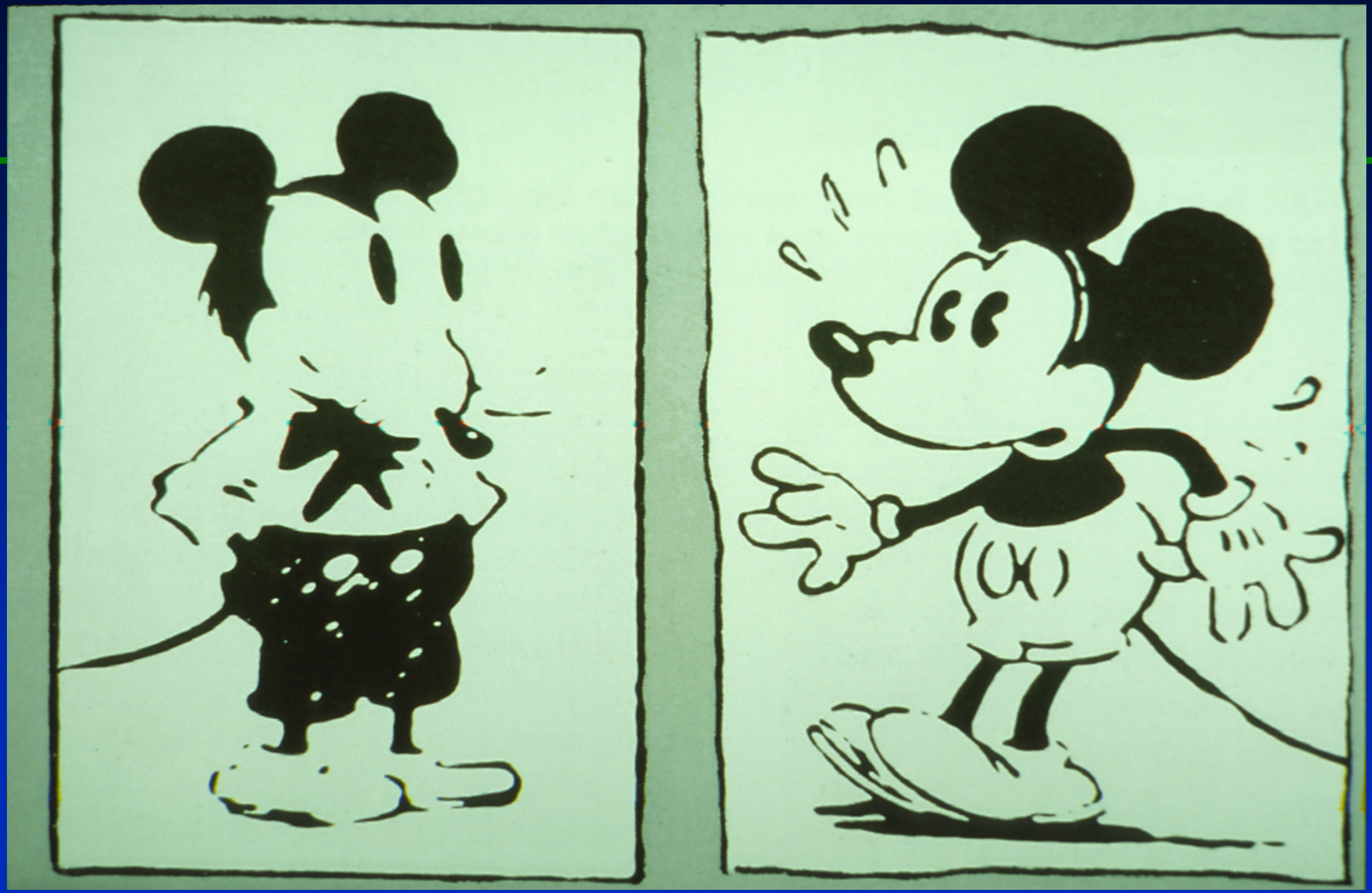
2D & 3D Animation

NBA 6120
Lecture 9
Donald P. Greenberg
February 26, 2018

2D Cel Animation

Mr. Walt Disney




Snow White
And The Seven Dwarfs
the
Disney Vault
www.thedisneyvault.webs.com

William Hannah

Joseph Barbera

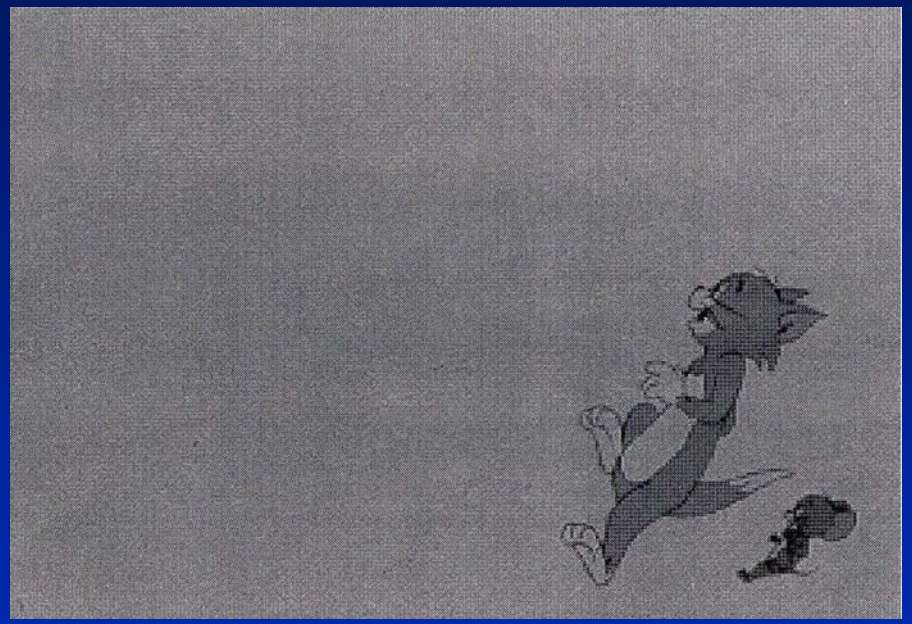
Cartoon Animation

- **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 draws the intermediate 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

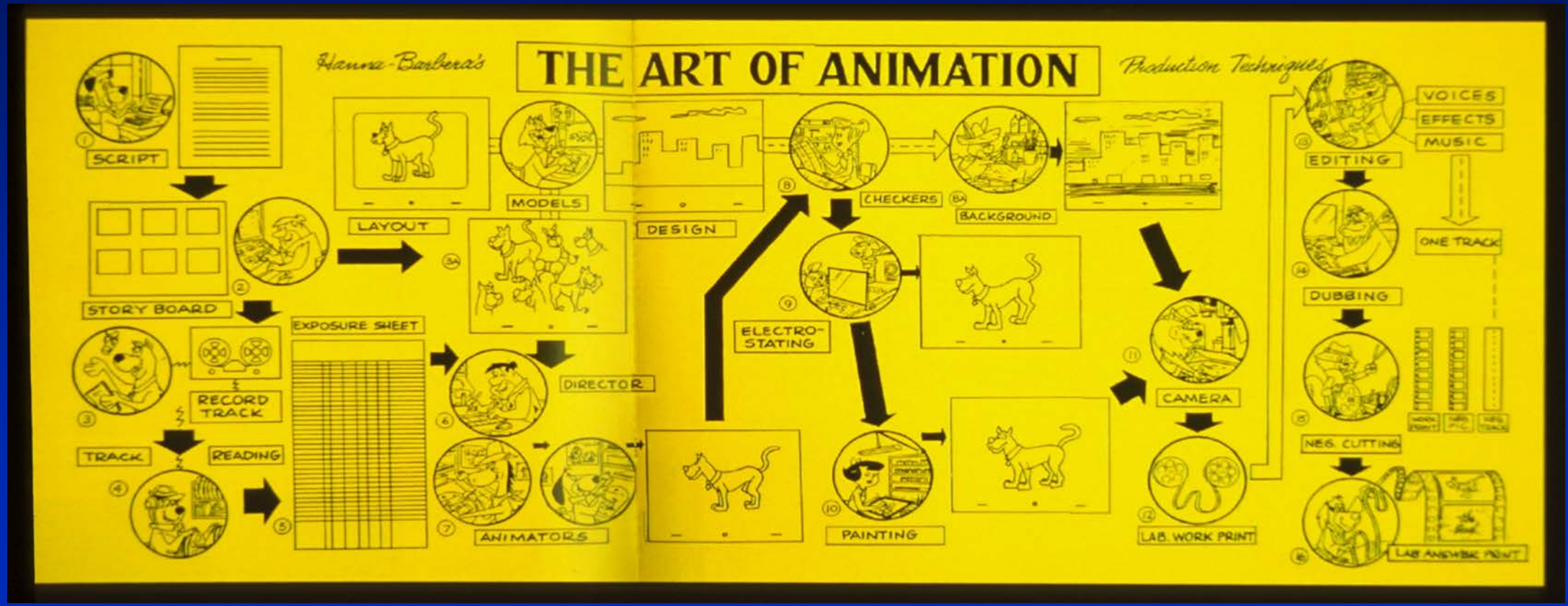
Cel-animation



Standard Animation Cel

Standard Animation Cel
With Background

Cel-animation

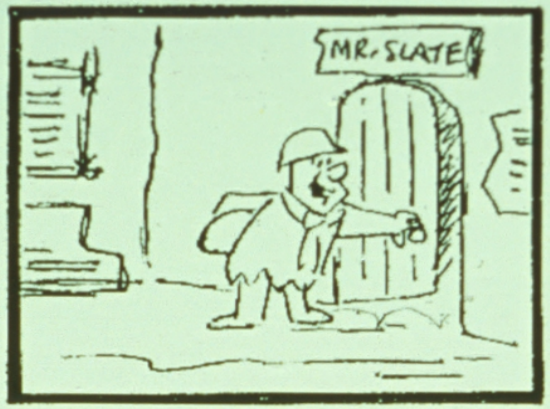


HANNA-BARBERA PRODUCTIONS

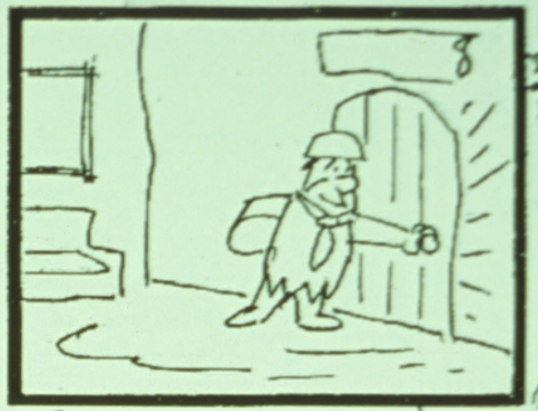
SONG
"MY FAVORITE TIME OF THE YEAR"
PROD. #110-1

FOLDS SC. #110 P.-35

SC. 111



FRED: MERRY CHRISTMAS, MISTER SLATE!



