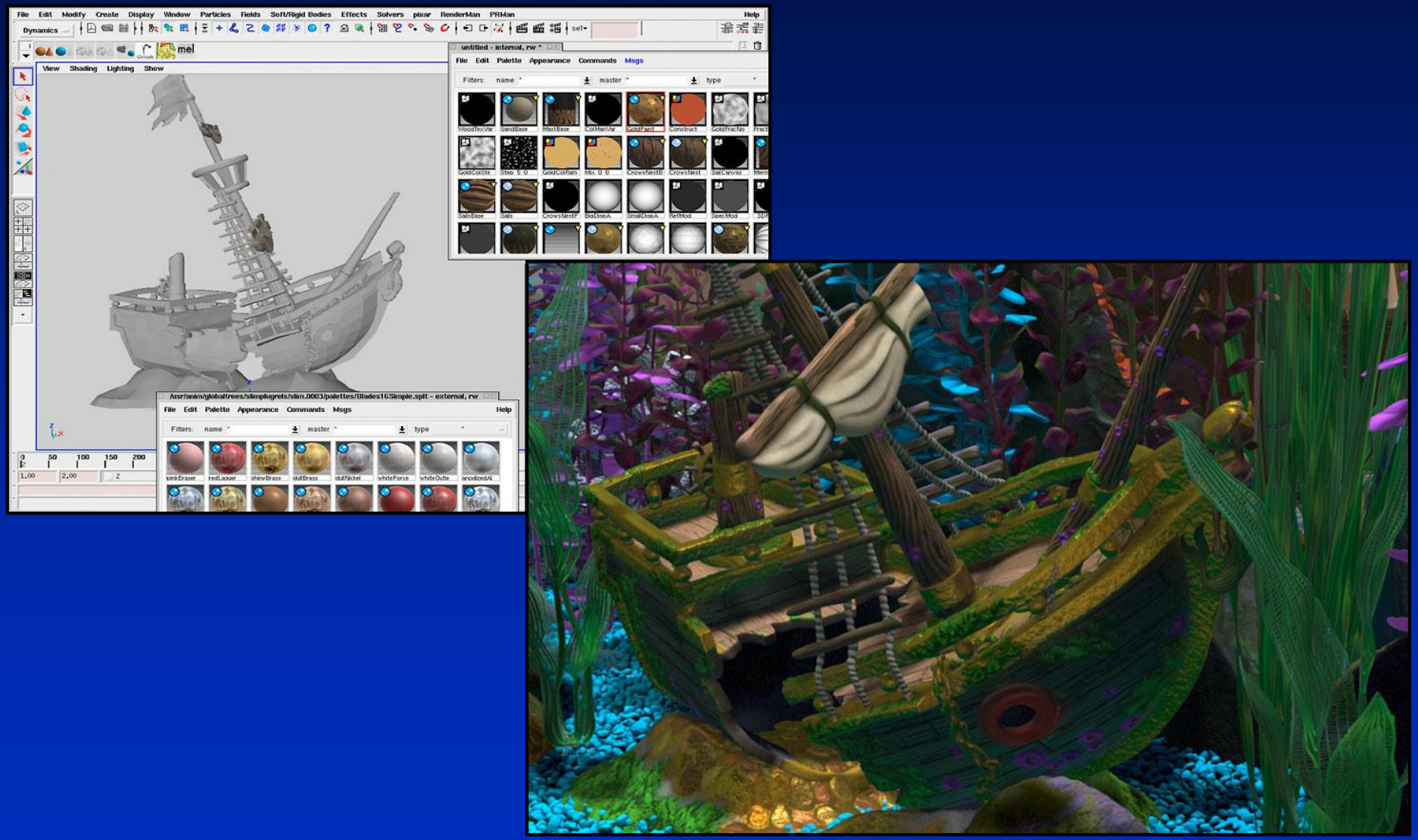


Modeling

- Defines the shape
- Process
  - Starts with art data
    - > Drawings
    - > Sculptures (sometimes scanned)
  - Recreate geometry in the modeling environment
- Models have to
  - Look good – to please the eye
  - Be functional – to fit in the pipeline
  - Work when deformed – for animation

