The Science Behind
PIXAR

Exhibit Opens Oct. 11, 2019

Take a peek inside.

Step-by-Step

"The Science Behind Pixar" exhibition is an immersive experience that explores how Pixar Animation Studios brings their beloved films and characters to life.

MODELING: Digital sculpting creates virtual 3D models
Character design starts with artists who create sketches and clay sculptures called maquettes to get each character just right. A digital modeler then creates a virtual 3D model of the character, sometimes digitally scanning the maquette. The final model is a virtual digital wireframe of points and the edges that connect them.

RIGGING: Digital rigs make movement possible
Riggers create rigs, or the virtual bones, joints and muscles for models. Rigs specify the relationships between body parts so that bending a knee will raise the foot but not move the hands. A good rig allows the animators to create poses easily and efficiently. Without the right controls, the model won't move the way it should. Too much flexibility makes posing the model too time consuming.

SURFACES: Appearance is controlled separately from shape
The way something looks tells a story. What is it made of? Is it new or old? Well cared for or neglected? After a virtual 3D model is created, a surfacing artist constructs its appearance with computer programs called shaders. They determine the way light scatters off the surface so it looks shiny, transparent and smooth (like glass) or dull and rough (like rust).

SETS AND CAMERAS: Virtual cameras view virtual 3D worlds
Movies need more than just characters. The setting of each scene and the way each image is framed convey the context, story and emotion. Set designers are architects. They build virtual environments from the ground up. Every pebble, tree and building helps turn the storyboards into a believable world. Camera artists use virtual cameras to shape what is shown on screen. They choose the composition, camera movement and lens type to support the story.

ANIMATION: Animation is acting
Pixar animators bring a story to life, posing characters to act out each scene. Animators start by creating key frames that mark out important positions in a movement. They then use a computer program to describe how the object moves between the key frames so the resulting animation conveys the desired emotions.

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DENVER MUSEUM OF NATURE & SCIENCE

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SIMULATION: Computer programs create automated motion
While animators focus on acting, simulation programmers create motion that makes scenes feel alive and believable. Some simulations — hair, fur and clothing — respond to the way a character moves. Other simulations re-create natural phenomena, such as fire or water. Programmers start with the underlying physics, but they balance believability with the artistic needs and the time it takes to run the simulation.

LIGHTING: Virtual lights enhance mood and believability
Lighting is an essential part of telling a story. Light shows you where to look and enhances the emotional feel of each scene. Pixar's lighting designers have the additional task of defining virtual lights in the computer. The color, position and intensity of each light needs to be programmed to achieve the desired artistic effect.

RENDERING: Rendering turns a virtual 3D scene into a 2D image
The virtual scene is set — the characters are shaded and posed, the lights and camera are in position and the simulations are ready to run. But no one knows what it looks like until the rendering process turns all that data and programming into an image we can see. Pixar generates low-resolution renders for work in progress and high-resolution renders for the final film.

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