(FX: DOOR SLAM!)

PAGE 3½ PROD.

PAGE 1

1

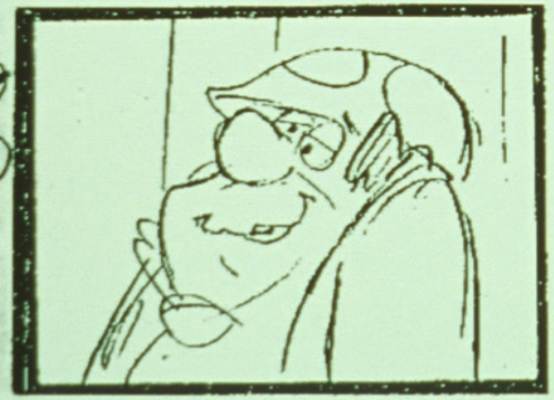
OCT 21 1977

REVISED 10/13/77

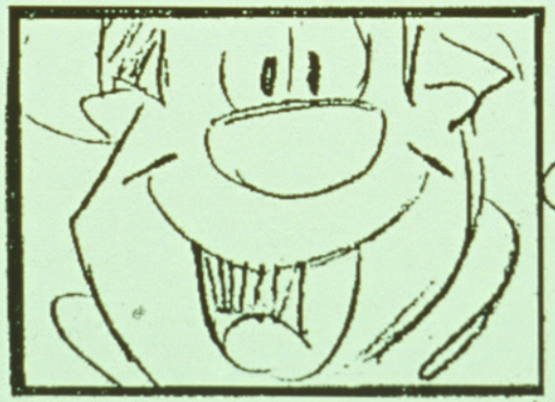
L.O. CHECK BG'S AROUND SC. #56 FOR CONSISTENCY

FINAL PRODUCTION BOARD

CUT 111A

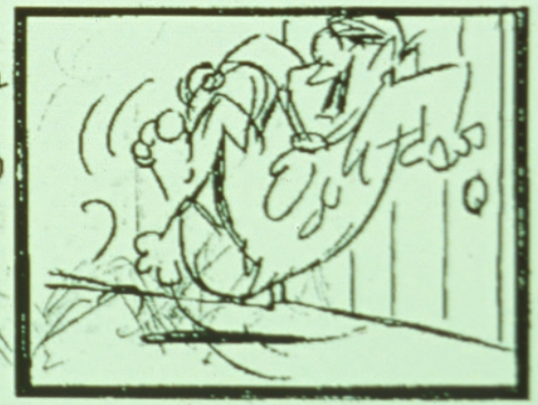


(FRED SAGS)
FRED: (RELIEVED) WHEW!



(INTO HAPPY REALIZATION)

CUT 111B



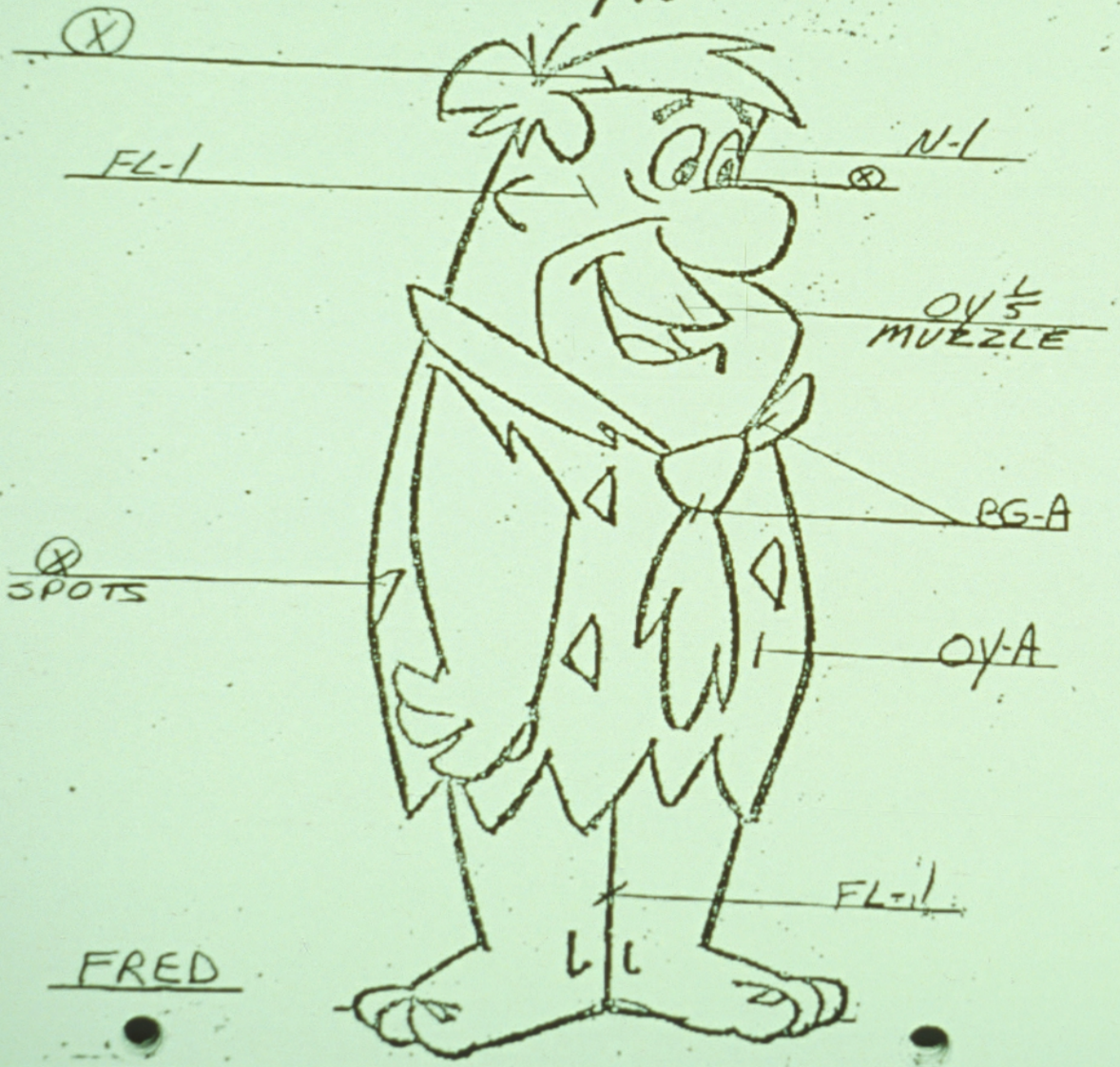
FRED: YABBA DABBA DOO——!

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

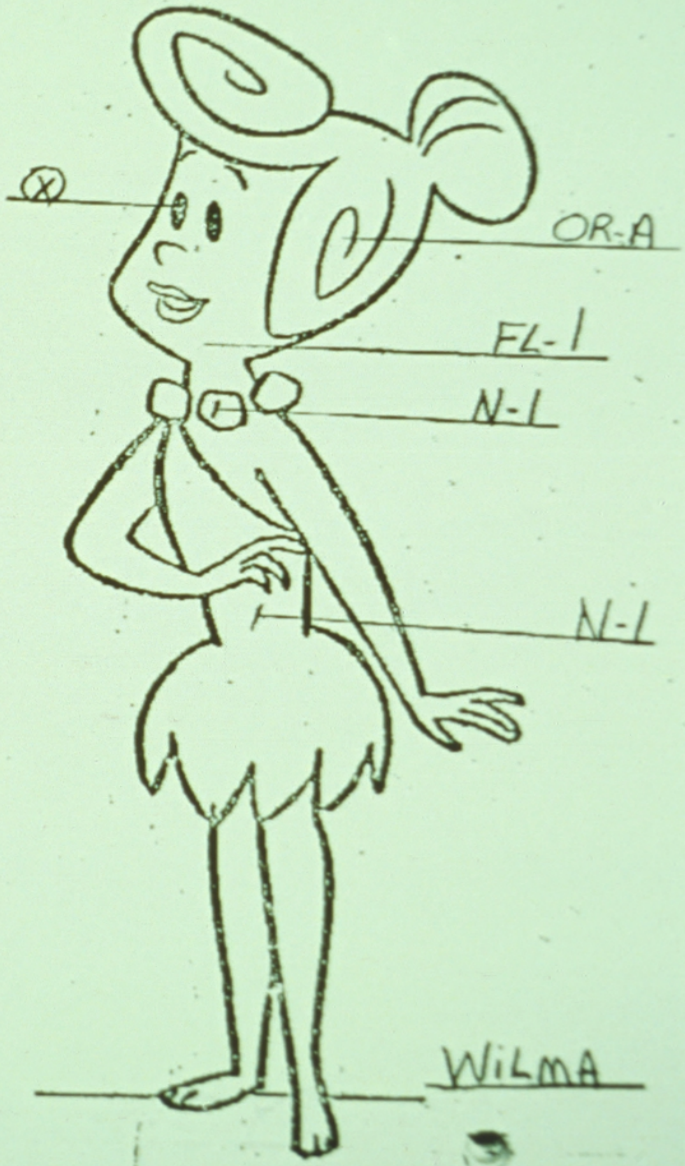
154 SERIES THE FLINTSTONES

© Hanna-Barbera Productions, Inc.

