MASTERING MARI®:

Texture Theory and Course Guide

FOUNDRY

Texture Theory course outline

This outline is designed to serve as a teaching aid and course guidance for texturing courses. After extensive studio and industry interviews, the common theme we heard was that students hadn't grasped texture theory or honed their artistic eye. With that feedback in mind, we've built out a course aid that starts with the basics of texture theory before delving into texturing in Mari. There are various reference videos and suggested exercises for students throughout the guide. Some of the lessons are beginner-level and explain concepts and how they relate to the software itself. Please feel free to use sections that are relevant to your course level and student knowledge.

If you have any questions, feedback or would like to collaborate on future versions of our Mari course, please send us an email at education@foundry.com.

CONTENTS

Texturing in Mari course outline

MODULE 1

Introduction to Textures

Part 1 Understanding textures in the context of VFX and Animation – a high-level overview

a. Importance of textures:

Textures in the context of visual effects and animation are essentially 2D images or patterns that are applied to 3D models or surfaces to add detail, realism, and visual interest. These images contain information such as color, surface properties, and other characteristics that help simulate real-world materials and environments.

Textures serve several crucial purposes:

- **Adding detail and realism:** Textures enable artists to add intricate details to 3D models, such as surface imperfections, bumps, scratches, or patterns, which enhance the overall realism of the asset.
- **Defining surface properties**: Different types of textures, such as diffuse maps, specular maps, and normal maps, are used to define various surface properties like color, reflectivity, roughness, and surface orientation. This helps to accurately mimic how light interacts with different materials so that the asset looks believable in all lighting conditions.
- **Enhancing visual appeal:** Textures can significantly enhance the visual appeal of a scene by adding depth, richness, and complexity to surfaces. They are worldbuilding tools – helping to convey important visual information, such as storytelling elements or mood.
- **Optimizing performance:** While textures can make scenes look more realistic, they also need to be optimized for performance, especially in real-time applications like video games. Properly optimized textures strike a balance between visual quality and performance efficiency.

- **Creating special effects:** Textures can be used to create special effects such as fire, smoke, water, or weather effects, by applying animated or procedural textures to surfaces or particle systems.

Overall, textures play a fundamental role in the creation of visually compelling and immersive digital environments, characters, and effects – helping to bridge the gap between virtual and real-world visuals.

Questions for students to spur conversation around texture in VFX and animation:

- How do you think textures contribute to the overall look and feel of a digital scene or object?
- Can you give an example of how textures are used in a specific VFX or animation application, like creating realistic environments or characters in a movie or video game?
- Can you think of examples where the texture took away from a film or show? i.e. where it was done badly and proved to be more distracting to you as a viewer?

b. How textures are used in a specific applications, like creating realistic environments or characters in a movie or video game:

Consider the example of creating realistic environments in a video game:

- **Terrain textures:** In an open-world game, terrain textures are used to simulate natural landscapes such as grassy fields, rocky mountains, sandy deserts, or snowy tundras. Each texture contains details like grass blades, pebbles, or snowflakes, in order to represent rich, changing environments and add believability to the in-game world.
- **Surface materials:** Textures are applied to objects within the environment to simulate different surface materials while following the art direction of the game. For instance, textures can be used to make buildings look like weathered brick, rusted metal, or polished marble, enhancing the realism of the game world.
- **Character textures:** In video games, textures are applied to character models to define their appearance, clothing, and accessories. Textures for characters include details such as skin tone, clothing fabric, armor plating, or facial features, which make characters visually distinct and recognizable.
- **Special effects:** Textures are also used to create special effects like fire, smoke, water, or explosions. Animated or procedural textures are applied to particle systems or environmental effects to simulate realistic-looking phenomena, adding dynamism and excitement to gameplay.

While textures can be based entirely in realism, they can also be used to amplify the art director's stylistic choices within the game – representing believable props in cell-shaded or brush stroke-heavy aesthetics. Ultimately, by using textures effectively, artists can create immersive and visually stunning environments that enhance the lived-in feel of the game world.

MODULE 2

Color Theory

Part 1 Understanding the basics of color theory and how it applies to texture creation

a. Understanding color theory:

- Color theory is the study of how colors interact with each other and how they can be combined to create harmonious and visually appealing compositions.

- It explores concepts such as hue, saturation, brightness, complementary colors, and color schemes (like monochromatic, analogous, complementary, and triadic).

- In texture creation, understanding color theory helps artists choose and manipulate colors effectively to achieve desired visual effects and convey specific moods or atmospheres.

- Artists use color theory to create textures that accurately represent real-world materials and environments, as well as to enhance the overall aesthetics and storytelling elements of a scene.

b. Influence of color theory on texture creation decisions:

- Knowledge of color theory guides decisions related to selecting base colors, adjusting color values and tones, and creating variations in color intensity and saturation within textures.

- Artists consider color harmony and contrast when designing textures, ensuring that colors complement each other and create a visually balanced composition.

- Understanding color psychology helps artists evoke specific emotions or responses in viewers through the use of color in textures.

- Color theory also informs decisions regarding lighting and shading within textures, as well as how colors interact with different surface properties like diffuse, specular, and emissive maps.

c. Examples of color theory importance in VFX texture creation:

- Character design: When creating textures for characters, artists consider color theory to define the character's personality, backstory, and role within the narrative. For example, warm colors like reds and oranges may be used to convey energy and passion, while cool colors like blues and greens may suggest calmness or serenity.

- Environment design: In environments such as landscapes or architectural structures, knowledge of color theory helps artists establish mood and atmosphere. For instance, using analogous color schemes with variations in saturation and brightness can create a cohesive and visually pleasing environment, while complementary colors might be employed to highlight focal points or create dramatic contrasts.

- Visual effects integration: Color theory plays a crucial role in integrating visual effects seamlessly into live-action footage. Artists must match the colors and lighting of CG elements, such as simulated fire or smoke, to the surrounding environment to ensure realistic integration and believability.

By applying principles of color theory in texture creation, artists can produce visually compelling and emotionally resonant imagery that enhances the overall quality and impact of VFX productions.

d. Exercises for students to practice

Color wheel exploration:
- Obtain a color wheel or create one using color swatches in a digital art software.
- Study the relationships between primary colors (red, blue, yellow), secondary colors (orange, green, purple), and tertiary colors (mixtures of primary and secondary colors).
- Experiment with mixing colors on the color wheel to create different hues, tints (adding white), shades (adding black), and tones (adding gray).
- Practice identifying complementary, analogous, and triadic color schemes on the color wheel.

Color mixing exercises:
- Set up a simple still-life arrangement or gather objects with different colors.
- Experiment with mixing paints or digital color palettes to match the colors of the objects as closely as possible.
- Pay attention to how colors interact when mixed, and observe the effects of adding or subtracting different colors to achieve desired results.

Color harmony studies:
- Select a reference image or artwork that you find visually appealing.
- Analyze the color scheme used in the image and identify the dominant colors, accents, and variations in hue, saturation, and brightness.
- Try to recreate the color scheme using a limited palette of colors, focusing on achieving similar harmonious relationships between colors.

Color psychology Exploration:

- Research the psychological associations and cultural meanings associated with different colors (e.g. red for passion, blue for tranquility).
- Experiment with creating mood boards or color swatches that evoke specific emotions or atmospheres using different color combinations.
- Reflect on how colors can influence perception and emotion in visual storytelling and communication.

Texture painting exercises:

- Practice painting textures using digital art software or traditional media.
- Experiment with applying different color variations and combinations to simulate various surface materials, such as wood, metal, fabric, or skin.
- Pay attention to how color choices affect the perceived texture and realism of the painted surfaces.