Character Modeling

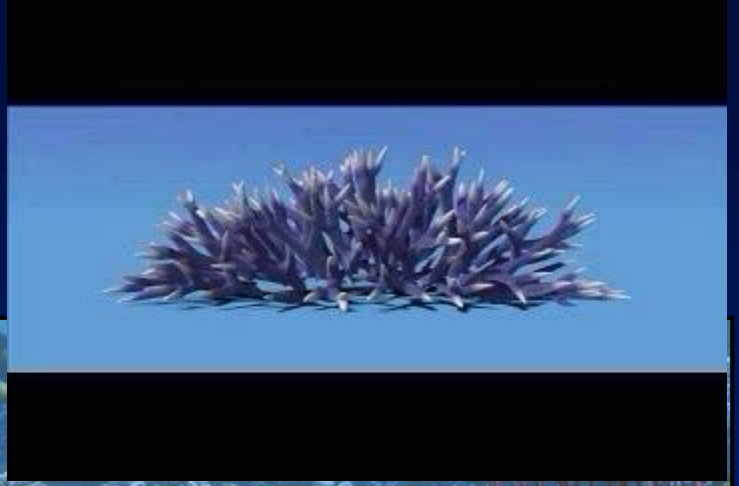
Shading



Backgrounds

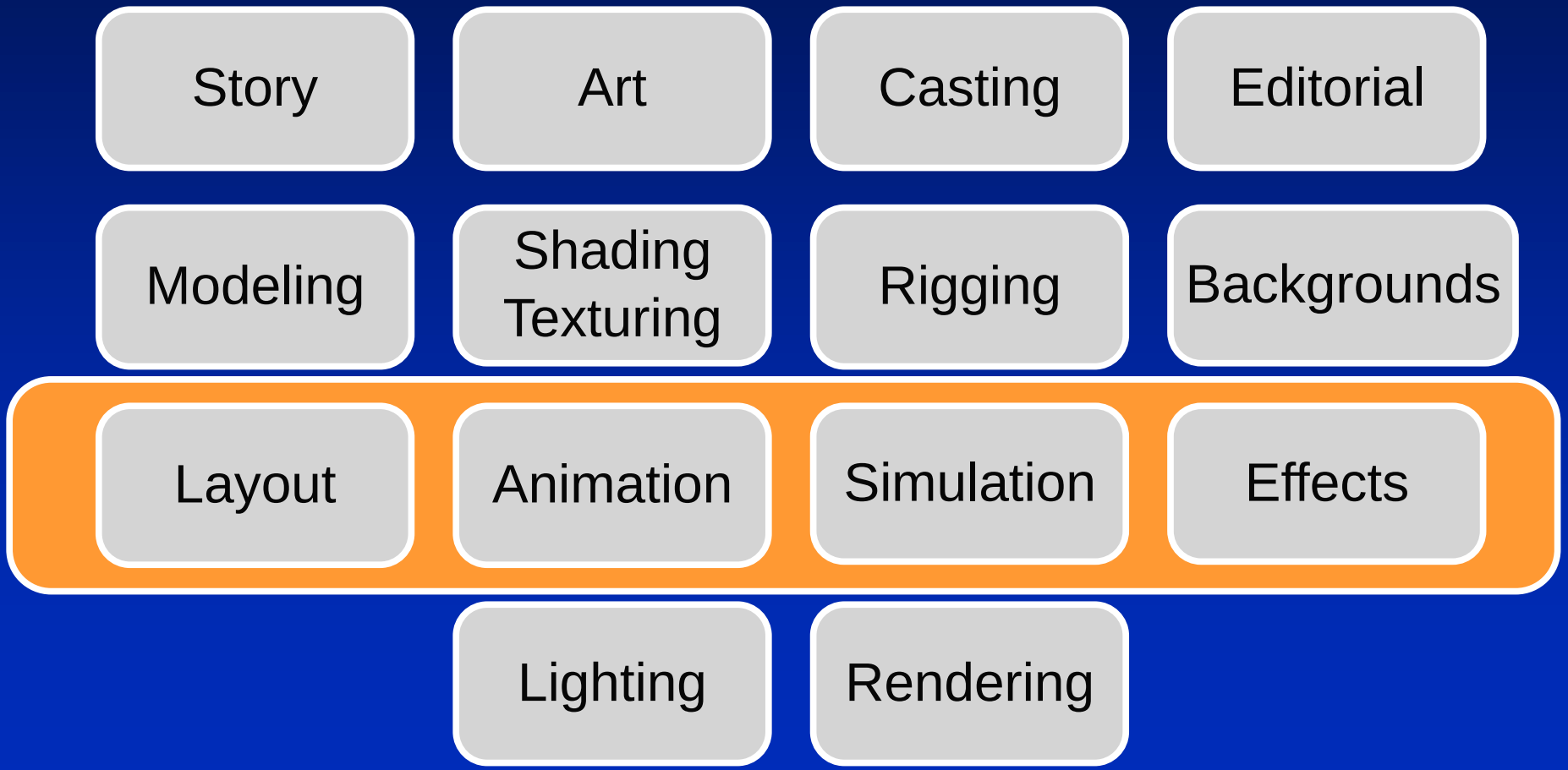
- Creates sets out of props
- Prepares a stage for acting