11/78



FRED



WILMA

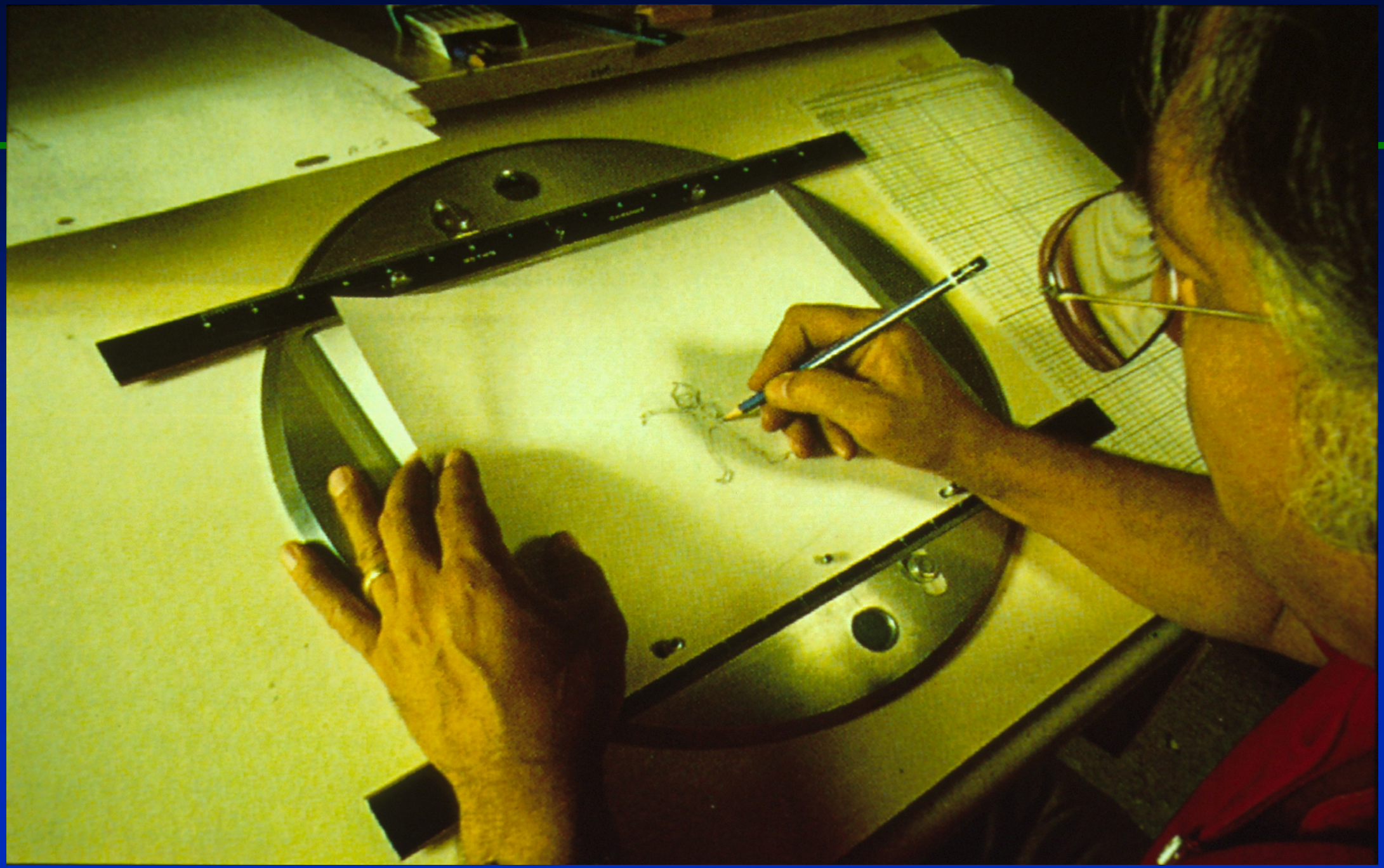
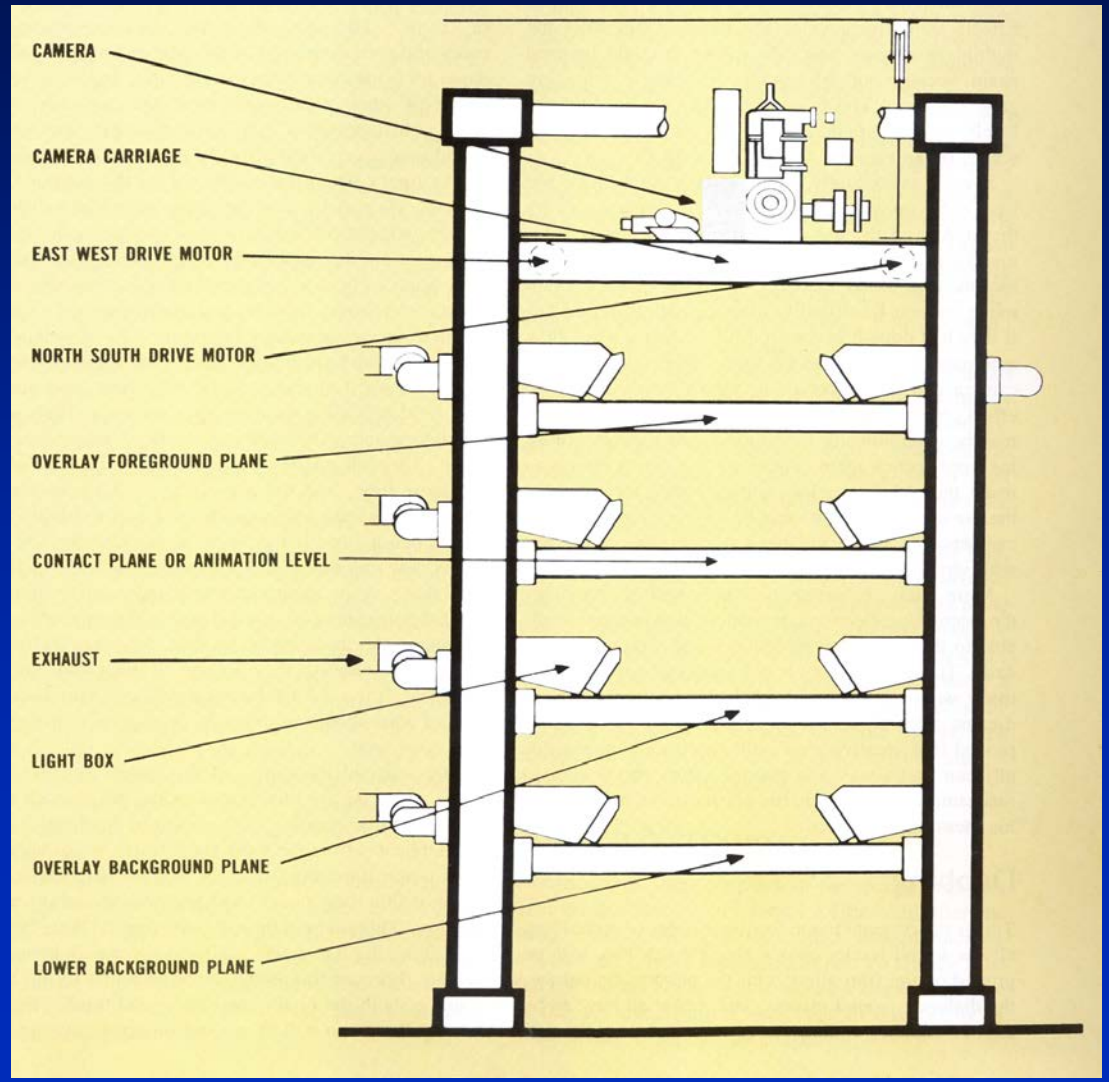


Figure 2a: Walt Disney's multiplane camera stand

Multi-Plane Camera



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, 1975

• 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

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

2 / COLOR SCRIPTS The goal is to begin to define the style and lighting scheme of the frame.

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

Building a Single Frame

3 / PROPS Toys are positioned in the 3-D “dressed set.” The director can fine-tune the camera’s movement to best capture the action.

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

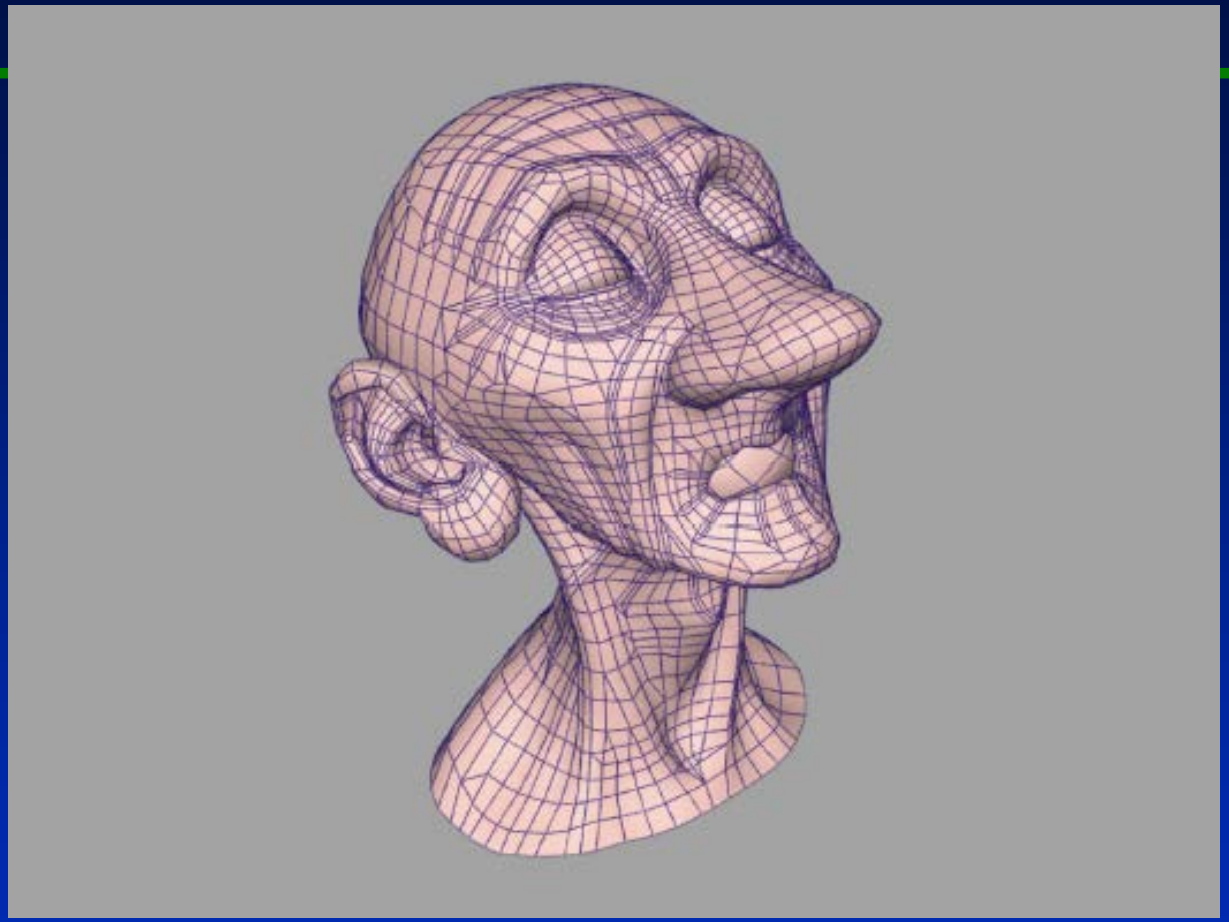
John Lehrer, "How It's Done," Wired 18.06. http://www.wired.com/magazine/18-06