Color theory applications in artwork:

- Create original artworks or compositions while consciously applying principles of color theory.
- Experiment with using color to convey mood, atmosphere, and narrative elements in your artwork.
- Solicit feedback from peers or mentors to evaluate the effectiveness of your color choices and compositions.

e. Extra training resources

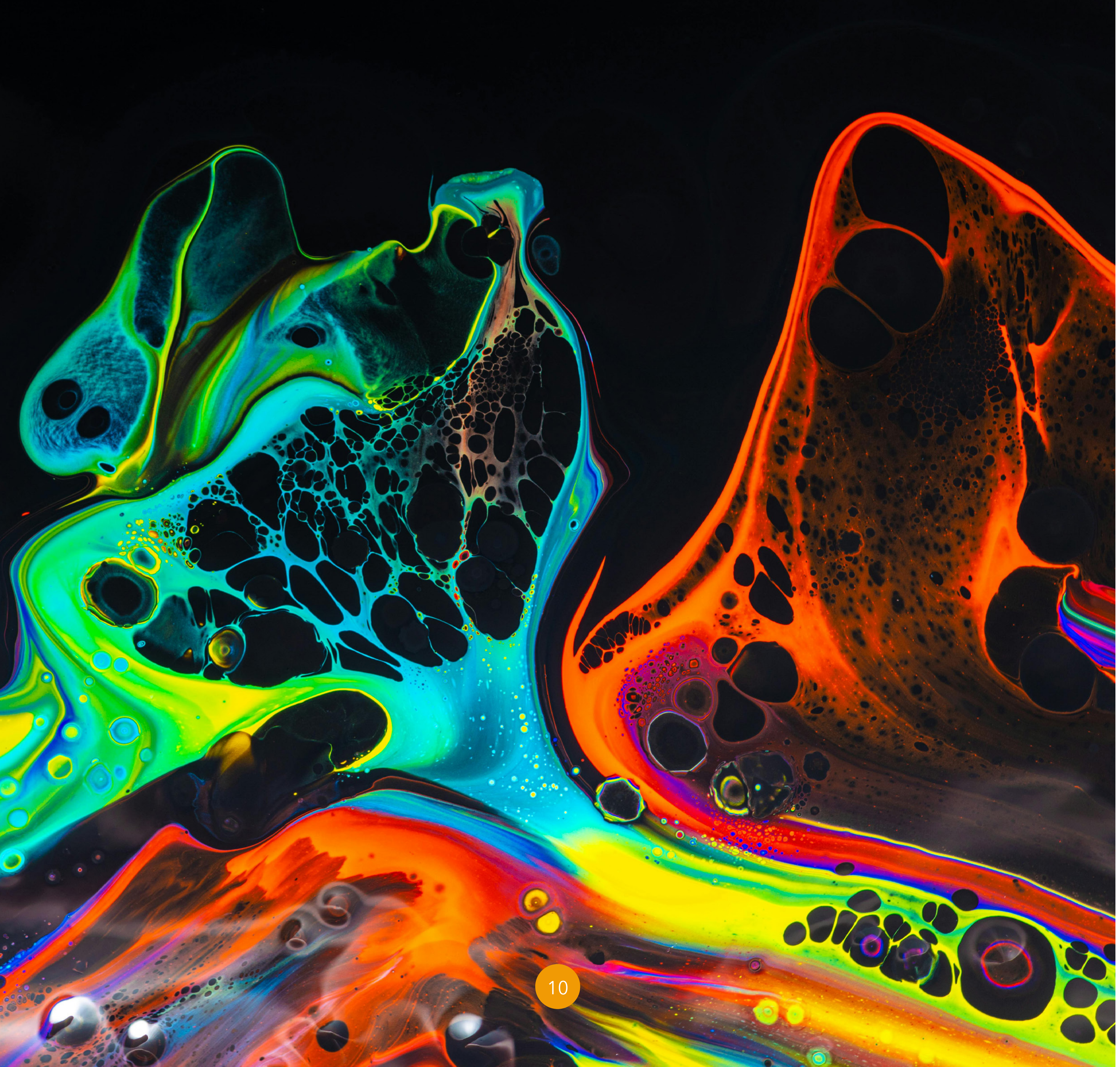
- Color theory for digital artists
- Color theory for beginners and how to actually use it in digital painting
- Basics of color theory

f. Training resources for Module 1 and 2

- How to (not) create textures for VFX
- Understanding UVs: Love them or hate them, they are essential to know
- UV maps explained
- Introduction to UV mapping – Learn the complete basics
- Texture maps explained – Essential for all texture artists
- Texturing Theory 101 – Understanding texture maps and channels
- Color theory for digital artists
- Color theory for beginners and how to actually use it in digital painting
- Basics of color theory
- Colorspace in Mari: preserving your color from brush to screen

MODULE 3

Texture Creation Workflow and Reference Images



Part 1 **Overview of the texture creation process and how it fits into the pipeline**

- In the context of visual effects (VFX), texture creation refers to the process of designing and generating detailed surface qualities for 3D models or elements within a digital scene. Textures add depth, realism, and visual interest to objects by simulating various surface properties such as color, roughness, glossiness, bumpiness, and transparency.

- Texture creation involves creating digital images, often referred to as texture maps, which are applied to 3D models to simulate different materials and surfaces. These texture maps contain information about color, shading, and surface details, allowing objects to appear lifelike when rendered in a digital environment.

- Textures also serve as a foundation for other elements in the VFX pipeline, such as lighting, shading, and rendering. They provide essential surface information that influences how light interacts with objects and how materials appear under different lighting conditions.

- Texture creation typically occurs during the asset creation phase of the VFX production process, following concept design and modeling stages.

- Artists gather reference materials and reference images to guide texture creation, ensuring accuracy and consistency with real-world materials and environments.

- Texture creation involves collaboration with other departments, such as modeling, lighting, and compositing, to ensure seamless integration of textures into the final rendered scenes.

- Throughout the production pipeline, textures may undergo revisions and adjustments based on feedback from supervisors, directors, and clients, with the goal of achieving the desired visual aesthetics and storytelling objectives.

- Ultimately, texture creation culminates in the final rendering stage, where textures are applied to 3D models and composited with other visual elements to produce the finished VFX shots or sequences.

Part 2 **Choosing reference images and using them as a guide for texture creation**

a. Reference images and their importance in texture creation

- Reference images serve as visual guides for artists during texture creation, providing a point of reference for the appearance, color, texture, and details of real-world materials and surfaces.

- They help artists understand the intricate nuances and characteristics of different materials, allowing for more accurate and realistic texture replication in digital environments.

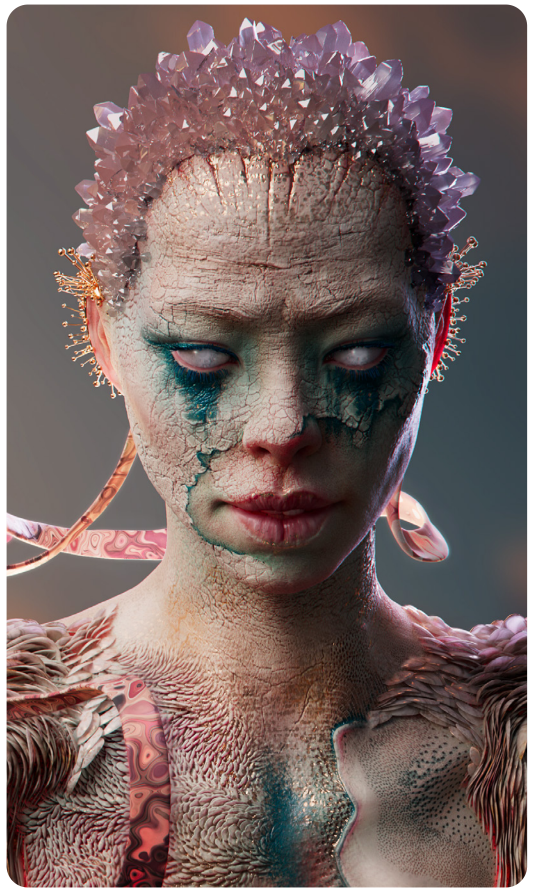
- Reference images aid in maintaining consistency and coherence across textures within a scene or project, ensuring that materials match their real-world counterparts and contribute to the overall visual storytelling.

b. Examples where reference images would be particularly useful in guiding texture creation

- **Natural environments:**
When creating textures for landscapes or outdoor scenes, reference images of rocks, soil, vegetation, and terrain features can provide valuable insight into the textures, colors, and patterns found in nature.