Backgrounds



The Simplified Pipeline

- Movement



Layout

- Defines the camera
  - Starting position
  - Framing – which objects are seen
  - Movement
- Defines basic object positions
  - Starting point for animation
- Story boards are used as reference

Animation

- Keyframed animation
  - Movement is specified by changing individual controls on characters at various frames
  - Similar to 2d animation
  - Used by Pixar and DreamWorks
- Motion capture
  - Movement is recorded using live actors
  - Editing to fix problems
  - Used by Sony Imageworks, Weta

Animation

- Very time consuming!
  - Requires big budgets and long development times
- Today it is the biggest distinction between large studios and smaller ones
- Hard to develop “economy of scale”

Simulation

- Not possible to animate everything
- Physically-based animation
  - Movement is computed to simulate physics
- Applications
  - Humans: hair, cloth, skin
  - Natural media: water, fire, smoke
  - Special effects: explosions

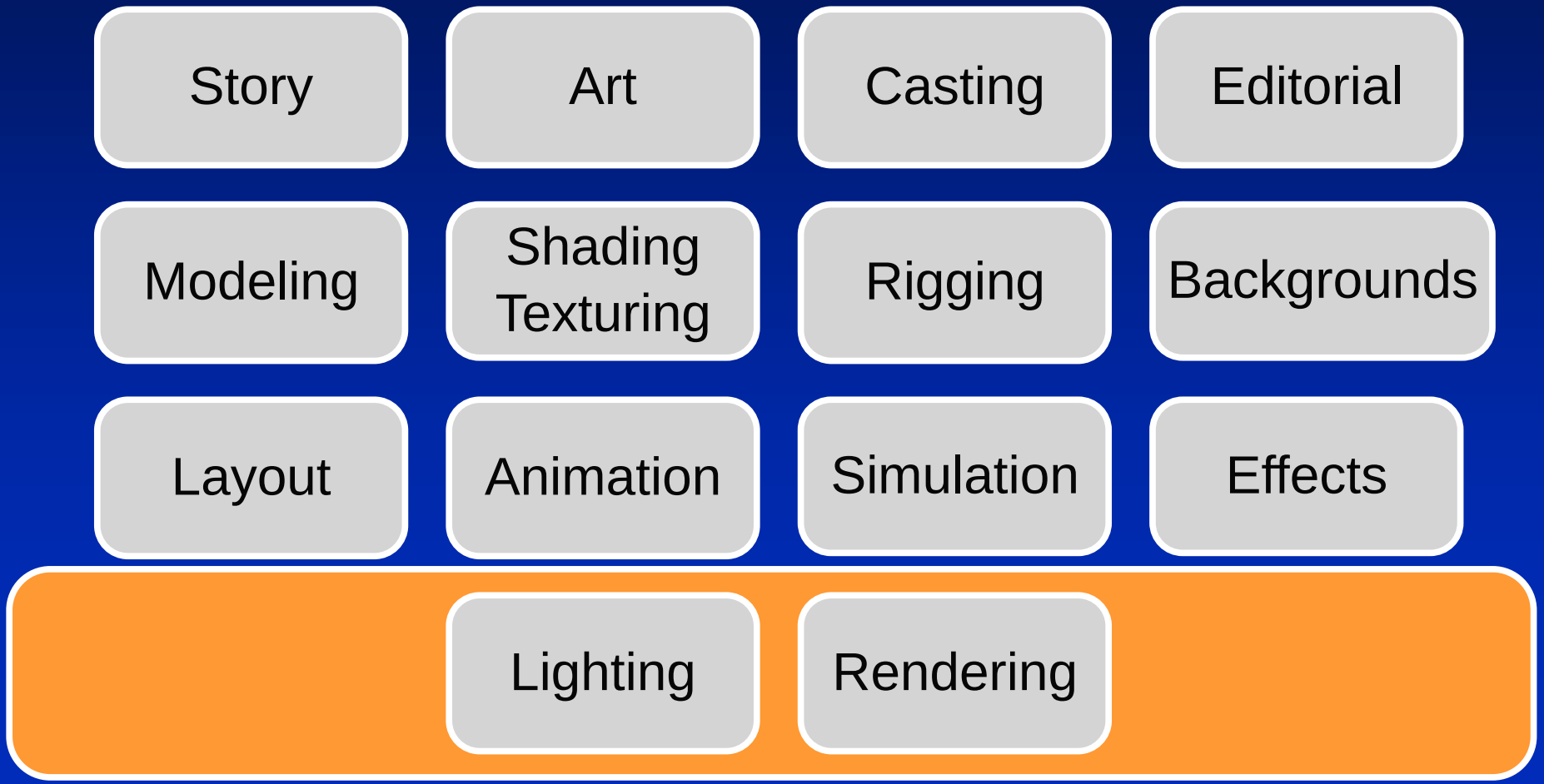
Effects

- Natural media: Water, Fire, Smoke
- Weather: Snow, Rain, Wind
- Special effects: Explosions, Morphing