The simplified pipeline

- Many departments

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

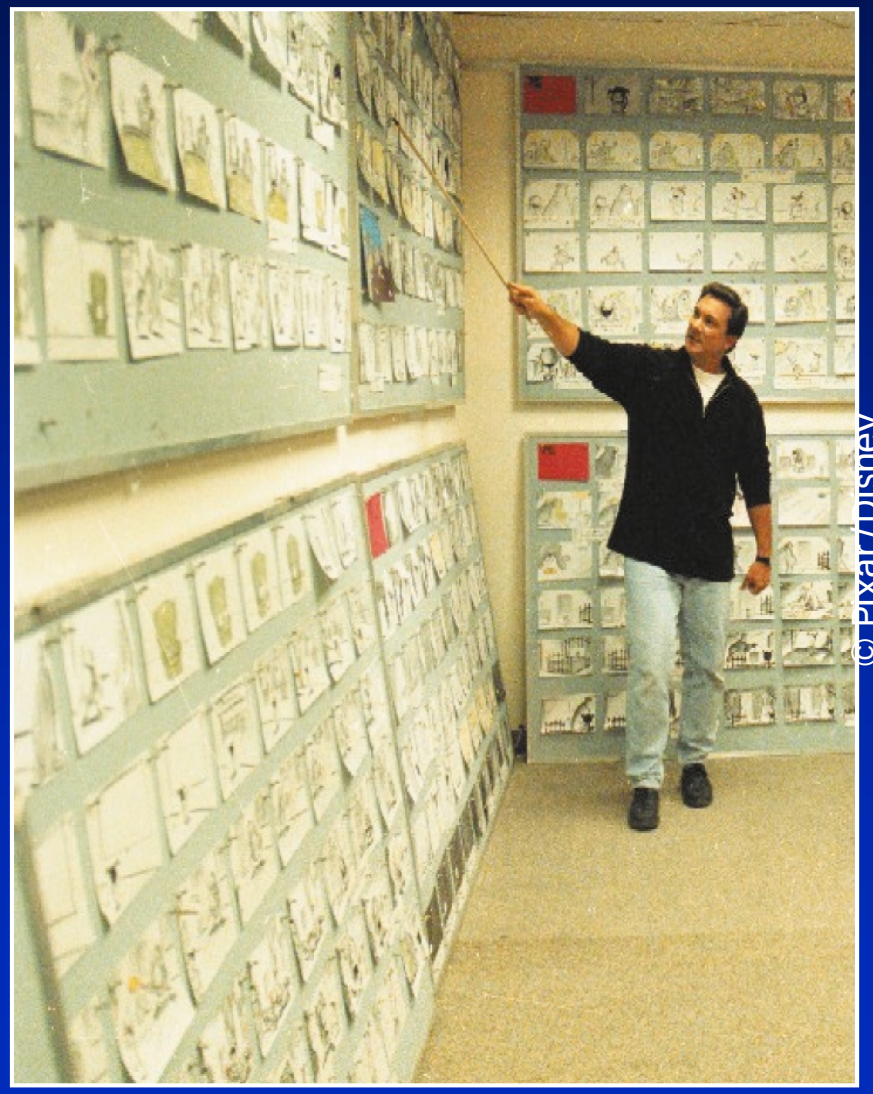
Jan Pinkava – *Storyboard* GERI'S GAME (Pencil)



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

Subdivision surfaces

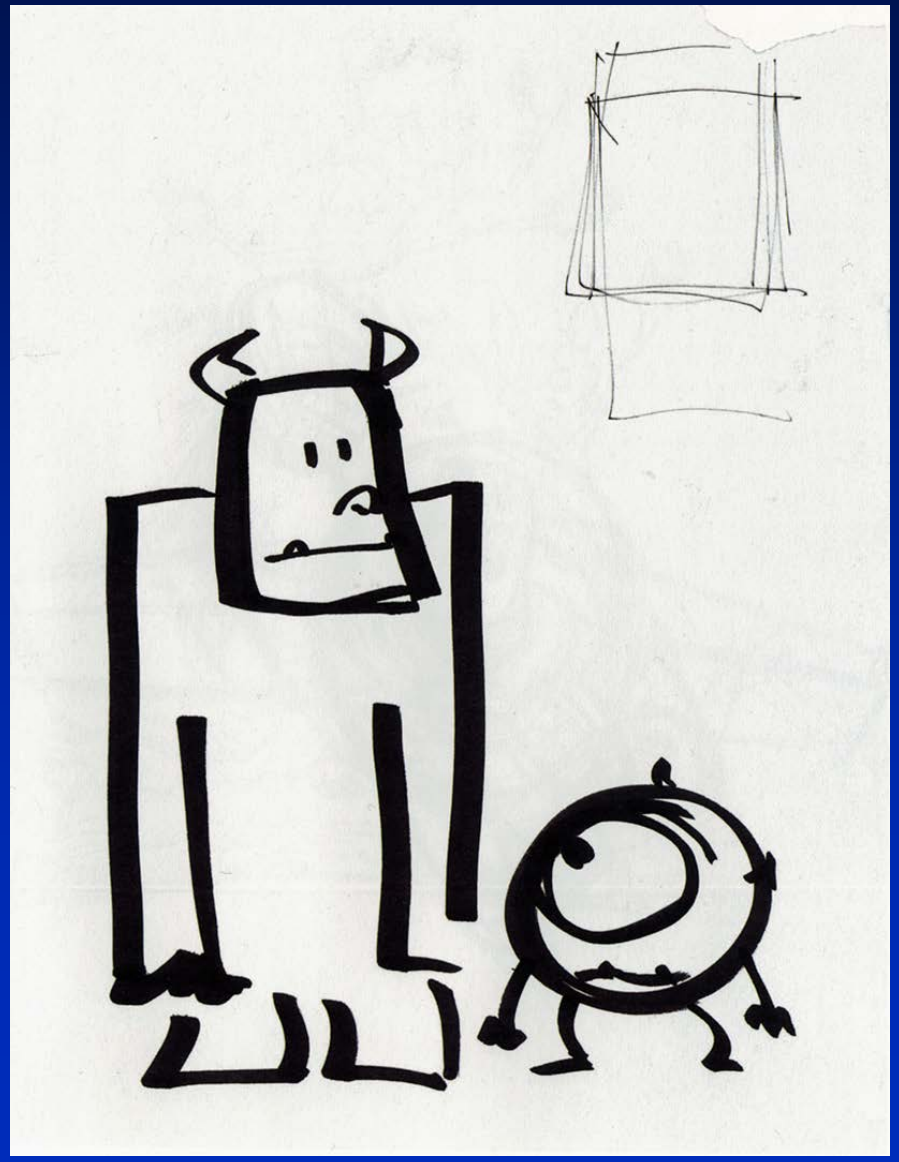
Story Development



Art Development

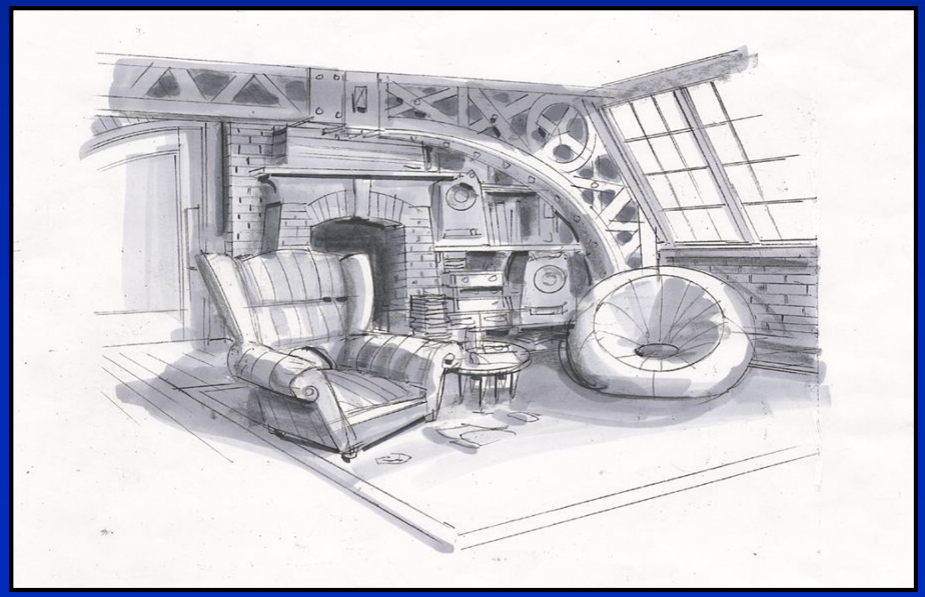
- Develop the look-and-feel of the movie
  - Characters and Sets
  - Follow it through production
  - Make the most of the *high-level* artistic decisions
- Traditional media
  - Sketches, Pastels, Sculptures
- Process
  - Start with real world objects
  - Develop the look: shape, colors, materials
  - Develop expressions and movements
  - For characters, sculptures are developed