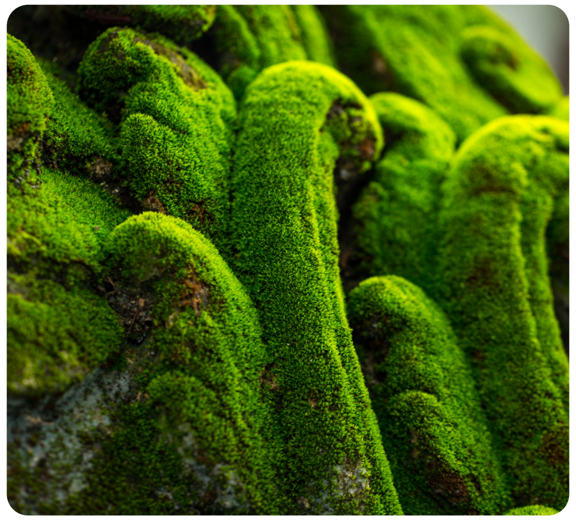
- **Architectural elements:**
For texturing buildings, structures, or architectural details, reference images of building materials such as bricks, concrete, wood, metal, and glass can inform the texture creation process, helping artists achieve architectural accuracy and authenticity.

- **Character textures:**
When texturing characters, reference images of skin, hair, clothing, and accessories can guide artists in capturing the subtle variations and details of human anatomy and clothing materials, resulting in more lifelike and believable characters.



c. Building out and organizing a reference image library for texture creation

- Artists can build a reference image library by collecting and categorizing reference images from various sources, including online image databases, photography websites, stock image libraries, personal photographs, and physical reference materials such as books and magazines.
- Reference images should be organized into specific categories or folders based on material type (e.g. wood, metal, fabric) or thematic elements (e.g. landscapes, architecture, characters) for easy access and retrieval.
- Artists may also create subfolders or tags within their reference image library to further classify images based on attributes such as color, texture, lighting, or perspective.
- It's important to regularly update and expand the reference image library to include new materials, textures, and visual inspiration, ensuring that artists have a diverse and comprehensive resource to draw upon for texture creation projects.



d. Exercises for students to practice

Research and gather reference images:
- Choose a specific material or surface texture you're interested in, such as wood, metal, fabric, or stone.
- Use online image search engines or stock image websites to find reference images related to your chosen material.
- Collect a variety of reference images that showcase different textures, colors, patterns, and lighting conditions for the chosen material.

Categorize reference images:
- Create folders or directories on your computer to organize your reference images.
- Divide the reference images into categories based on material type (e.g. wood, metal, fabric) or thematic elements (e.g. landscapes, architecture, characters).
- Within each category, create subfolders or tags to further classify images based on attributes such as color, texture, lighting, or perspective.

Create a digital mood board:
- Use digital mood board platforms or software tools to create visual collages of reference images.
- Arrange the reference images on the mood board in a visually appealing and organized manner.
- Add annotations or notes to each reference image to describe specific features, details, or attributes relevant to texture creation.

Build a physical reference library:

- Print out selected reference images and create a physical reference library using binders, folders, or albums.
- Organize the printed reference images into categories and subcategories based on material type or thematic elements.
- Include additional information or notes alongside the printed reference images to provide context and insights for texture creation.

Practice keyword tagging and metadata organization:

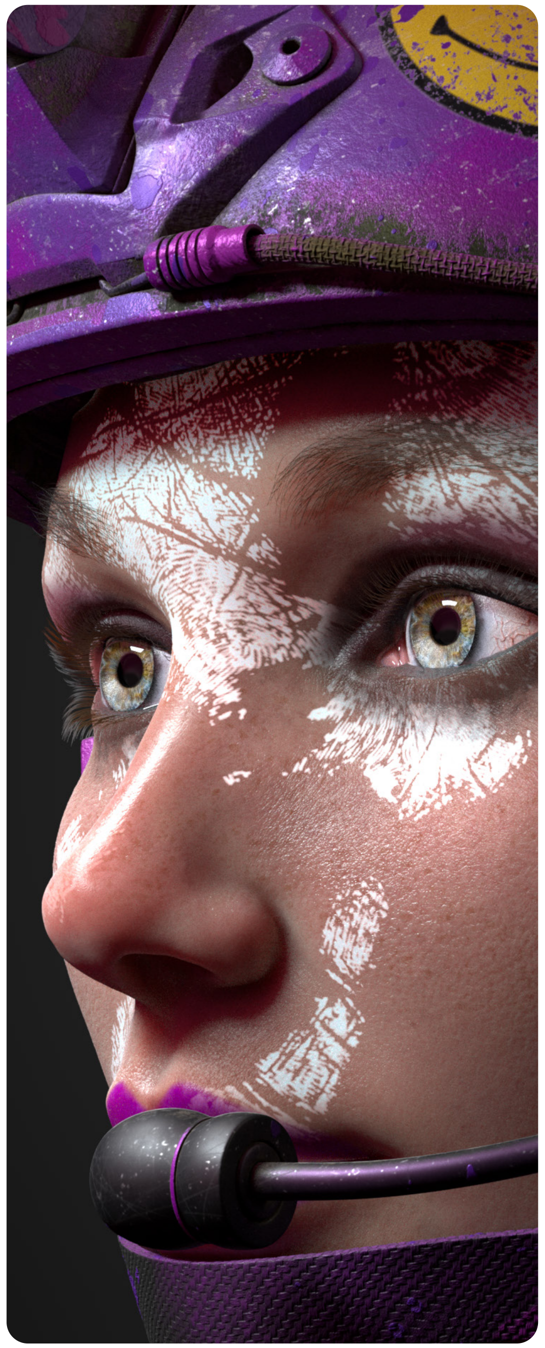
- Use keyword tagging and metadata organization features in image management software or platforms.
- Assign relevant keywords and metadata tags to each reference image to facilitate search and retrieval.
- Experiment with different tagging strategies to enhance the organization and accessibility of your reference image library.

Regularly update and expand your reference library:

- Continuously search for new reference images to expand your library and diversify your visual inspiration.
- Update and refine your organizational structure as needed to accommodate new materials, textures, and thematic elements.
- Regularly review and curate your reference image library to remove outdated or redundant images and ensure its relevance and usefulness for future texture creation projects.

e. Extra training resources

- Texturing.xyz
- The key to insanely detailed textures
- The importance of reference images
- PurRef: all your reference images in one place



MODULE 4

UVs, Mapping & More

Part 1 Understanding texture mapping and UV coordinates

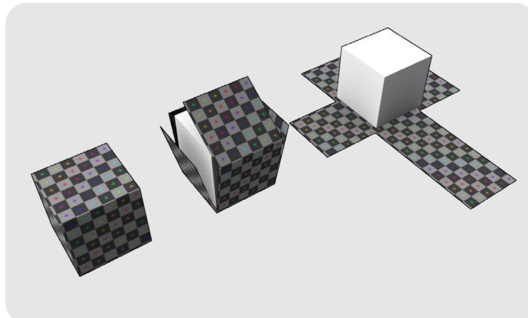
a. Texture mapping overview:

Texture mapping is like wrapping a gift with decorative paper. In the world of 3D computer graphics, it's a way to add detail and color to 3D models. Imagine you have a plain cardboard box, and you want to make it look like a treasure chest. Texture mapping enables you to stick a picture of wood grain or gold onto the box to make it look like wood or metal.

So, in simple terms, texture mapping is the process of taking 2D images, called textures, and wrapping them around 3D objects to make them look more realistic and interesting.

b. UV coordinates and how they relate to texture mapping:

Think of UV coordinates as a set of instructions that tell a computer how to wrap a texture around a 3D object. Just like latitude and longitude lines on a map, UV coordinates are a way to pinpoint specific locations on the surface of a 3D model. The 'U' and 'V' in UV coordinates stand for horizontal and vertical directions, similar to the X and Y axes in a graph. When you 'unwrap' a 3D model into a flat, 2D surface (like peeling an orange and laying its peel flat), you can assign UV coordinates to every point on that surface. These coordinates tell the computer exactly where each point is located in the texture image. So, UV coordinates are like a map that guides the computer on how to apply the texture to each part of the 3D model accurately.



c. UV coordinates and how they relate to 3D models

UV mapping is like creating a custom-made suit for a 3D model. It ensures that the texture fits perfectly onto every part of the model, just like tailoring a suit to fit every curve and contour of a person's body. Without UV mapping, textures might stretch, distort, or overlap incorrectly on the 3D model, making it look weird or unrealistic. UV mapping ensures that textures are applied smoothly and accurately, enhancing the overall visual quality of the model.

UV mapping plays a crucial role in determining how textures are wrapped around and applied to 3D models, ensuring they look as realistic and detailed as possible. Without UV maps, it would be impossible to accurately apply textures to specific areas of a 3D model.