- Very specific
- Encompasses modeling, animation and shading

The Simplified Pipeline

- Final images



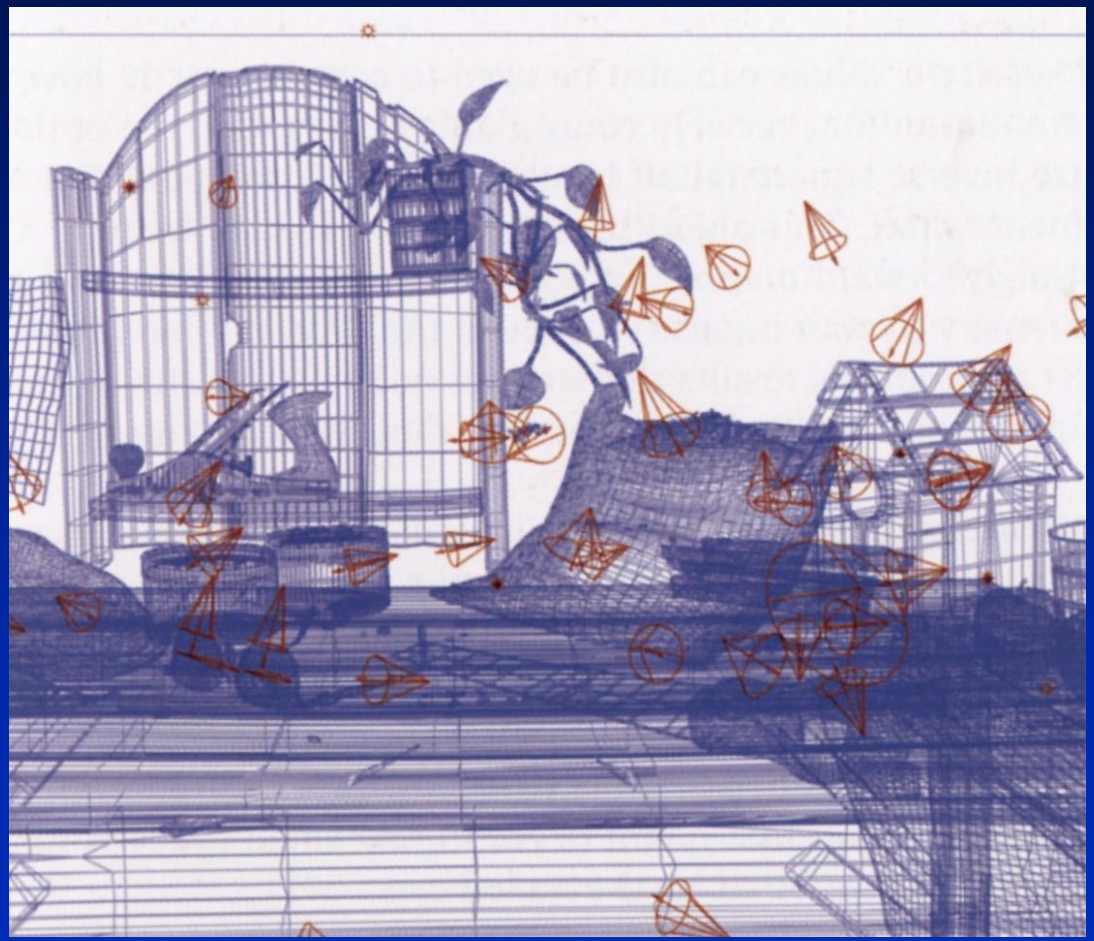
Lighting

- Defines scene illumination
- Process
  - Study real world footage
  - Study material/light interaction
    - > Simple materials: plastic, woods, etc.
    - > Complex materials: metals
    - > Characters: skin, hair
  - Start with art images
  - Add and change lights to obtain the final picture

Lighting

Darren Brooker. “Essential CG Lighting Techniques,” 2003 .

Lighting



Darren Brooker. “Essential CG Lighting Techniques,” 2003 .

Lighting

Particulate Matter

Surge and Well

Caustics

Murk

Reflection Refraction

Rendering

- Compute the final images

John Lehrer. "How It's Done." Wired 18.06. http://www.wired.com/magazine/18-06

End