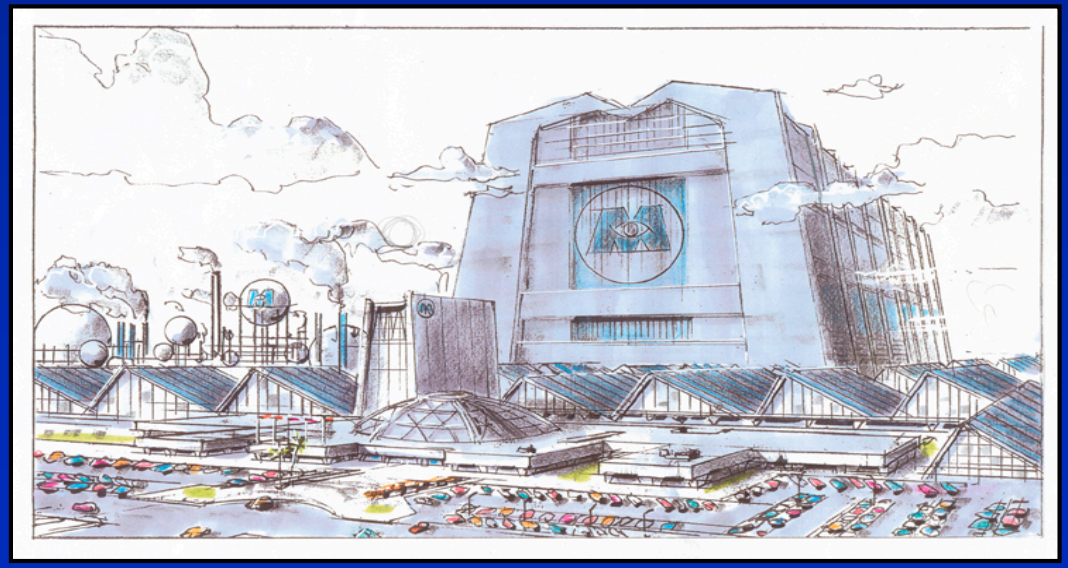
Pete Docter – Sullivan and Mike (Marker)