UV maps facilitate the process of applying textures to 3D models in software like Mari by enabling artists to create a custom image based on a 2D 'pattern' of the 3D model. The model is unfolded at the seams and laid out flat on a 2D plan, and the artist can then produce a custom image based on this pattern and apply it to the 3D model. This process makes it possible to produce models rich in color and detail. The UV mapping process is typically done after the 3D modeling is complete and before any form of animation.

d. Exercises for students to practice understanding UV maps

Basic UV mapping exercise:

- Start with a simple 3D model, such as a cube or a sphere.
- Use UV mapping software or tools within your 3D modeling software to create UV maps for the model.
- Experiment with different UV mapping techniques, such as planar, cylindrical, or spherical mapping, to see how they affect the layout of UV coordinates on the model's surface.
- Practice unwrapping UVs and adjusting their layout to minimize distortion and optimize texel density.

Texture projection exercise:

- Apply a simple texture (such as a checkerboard pattern) to your 3D model.
- Use UV mapping techniques to project the texture onto the model's surface based on the UV coordinates.
- Observe how the texture wraps around the model according to the UV map, and experiment with different mapping options to achieve desired results.

Advanced UV mapping exercise:

- Choose a more complex 3D model, such as a character or a prop with multiple components.
- Practice creating UV maps for each component of the model, taking into account seams and overlapping geometry.
- Experiment with advanced UV mapping techniques, such as UV unwrapping algorithms or manual editing, to achieve optimal UV layouts for texture painting.

Texture painting practice:

- Use a texture painting tool like Mari to paint textures directly onto your UV-mapped 3D model.
- Start with simple textures and gradually add more complex details and effects using brushes, stencils, and layers.
- Pay attention to how the painted textures align with the UV map and how changes in the UV layout affect the appearance of the painted textures.

e. Extra training resources for understanding and explaining UV mapping

- Understanding UVs: Love them or hate them, they are essential to know
- UV maps explained
- Introduction to UV mapping – Learn the complete basics
- UV maps explained
- What is UV mapping
- What is UV mapping and unwrapping

Part 2 Overview of different texture types (diffuse, specular, normal maps, etc.)

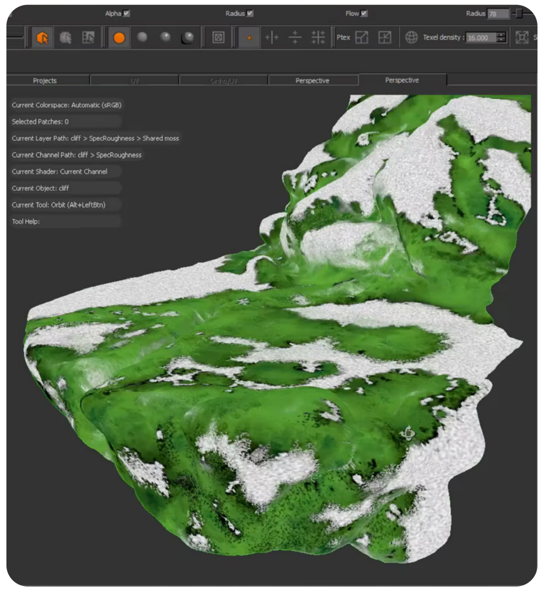
a. Explanation of texture maps in VFX and animation:

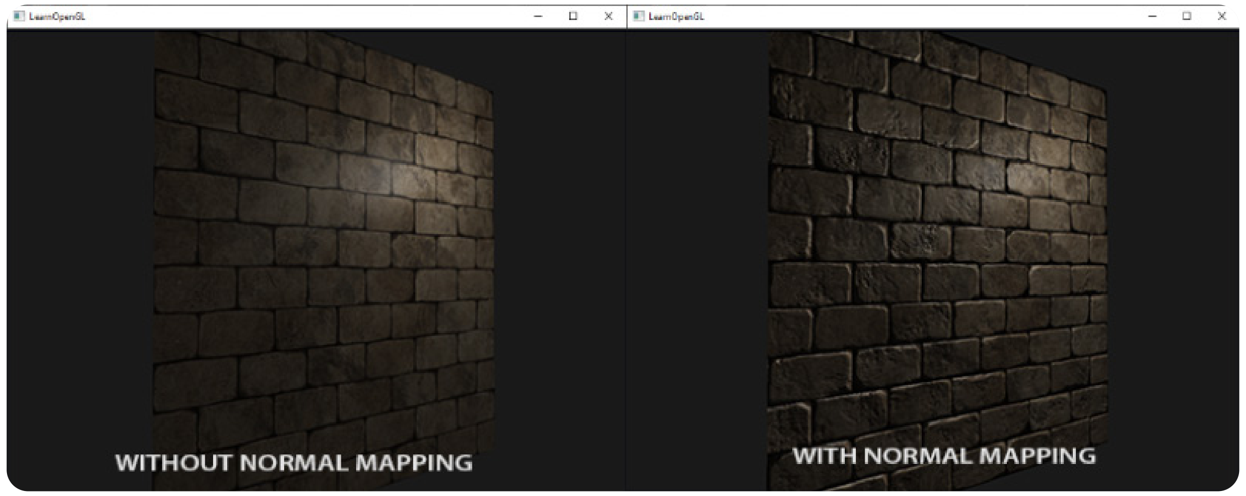
Texture maps, also known as texture files or image textures, are essential elements in VFX and animation. They are 2D images that contain information used to simulate the surface properties of 3D objects. These maps are applied to 3D models to add detail, realism, and visual interest to the rendered scene. From a VFX and animation perspective, texture maps serve as the visual building blocks that define various surface characteristics, such as color, reflectivity, bumpiness, and transparency. By applying texture maps, artists can create lifelike environments, characters, and effects within digital scenes.

Here are some common types of textures used in VFX and animation:

- Diffuse map: Represents the base color or texture of an object without any lighting effects. It defines how light is diffusely reflected off the surface. In VFX, a diffuse texture represents the base color or albedo of a surface. It determines how light is absorbed and scattered by the material. For example, a red diffuse texture applied to a surface will make it appear red when lit. Diffuse textures are essential for establishing the overall color and appearance of objects in a scene. During the rendering process, the renderer uses the information from the diffuse texture to calculate the base color of each pixel in the final image. This calculation considers factors such as lighting conditions, surface orientation, and material properties.

- Specular map: Controls the intensity of specular highlights on the surface, indicating areas that are more reflective or shiny than others. Specular highlights are the bright, reflective spots that appear on shiny surfaces when illuminated by a light source. By adjusting the values in a specular map, artists can control the intensity, size, and sharpness of specular highlights. For example, increasing the brightness in areas of the map corresponding to glossy regions of a material will make those areas appear shinier in the rendered image. Specular maps also influence the behavior of light rays as they interact with the surface, affecting the perceived material properties such as reflectivity and glossiness.



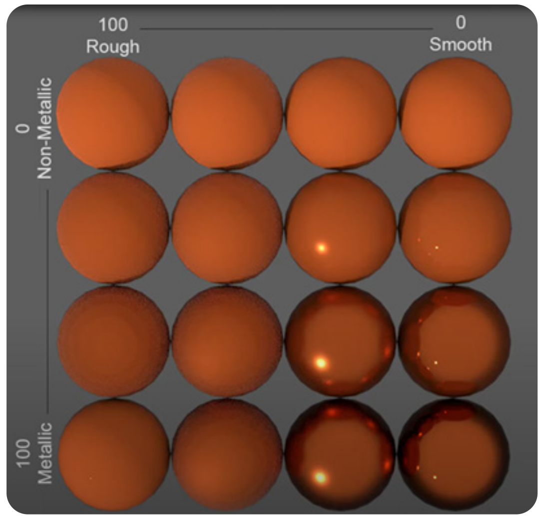


- **Normal map:** Encodes surface detail information, such as bumps, wrinkles, or creases, by manipulating the shading of the surface normals. They simulate the effect of small-scale bumps, wrinkles, or other surface irregularities without increasing the model's geometric complexity. In the shading process, normal maps alter the direction of light rays, creating the illusion of depth and surface detail on the model. This enhances the realism of the rendered image by adding visual complexity to otherwise flat surfaces. Techniques for creating normal maps vary, but commonly involve capturing high-resolution surface detail from sculpted models or generating them procedurally based on height or displacement maps.

- **Displacement map:** Alters the geometry of the 3D model by displacing vertices based on grayscale values, creating more intricate surface detail. These maps modify the actual geometry of a 3D model by displacing vertices based on texture information. They are commonly used for creating detailed surface geometry, such as wrinkles in fabric or fine surface irregularities.