Art Development - Characters

Art Development - Environments



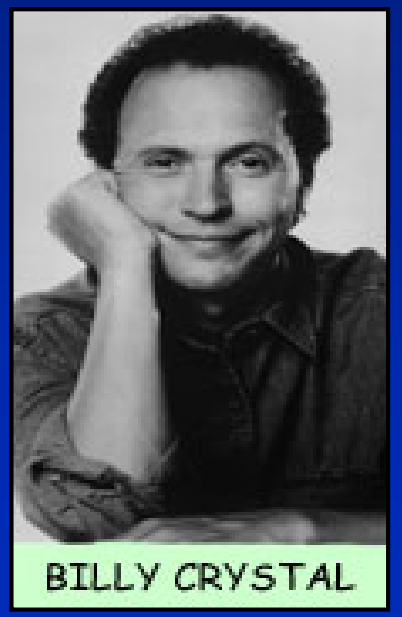


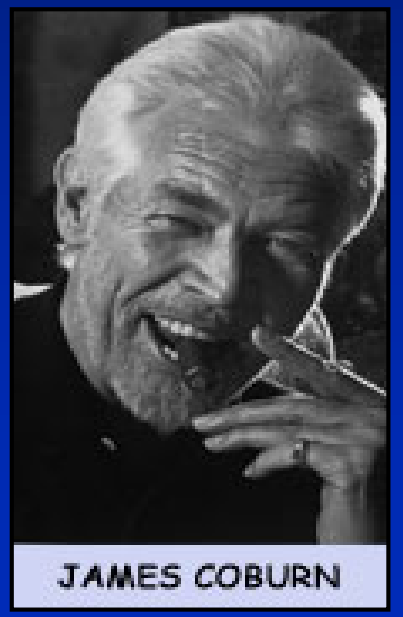
Casting

- Voices have to match your characters



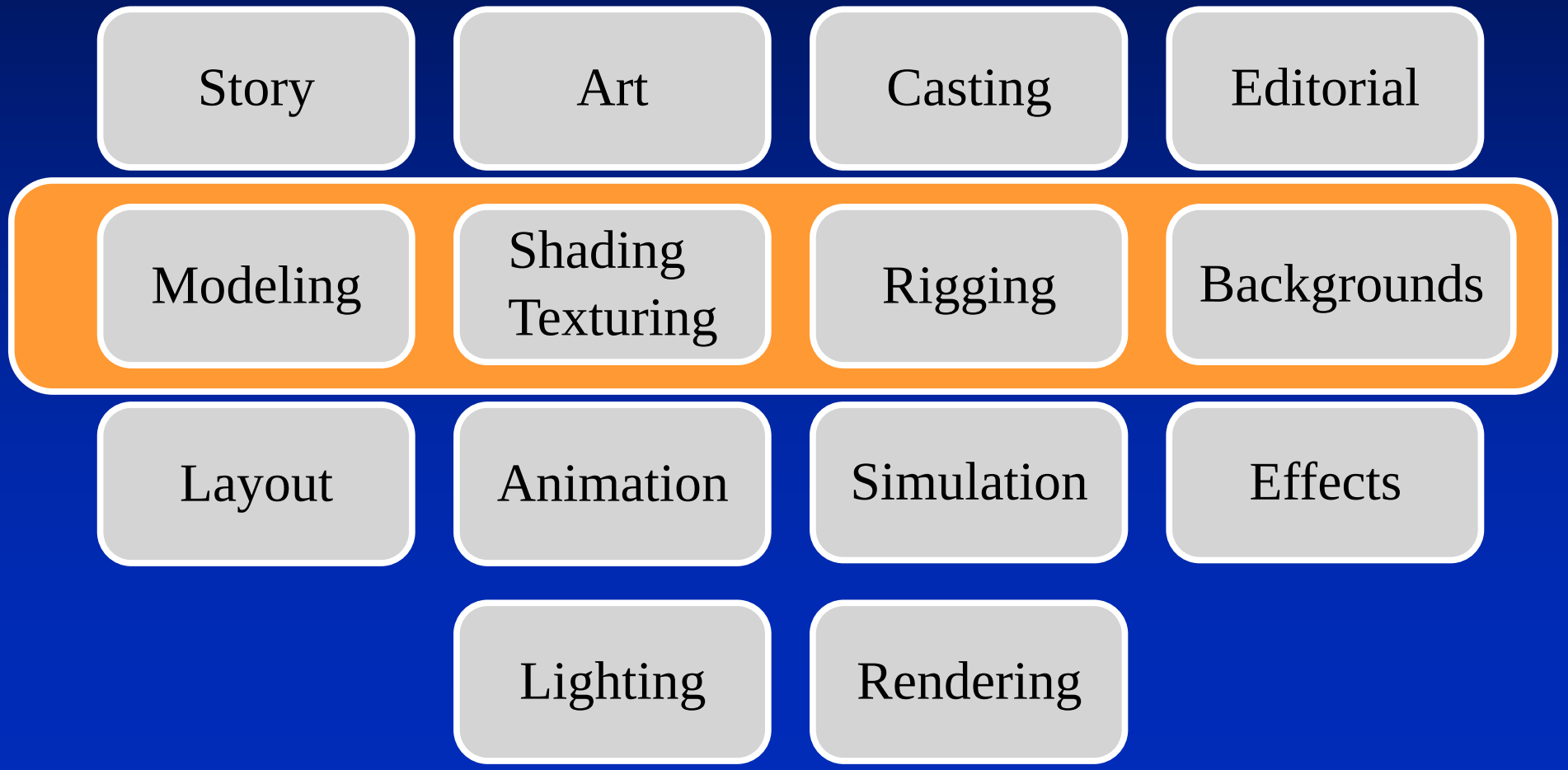






The Simplified Pipeline

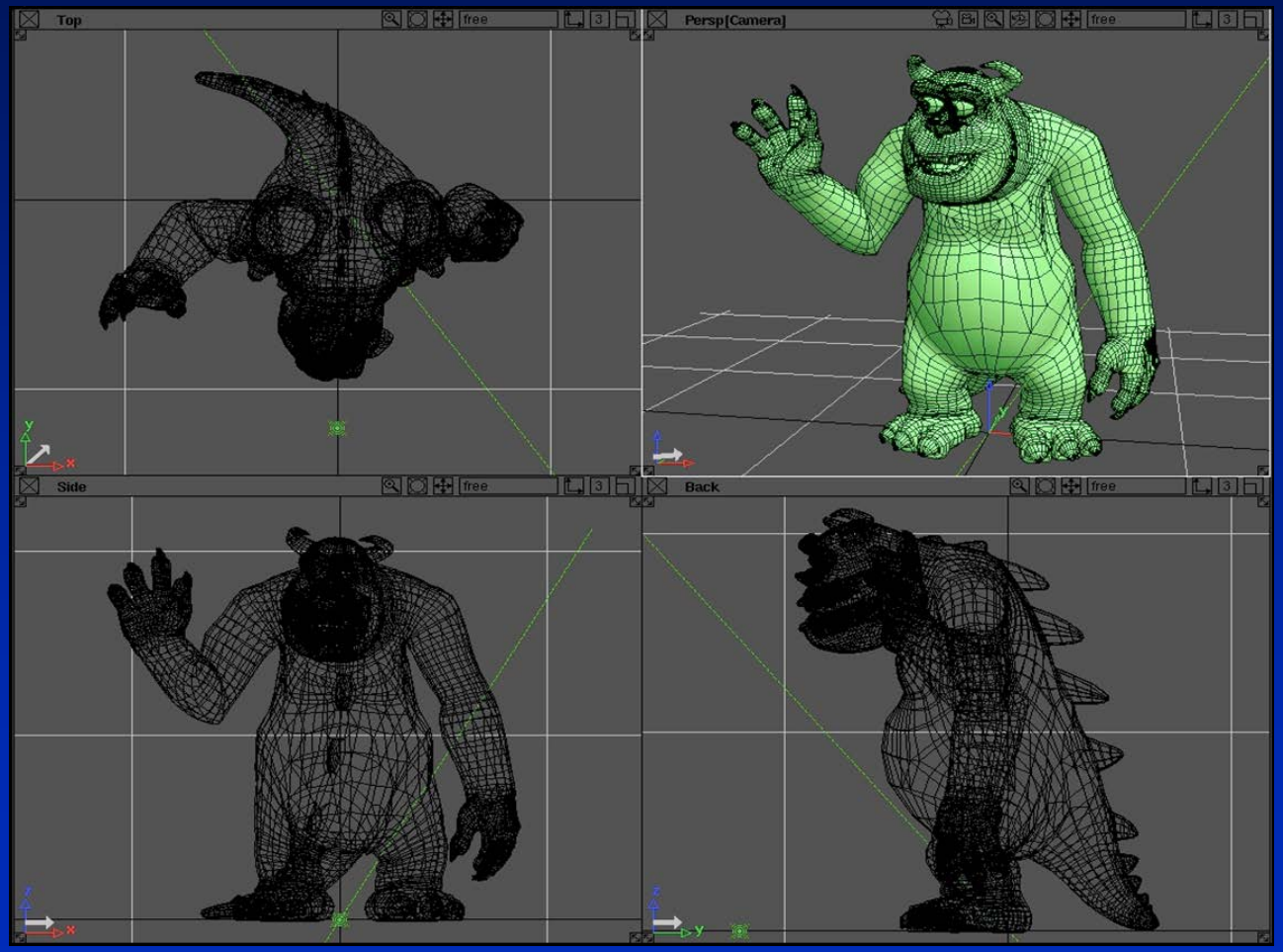
- Characters and Sets



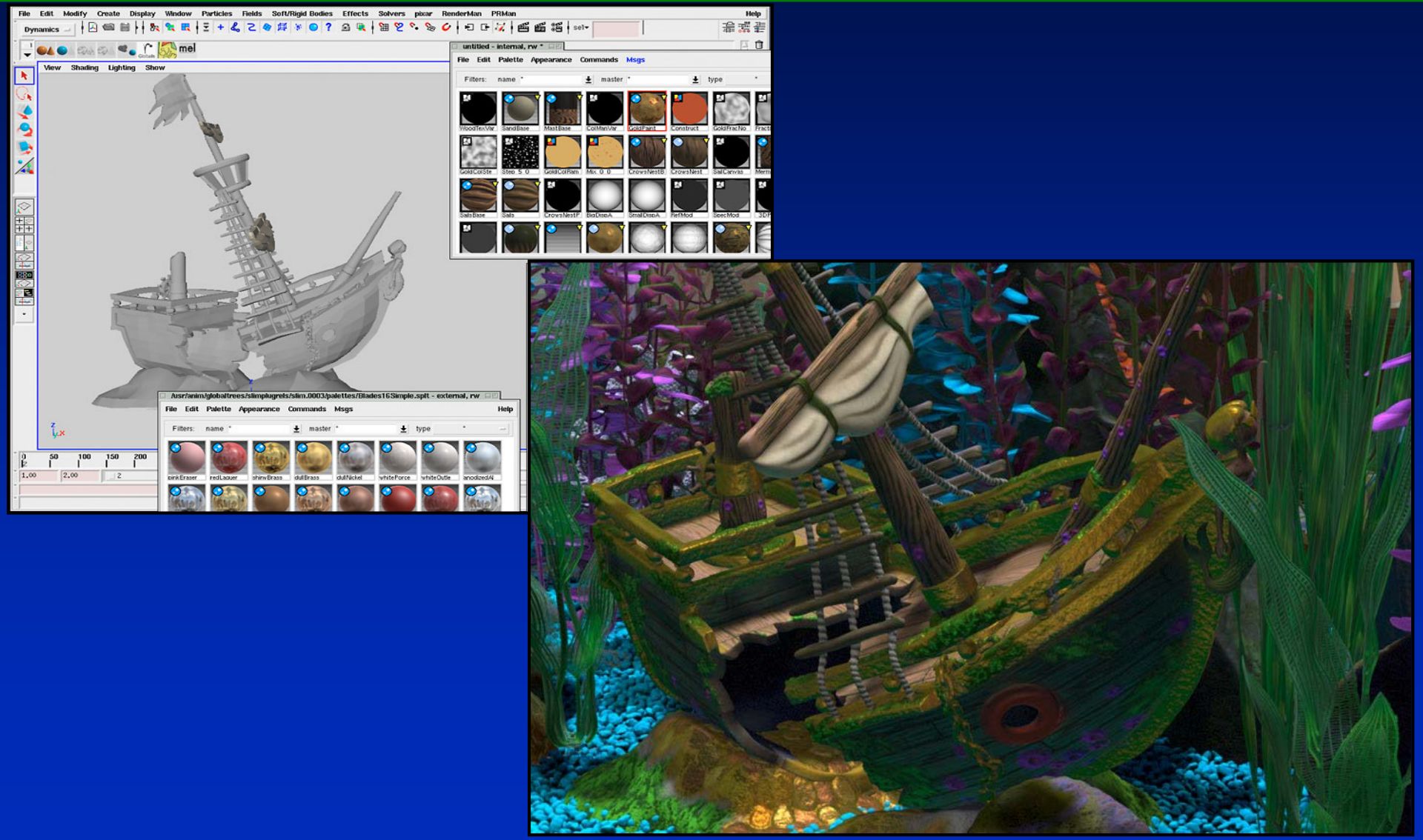
Modeling

- 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



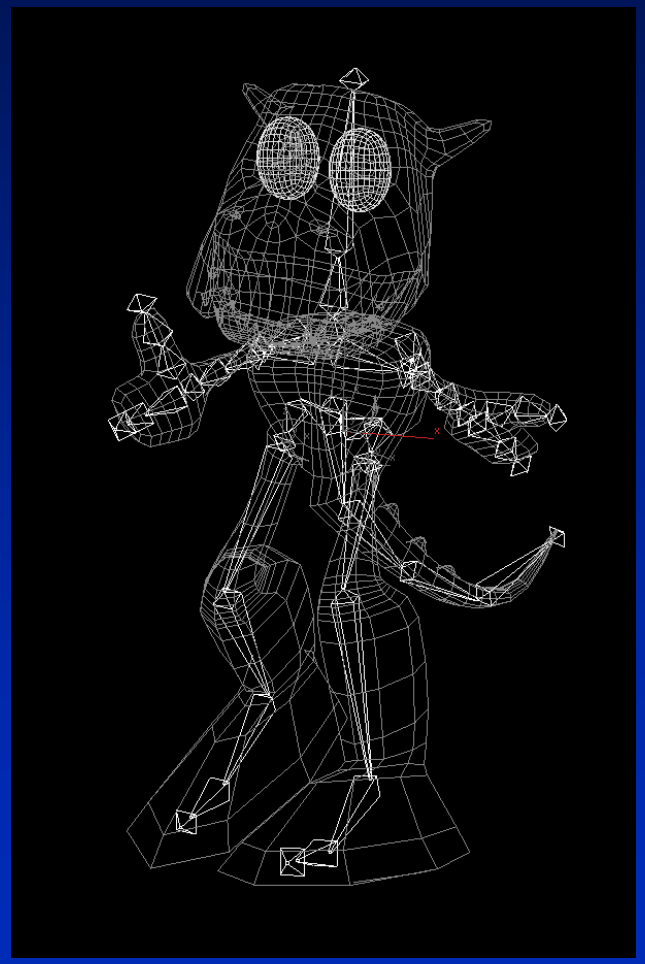
Shading



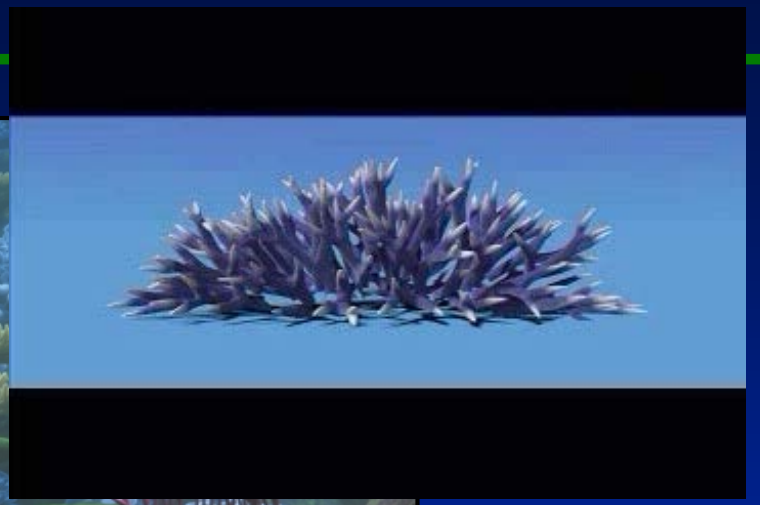
Character Rigging

- Prepares a character for animation
  - Defines the deformation of the shape
    - > Shape changes when the character moves
  - Defines controls for animators
- Process
  - Start with art data
  - Work with animation to test the look and controls