- Ambient occlusion map: Simulates the effect of ambient light by darkening areas where surfaces come into contact or are close together, enhancing the perception of depth and realism. They are used to enhance the realism of shading by adding subtle shadowing and depth to crevices and corners.

- **Emissive map:** Adds self-illumination to specific areas of an object, making them appear to emit light independently of external light sources.



- **Roughness map:** Determines the microsurface roughness of a material, affecting how light interacts with the surface and creating variations in glossiness.

- **Opacity map:** Defines areas of transparency or opacity within an object, allowing light to pass through or be blocked accordingly.

b. Purpose of each type of texture

Each type of texture serves a specific purpose in defining the appearance and behavior of surfaces within a digital scene:

- **Diffuse map:** Establishes the base color and texture of an object, providing its primary visual identity.

- **Specular map:** Controls the reflection properties of the surface, determining where highlights appear and how intense they are.

- **Normal map:** Adds surface detail and depth to objects without increasing their geometric complexity, enhancing realism.

- **Displacement map:** Enhances surface detail by physically altering the geometry of the model, creating more realistic textures.

- **Ambient occlusion map:** Enhances the perception of depth and realism by simulating the occlusion of light within crevices and corners.

- **Emissive map:** Adds luminosity and glow effects to specific areas of an object, creating the illusion of light emission.

- **Roughness map:** Modifies the surface roughness, affecting how light is scattered or reflected off the surface.

- **Opacity map:** Defines transparent or opaque regions within an object, allowing for the creation of translucent or masked surfaces.

c. Creation or generation of textures

Textures can be created or generated using various techniques and software tools, depending on the desired outcome and artistic workflow. Some common methods include:

- **Digital painting:** Artists can use software like Mari, Photoshop, or Substance Painter to manually paint textures directly onto UV-unwrapped 3D models.

- **Photogrammetry:** Textures can be generated from real-world photographs or scans of physical objects, capturing surface details and colors with high fidelity.

- **Procedural generation:** Textures can be generated algorithmically using procedural techniques, such as noise patterns, fractals, or mathematical functions, providing infinite variations and control over surface properties.

- **Texture libraries:** Artists can utilize pre-existing texture libraries or resources containing a wide range of texture maps, which can be customized and adapted to suit specific project requirements.

Overall, texture maps play a vital role in achieving realism, detail, and visual impact in VFX and animation, offering artists a powerful toolset for creating compelling digital imagery.

d. Exercises for students to practice

Texture identification exercise:

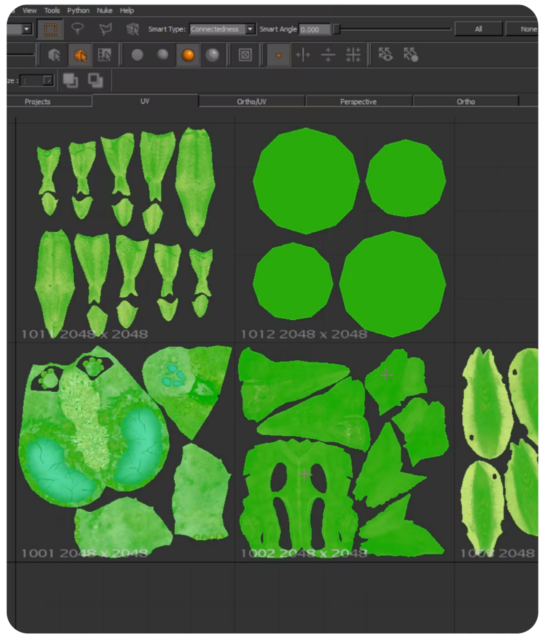
- Gather a collection of images or samples representing different texture types (e.g. diffuse, specular, normal maps, etc.).
- Study each texture closely and try to identify its characteristics and purpose.
- Make notes on what makes each texture unique and how it contributes to the overall appearance of a surface.
- Practice differentiating between texture types by comparing and contrasting their visual attributes.

Texture creation exercises:

- Experiment with creating your own textures using digital painting software like Photoshop or Mari.
- Start with simple textures and gradually increase complexity as you gain confidence.
- Focus on understanding how different tools and techniques can be used to achieve specific surface effects, such as roughness, glossiness, or bumpiness.
- Explore different brush presets, layer blending modes, and adjustment layers to manipulate texture characteristics like color, contrast, and detail.

Texture mapping and UV unwrapping practice:

- Practice UV unwrapping techniques using 3D modeling software like Mari, Substance, Blender, Maya, or 3ds Max.
- Create basic 3D models (e.g. a simple cube or sphere) and experiment with unwrapping their UV coordinates.
- Apply texture maps to your UV-unwrapped models and observe how the textures conform to the geometry of the objects.
- Experiment with adjusting UV layouts to minimize distortion and maximize texture resolution.
- Practice UV mapping on more complex models, such as characters or architectural elements, to develop your skills further.



Texture integration exercise:

- Choose a simple 3D scene or object and experiment with integrating different types of textures to enhance its appearance: Example project file
- Apply diffuse, specular, normal, and other texture maps to various surfaces within the scene, such as walls, floors, or props.
- Observe how each texture type affects the overall look and feel of the scene, including its lighting and shading properties.
- Experiment with adjusting texture parameters, such as color intensity, reflectivity, or bump strength, to achieve desired visual effects.

Texture analysis and critique:

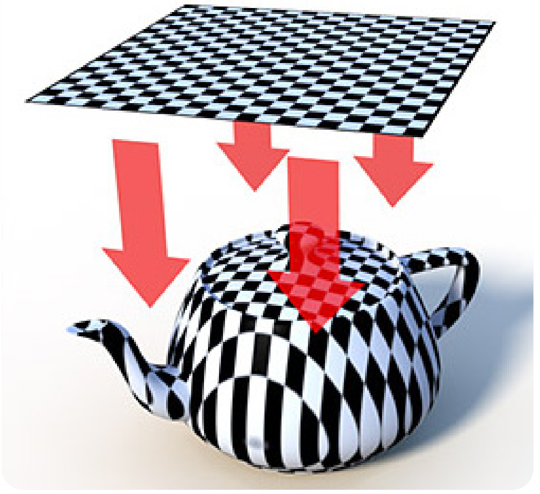
- Study examples of textures used in professional VFX and animation projects, such as movies, video games, or digital artwork.
- Analyze how different texture types are applied to create realistic environments, characters, and effects.
- Critique the effectiveness of texture usage in terms of visual appeal, realism, and storytelling.
- Identify strengths and weaknesses in texture implementation and consider how you could apply similar techniques in your own work.

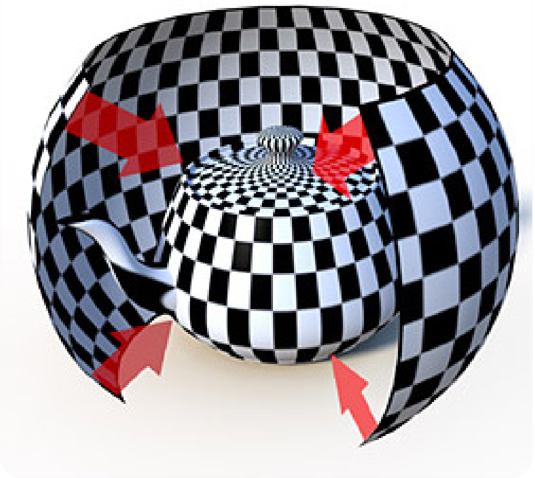
e. Extra training resources

- Texturing theory 101 – Understanding texture maps and channels
- Texture maps explained – Essential for all texture artists

f. UV mapping techniques

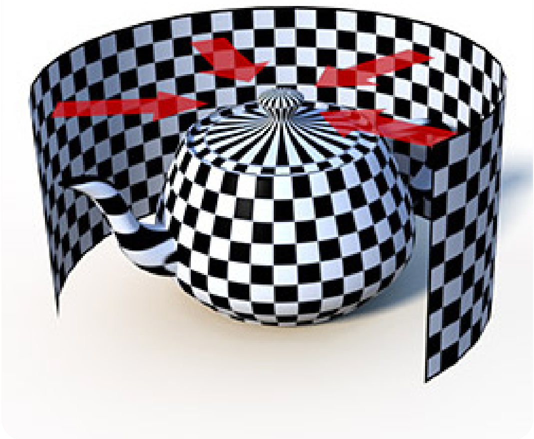
Planar mapping: Planar mapping projects the UV coordinates from one direction onto the model's surface. It's like unfolding the 3D model onto a flat plane.Planar mapping is best for objects with predominantly flat surfaces or surfaces that face a specific direction. It's useful for simple, flat objects like walls, floors, or billboards. However, planar mapping may cause distortion on curved or complex surfaces.



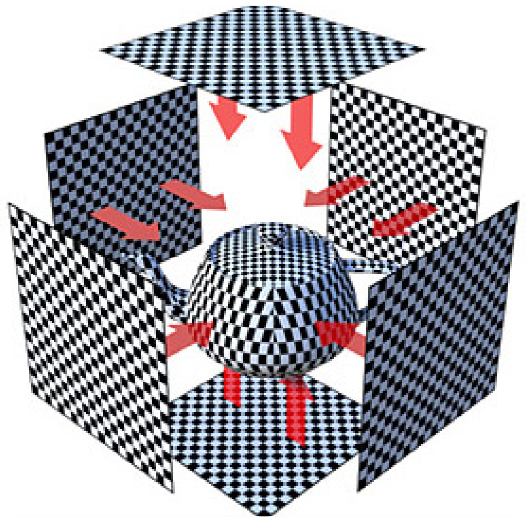


Spherical mapping: Spherical mapping projects the UV coordinates from a point inside the model, creating a spherical projection. It's often used for spherical or rounded objects like spheres or globes. Spherical mapping projects the 3D model onto the surface of a sphere. It's suitable for objects with a spherical shape, like planets or eyeballs. Spherical mapping also minimizes distortion on these objects.

Cylindrical mapping: Cylindrical mapping wraps the UV coordinates around the model as if it were wrapped around a cylinder. This technique is suitable for objects with cylindrical or curved shapes, such as barrels or columns. Cylindrical mapping works well for objects with cylindrical or tube-like shapes, like pipes or soda cans. Cylindrical mapping minimizes distortion on these types of objects.



Box mapping: Box mapping projects the UV coordinates from each side of the model, essentially creating a cube around the model and projecting onto each face. It's useful for objects with box-like shapes, such as crates or buildings. Box mapping involves projecting the 3D model onto the six faces of a cube, then unfolding the cube to create a 2D image. It's useful for quickly texturing objects with sharp angles, like buildings or furniture. However, box mapping may cause visible seams and distortion on curved surfaces.



g. Common challenges artists face when creating UV maps for complex 3D models and how to optimize them

Some common challenges artists face when creating UV maps for complex 3D models include visible seams, blurry or distorted textures, and ensuring a seamless appearance of textures on the model. These issues often arise due to incorrect placement of seams, manual editing of UV maps, or insufficient image resolution in textures.

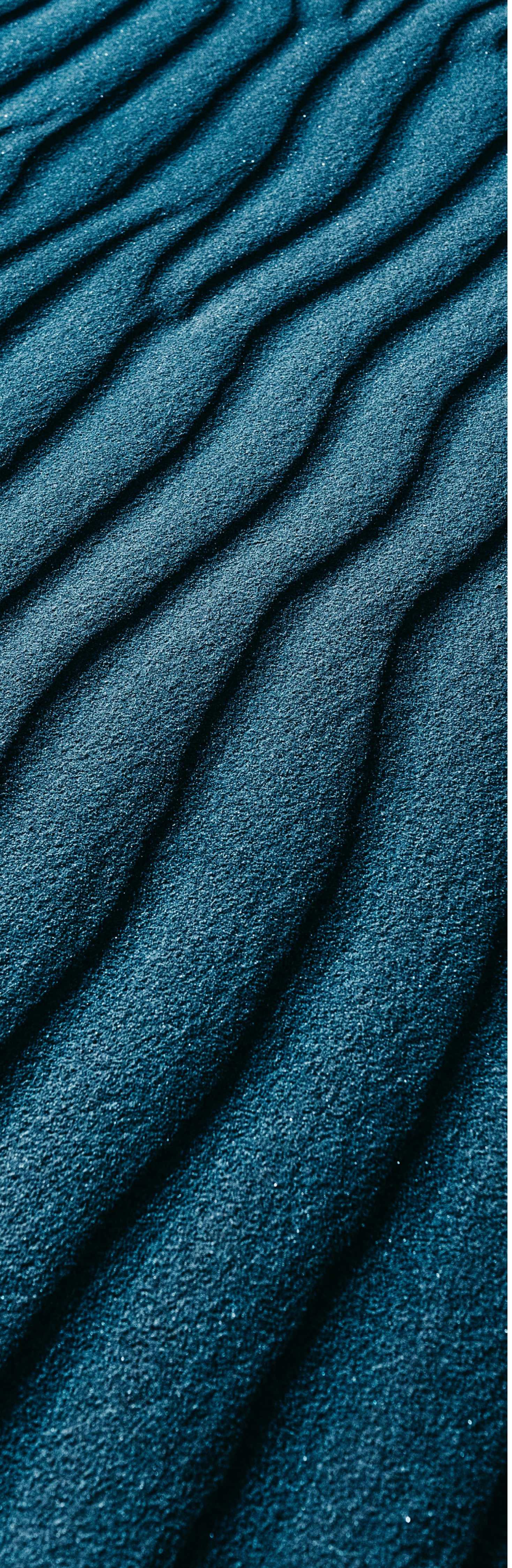
To optimize UV maps and minimize distortion while maximizing texture resolution, artists can follow these best practices:

- **Place seams carefully:** Artists should place seams in less visible areas, such as where two different textures meet or on natural breaks in the model's geometry.
- **Use high-resolution textures:** High-resolution textures can help reduce blurriness and improve overall visual quality. However, artists must balance resolution with performance considerations.
- **Avoid manual editing:** Manually editing UV maps can introduce distortion. Instead, artists should use unwrap operations and minimize stretch in the UV editor to maintain the correct aspect ratio and minimize distortion.
- **Utilize seaming techniques:** Techniques such as smart UV project, cylinder, and sphere projections can help minimize distortion when unwrapping complex models.
- **Retopologize:** If necessary, artists can retopologize high-resolution models to create an optimized low-poly version suitable for real-time rendering or animation. This process can help minimize distortion and facilitate better UV mapping.
- **Bake details:** Artists can bake normal maps, ambient occlusion, and other necessary maps from high-resolution sculpts onto low-poly models to preserve details without increasing polygon count.
- **Test and adjust:** Artists should test their models in the intended environment, such as a game engine or VFX pipeline, and make adjustments as necessary to ensure compatibility and desired performance. Collaborating with animators, riggers, and technical artists throughout the process can help address any issues that may arise.

h. Optimizing UV maps for texture painting in Mari

When optimizing UV maps for texture painting in Mari, artists should consider the following factors to minimize distortion and maximize texel density for better texture quality:

- **Aspect ratio:** Maintaining the correct aspect ratio of UV islands can help preserve the quality of the texture. Artists should avoid stretching or squishing UV islands as it can lead to distortion or loss of detail.
- **Minimize distortion:** Distortion in UV maps can lead to texture artifacts, such as stretching, blurring, or pixelation. Artists should avoid overlapping UV islands and ensure that they are placed within the UV space to minimize distortion.
- **Packing density:** Packing UV islands tightly within the UV space can help maximize texture resolution and minimize distortion. However, artists should be careful not to overpack UV islands, as this can lead to loss of detail and texture artifacts.
- **Texel density:** Texel density refers to the number of pixels in a texture that correspond to a single polygon in the 3D model. Artists should aim for consistent texel density across the UV map to ensure that textures appear consistent and detailed.
- **Seams and borders:** Artists should place seams and borders in areas where they will be less visible, such as between different textures or in natural breaks in the model's geometry. This can help minimize texture artifacts and improve the overall visual quality of the model.



To minimize distortion and maximize texel density in UV maps for better texture quality, artists can follow these best practices:

- **Use high-quality 3D models:** High-quality 3D models with clean geometry and few distorted polygons can help minimize distortion in UV maps.
- **Use UV projection:** UV projection can help maintain the correct aspect ratio and minimize distortion when unwrapping complex models.
- **Use the 'Optimize' tool:** Mari's Optimize tool can help minimize distortion and improve packing density in UV maps.
- **Adjust UV placement and scaling:** Artists can adjust the placement and scaling of UV islands to minimize distortion and maximize texel density.
- **Retopologize:** If necessary, artists can retopologize high-resolution models to create an optimized low-poly version suitable for real-time rendering or animation. This process can help minimize distortion and facilitate better UV mapping.