Rigging

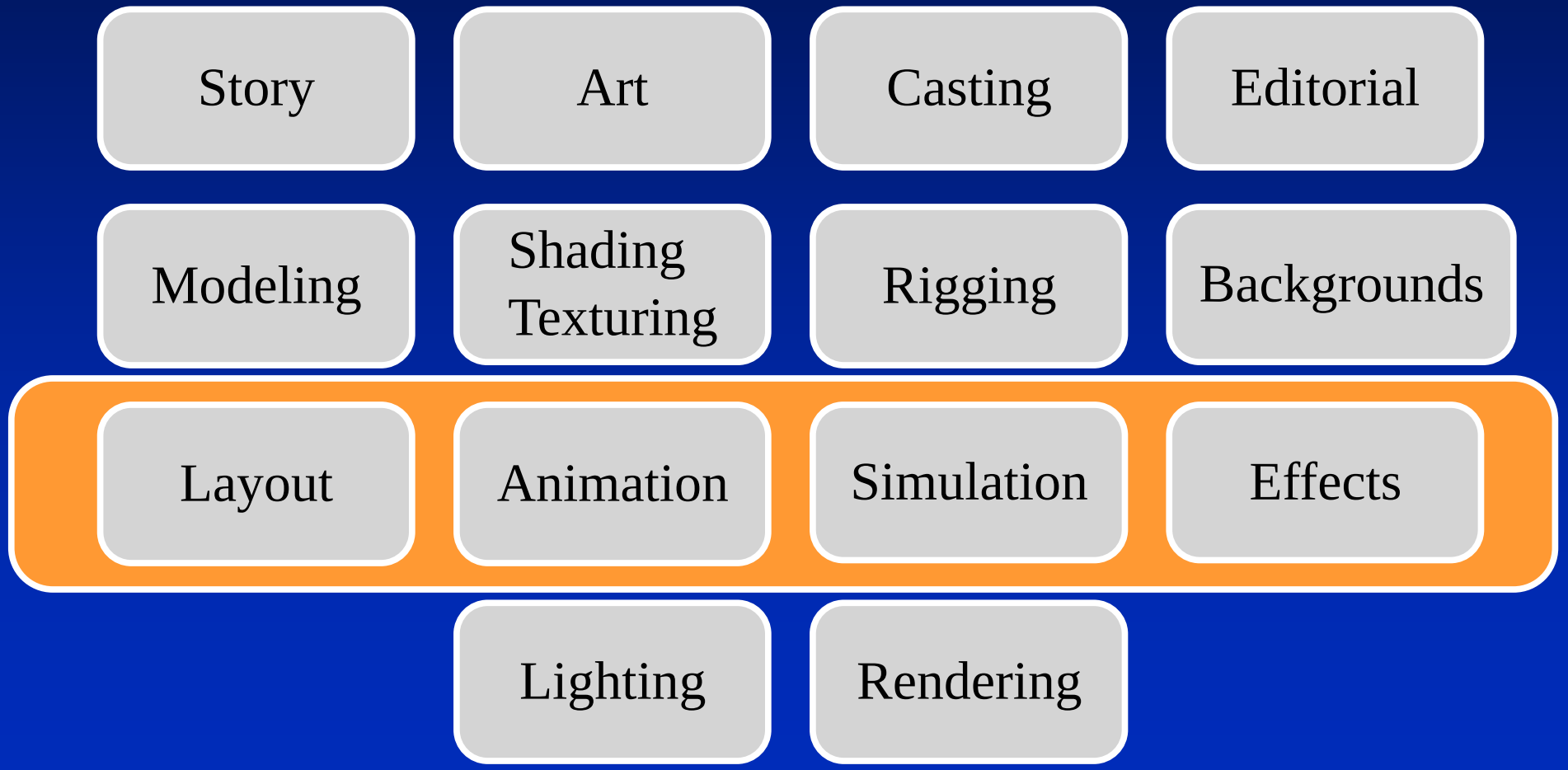


Backgrounds



The Simplified Pipeline

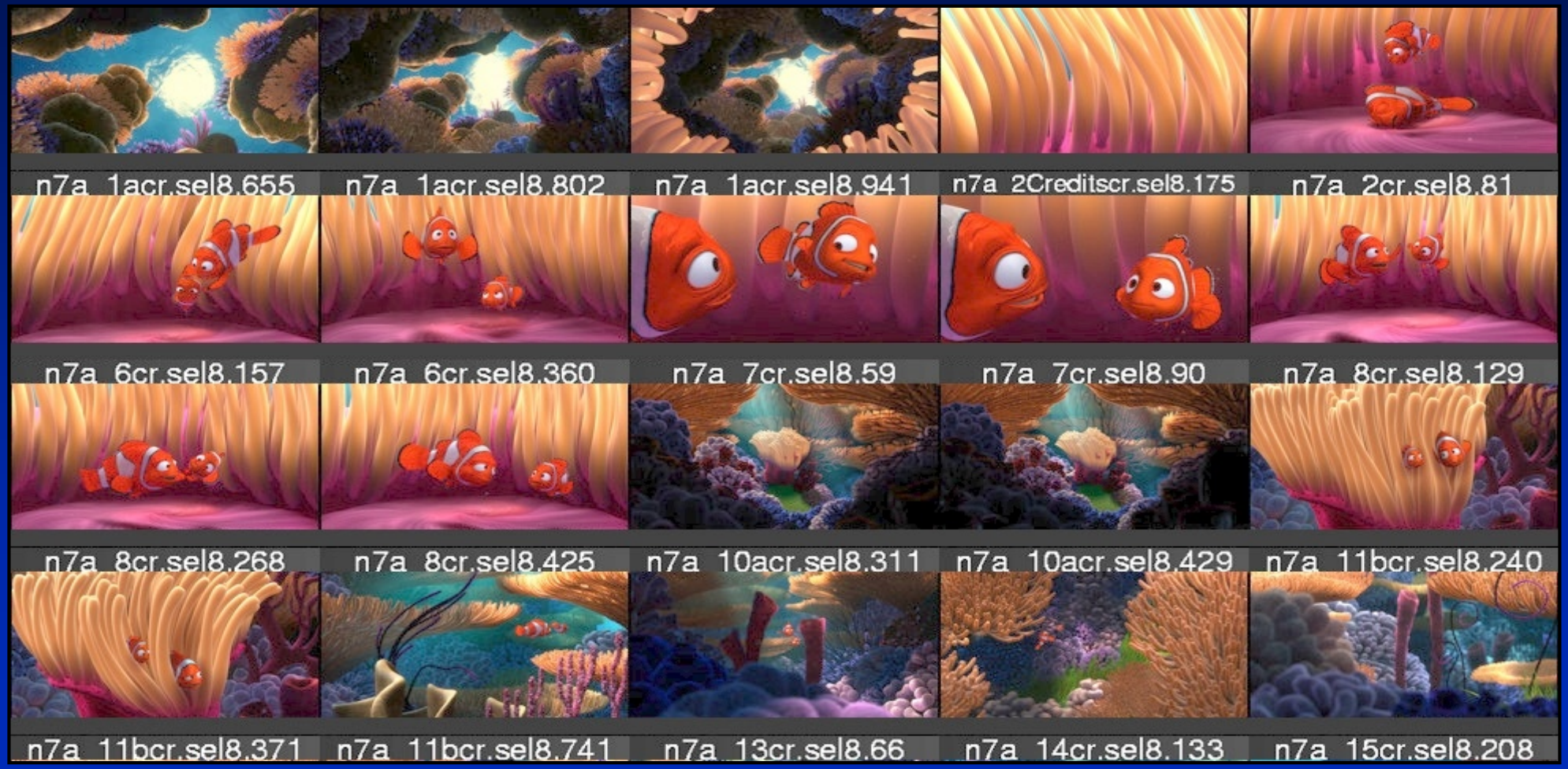
- Movement



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

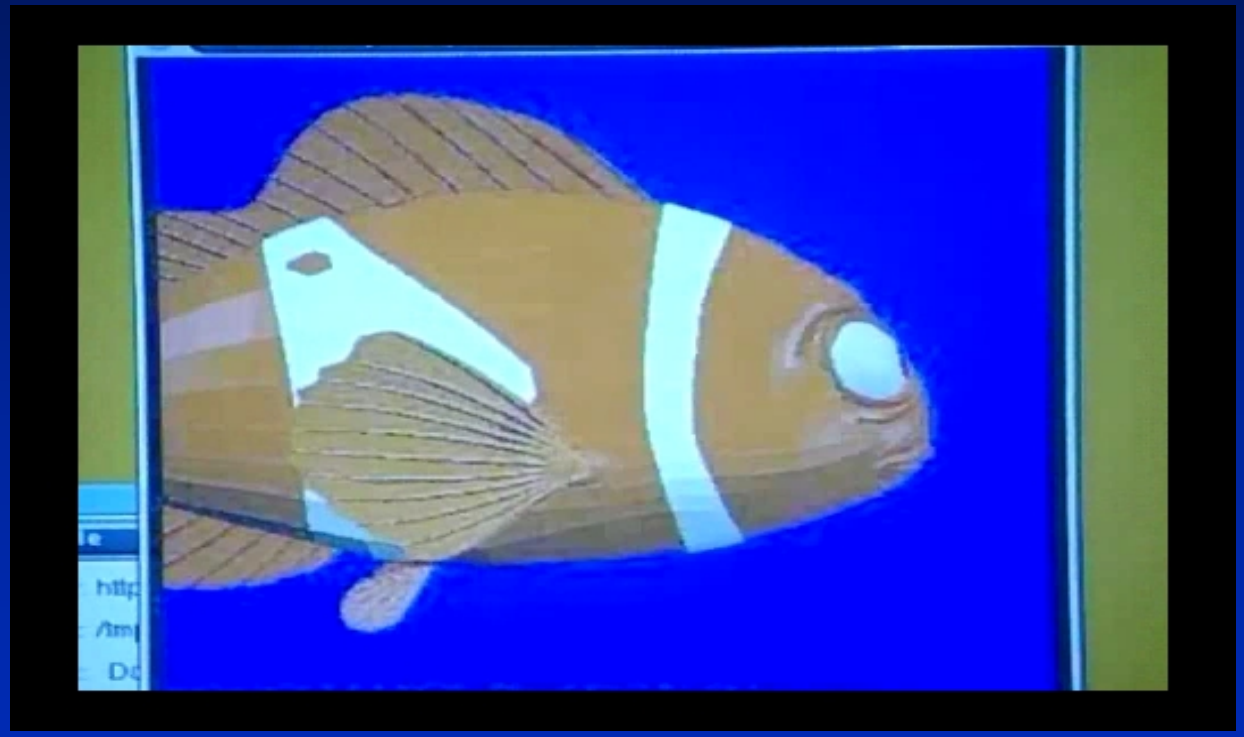
Layout



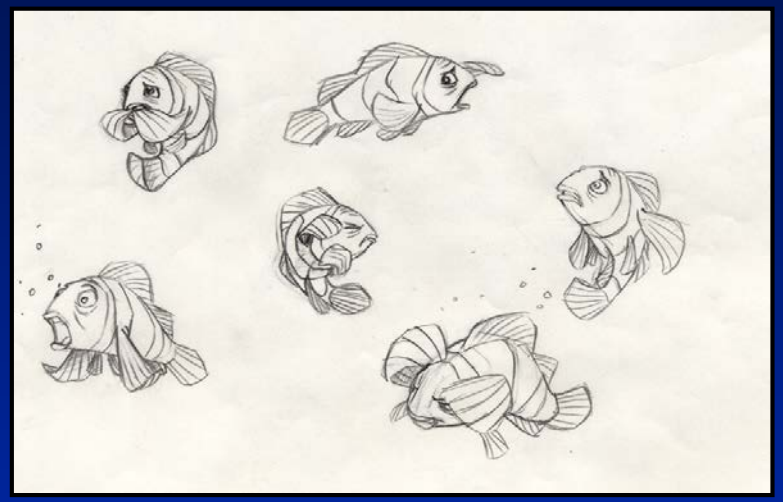
Animation

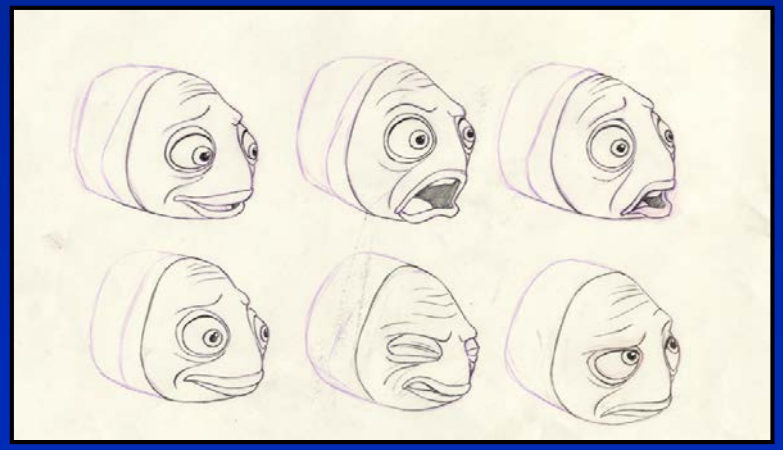
- Keyframed animation
  - Movement is specified by changing individual controls on characters at various frames
  - Similar to 2d animation