Part 3 Best practices for texture resolution and file formats

a. Relationship between texture resolution and polygon count

The relationship between texture resolution and polygon count is that the texture resolution must match the level of detail in the 3D model to maintain visual quality. High-polygon models require higher resolution textures to maintain detail, while low-polygon models can use lower resolution textures.

Artists can determine the appropriate texture resolution for a given 3D model by considering the level of detail in the model, the desired visual quality, and performance considerations. They should consider the intended use of the model (e.g. real-time rendering, animation, VFX) and the hardware requirements of the target platform.

b. Advantages and disadvantages of using high-resolution textures versus low-resolution textures

The advantages of high-resolution textures are that they can provide more detail and visual quality, while the disadvantage is that they can require more memory usage and rendering time. The advantages of low-resolution textures are that they can reduce memory usage and rendering time, while the disadvantage is that they may lack detail and visual quality.

c. Balance texture resolution with performance considerations

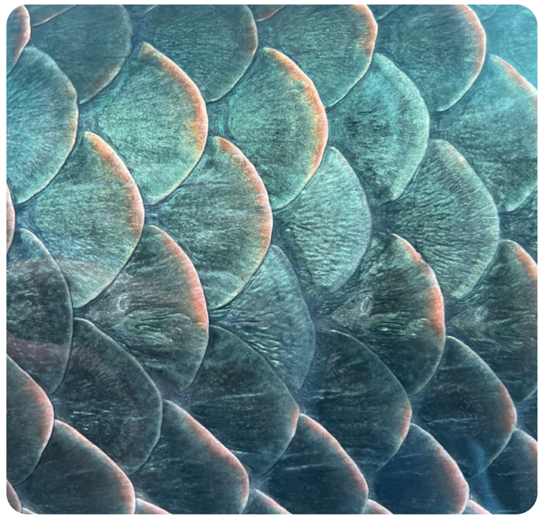
Artists can balance texture resolution with performance considerations by optimizing the texture resolution for the intended use and hardware requirements of the target platform. They can use techniques such as mipmapping, texture atlasing, and texture compression to reduce memory usage and improve rendering performance.

- **Use of mipmaps:** Use mipmapping to reduce the impact of high-resolution textures on memory usage and performance. Mipmaps are pre-scaled versions of the texture used for different levels of detail.
- **Texture atlases:** Combine multiple textures into a single texture atlas to reduce the number of texture lookups and improve performance.
- **Level of Detail (LOD):** Use LOD techniques to dynamically adjust texture resolution based on the distance from the camera, optimizing performance.

d. Common issues when working with textures at different resolutions, and how artists can address them

Some common issues that can arise when working with textures at different resolutions include texture stretching, distortion, and blurriness. Artists can address these issues by adjusting the UV map placement, scaling, and orientation to match the texture resolution. They can also use texture filtering and anti-aliasing techniques to improve the visual quality of textures.

Overall, when working with texture resolution and file formats, artists should consider the level of detail in the 3D model, the desired visual quality, and performance considerations. They should aim to balance texture resolution with memory usage and rendering time, and use best practices for file naming, organization, and compatibility. By understanding these concepts and techniques, artists can create high-quality textures for 3D models that maintain visual fidelity and optimize performance.



e. File formats basics: advantages and disadvantages

The most common file formats used for textures in 3D modeling and rendering include:

- **JPEG:** A lossy file format that provides good compression and is widely supported in 3D modeling and rendering software.
  - **Advantages:** Smaller file sizes, suitable for web and real-time applications.
  - **Disadvantages:** Quality loss due to compression artifacts, not suitable for high-quality textures.
- **PNG:** A lossless file format that supports transparency and is widely supported in 3D modeling and rendering software.
  - **Advantages:** Retains original quality without compression artifacts, suitable for high-quality textures.
  - **Disadvantages:** Larger file sizes compared to lossy formats.

- **TIFF:** A lossless file format that supports high-color depth and is widely supported in 3D modeling and rendering software.
  - **Advantages:** Retains original quality without compression artifacts, suitable for high-quality textures.
  - **Disadvantages:** Larger file sizes compared to lossy formats.
- **EXR:** A high-dynamic-range (HDR) file format that supports high-color depth and is widely used in VFX and animation.
- **HDR:** A high-dynamic-range (HDR) file format that supports high-color depth and is used in lighting and environment mapping.

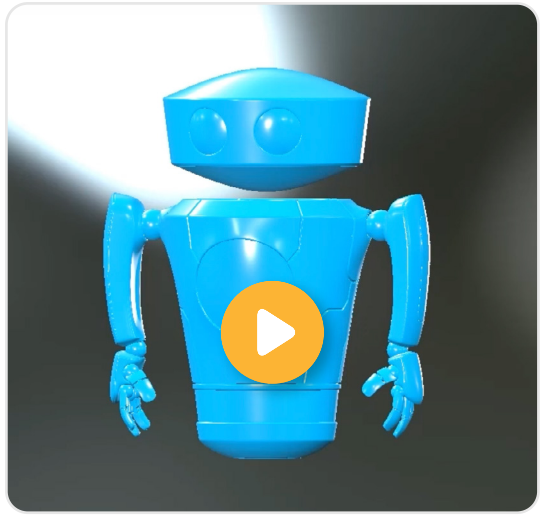
f. Best practices for naming and organizing texture files to maintain a clear and efficient workflow

The best practices for naming and organizing texture files include using descriptive and consistent naming conventions, organizing textures into folders based on the 3D model or scene, and using version control to track changes to the textures. Artists should also consider using naming conventions that indicate the texture resolution, file format, and intended use.

Part 4

Introduction to texture painting software (such as Mari) and its interface

For this, we want to jump into Mari so students have a visual of its interface. The best way to get started with Mari is to have students follow along with the Day 1 in Mari: The Basics video created by Michael Wilde



Training resources for Module 4

- Texturing fundamentals – How to paint in materials for VFX
- The importance of reference images
- Mari tutorial: Photo-realistic texturing full process
- Mari for beginners
- Mari: from beginner to pro

MODULE 5

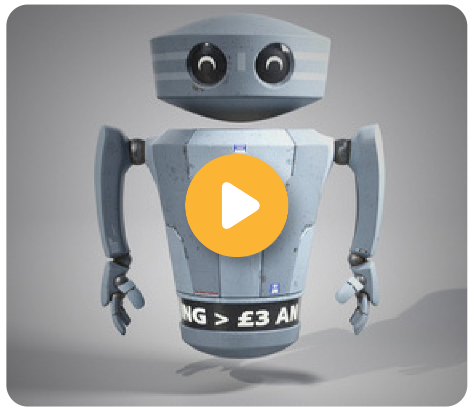
Textures Techniques

For this section, we'll rely on training videos so you and students have a visual to follow along for each subject.

Part 1

Techniques for creating textures, including painting and procedural painting

For this part, we'll direct students to view the Day 2 in Mari training video from Michael Wilde.
He'll explore using procedurals, different blending modes, and using images to add realistic detail. The robot asset in the video is available for download so students are able to follow along



Part 2

Creating textures for specific materials

For this section, we'll rely on videos so students can see how to create examples of different textures:

- Skin in Mari
- Metallic material in Mari
- Creating a glass material in Mari
- Creating wood material in Mari
- Mari Procedural Node guide

Part 3

Supplemental and more advanced topics you could cover based on students level:

- Using displacement maps to add depth to textures
- Creating textures for complex surfaces, such as hair and fur
- Introduction to shader networks and their role in texture creation
- Best practices for texture optimization and efficiency

MODULE 6

Texturing for Animation and VFX

It's important to understand the differences between animation and VFX studios, as both require texturing in different ways and for different results:

Texturing in Animation

Texturing in VFX

Concepts students should grasp from previous modules and understanding texturing in VFX vs. Animation:

- Understanding the role of textures in animation and VFX pipelines
- Texture optimization
- Creating textures for characters and environments in animation and VFX
- Best practices for texture management and organization in a production environments

Texturing in Mari course outline

Now that students understand texture theory and techniques, let's see how this works with Mari. Students will need access to Mari for this section. With your educational classroom licenses, the school can access Mari as part of the Education Collective. Students can access Mari from their personal computers with our student licenses.