  - Used by Pixar and DreamWorks
- Motion capture
  - Movement is recorded using live actors
  - Editing to fix problems
  - Used by Sony Imageworks, Weta

Animation



© Pixar / Disney





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

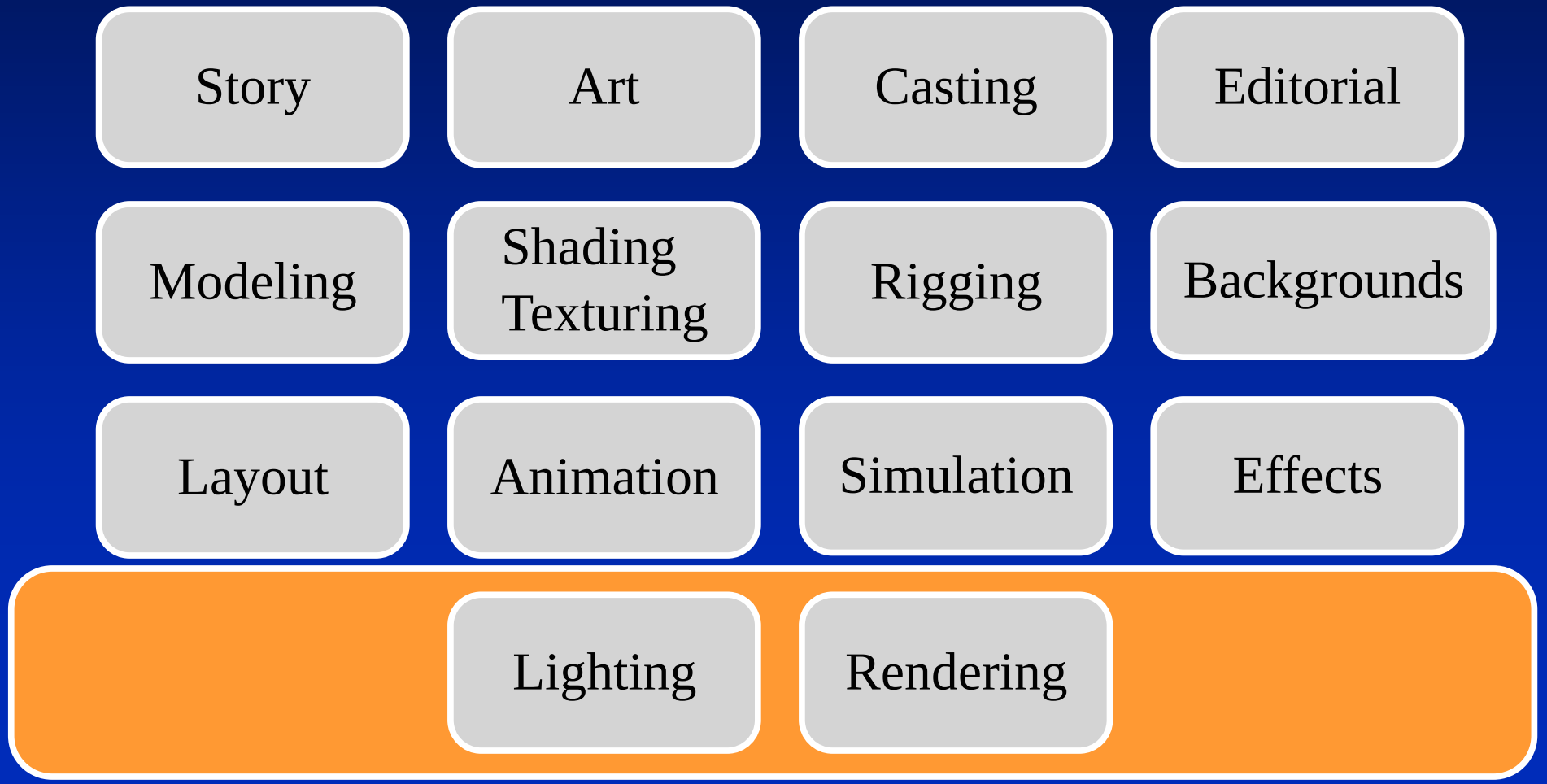
Effects

- 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



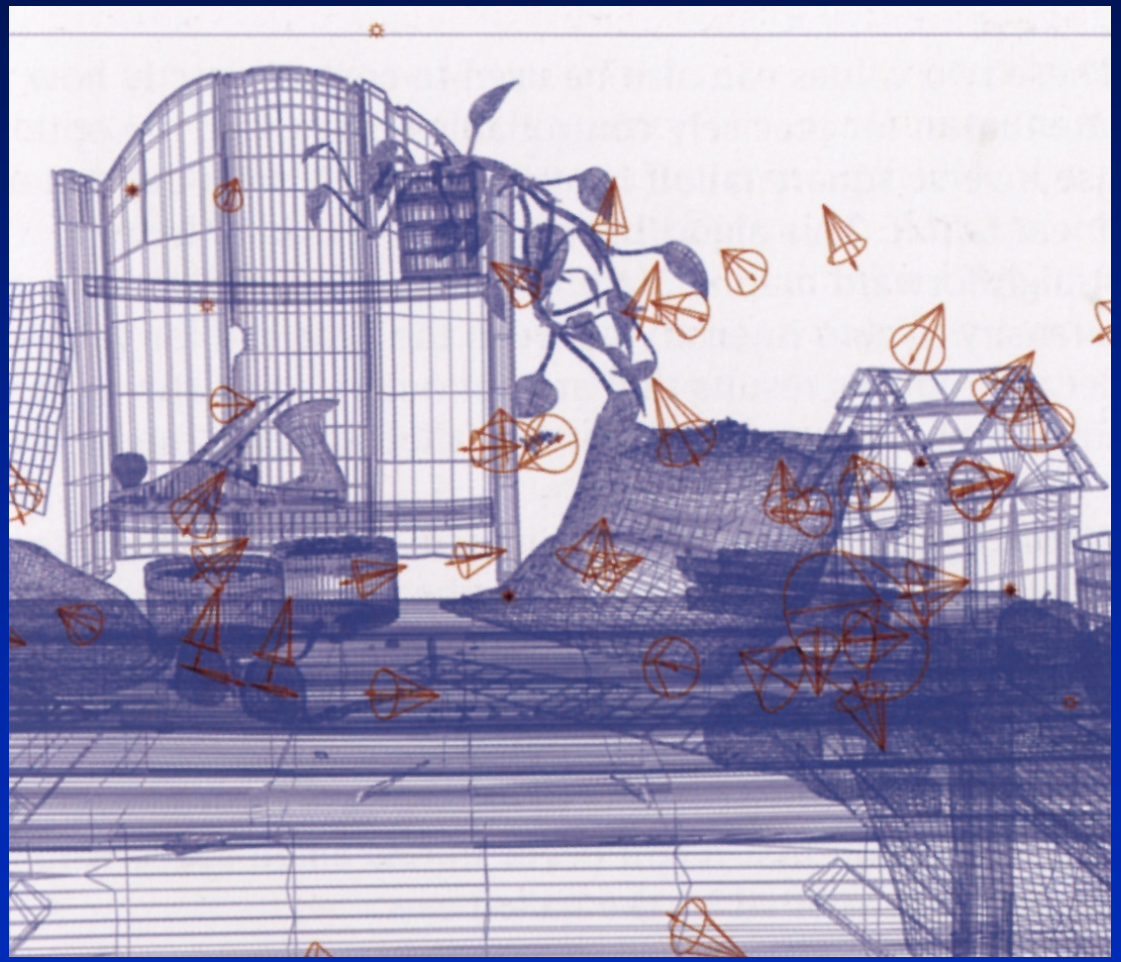
Lighting

- 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 .

Rendering

- Compute the final images

End