More details for accessing the student license can be found on our student page: https://www.foundry.com/education/students

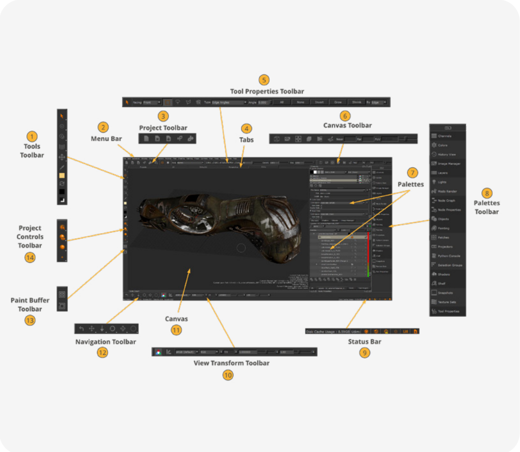
Mari install guide: https://learn.foundry.com/mari/Content/install.html

MODULE 1

Introduction to Mari and Layer-Based Workflow

1. Introduction to Mari and its interface:

The Mari workspace consists of a menu bar, a canvas, toolbars, palettes, and a status bar. Palettes are used for working with items such as channels or shaders. They can be either docked in the application or made to float wherever you find them most useful. You can also place toolbars at the top or bottom and on the left- or right-hand side of the canvas. The hyperlink above will direct you to our Mari user guide with the workspace details.



2. Mari interface: get to know the basics – video:

This video from Meshmen Studio provides an in-depth tour of the Mari user interface, covering various tools, menus, and features such as the toolbar, sidebar, and top menu, as well as explaining how to use them for tasks like painting, layer management, and color management.

3. Mari Painting Tools and painting on layers – video:

This video from Meshmen Studio covers the various paint and paint buffer tools in Mari, including brushes, rollers, and blur brushes,, demonstrating how to use them to create different effects and textures on a 3D model. The tutorial also explains the importance of understanding how the paint buffer works and how to use it to achieve desired results.

4. Overview of layer-based workflow:

For a number of artists, layers were the first painting system they used in Mari. Layers are created as part of a layer stack, which is in turn held within a specific channel. Each channel has a different layer stack that contains a new set of layers. You can create paint layers, layer masks, adjustments, procedurals, and layer groups within the Layers palette. The layer system combines effects in a non-destructive manner while replicating a familiar workflow for traditional artists. The real strength of the layer system lies in the way layers integrate with shaders and channels and its logical setup.

5. Creating and managing layers - video:

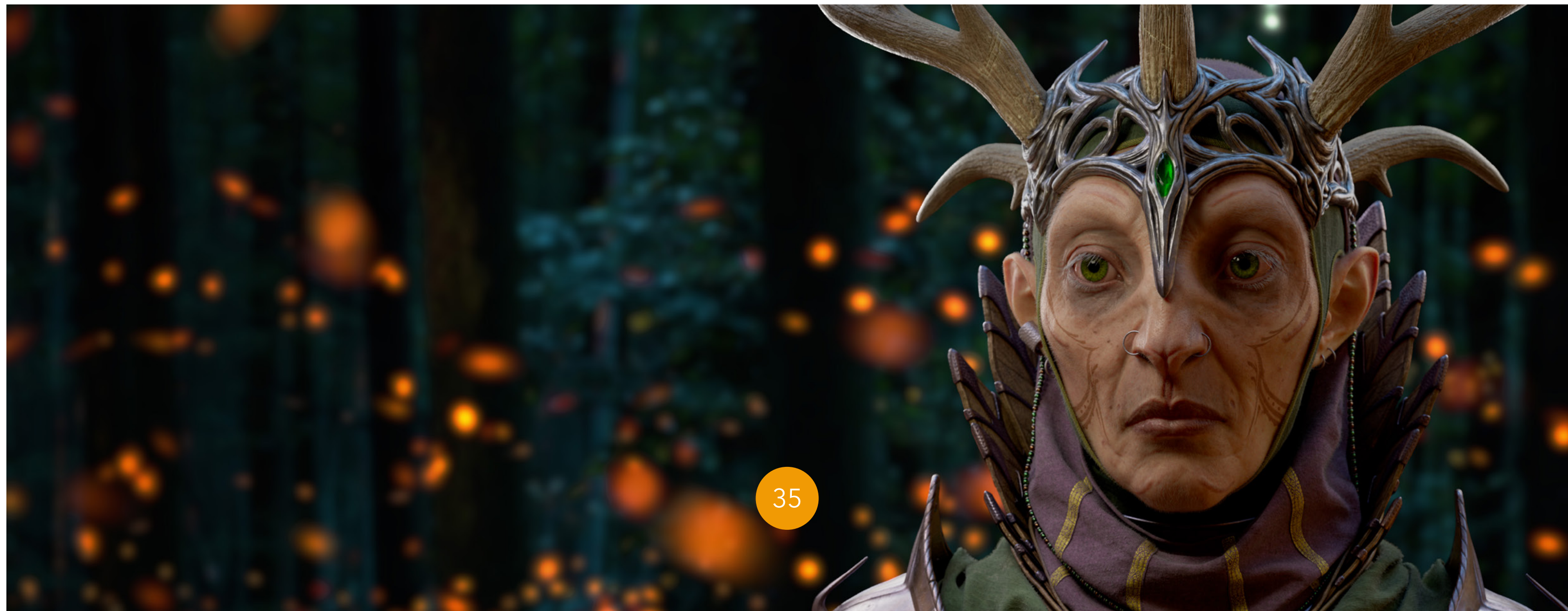
This video from Meshmen Studio covers the basics of layers in Mari, including importing layers, layer masks, adjustment stacks, procedural layers, graph layers, and materials. It demonstrates how to work with layers, masks, and materials to achieve complex textures and looks, and provides a foundation for more advanced techniques in future tutorials.

6. Using layer masks and adjustments - video:

This video from Meshmen Studio shows material layer tools and how you can use them to maximize your layer texturing workflows. He begins the texturing of the asset you can also download and follow along for free. The video covers techniques such as color to scalar, color to mask, and layer grouping to create a complex material assignment system.

7. Exporting layer-based textures:

On this Foundry Learn document, students will learn how to export textures from layers in Mari. It covers two methods: exporting entire layers without flattening or flattening them first, and exporting individual files by picking patches. It also discusses how to export a sequence of files with consistent naming/numbering.



MODULE 2

Understanding Nodes and Node-Based Workflow

1. Introduction to Mari and its interface:

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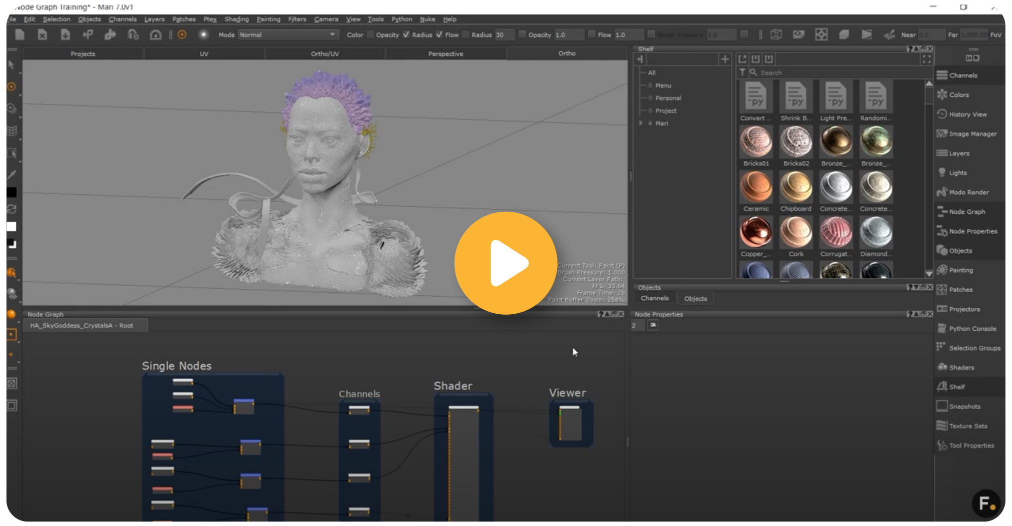
1.Understanding Mari's node graph system, node graph UI, and how to create a node tree:

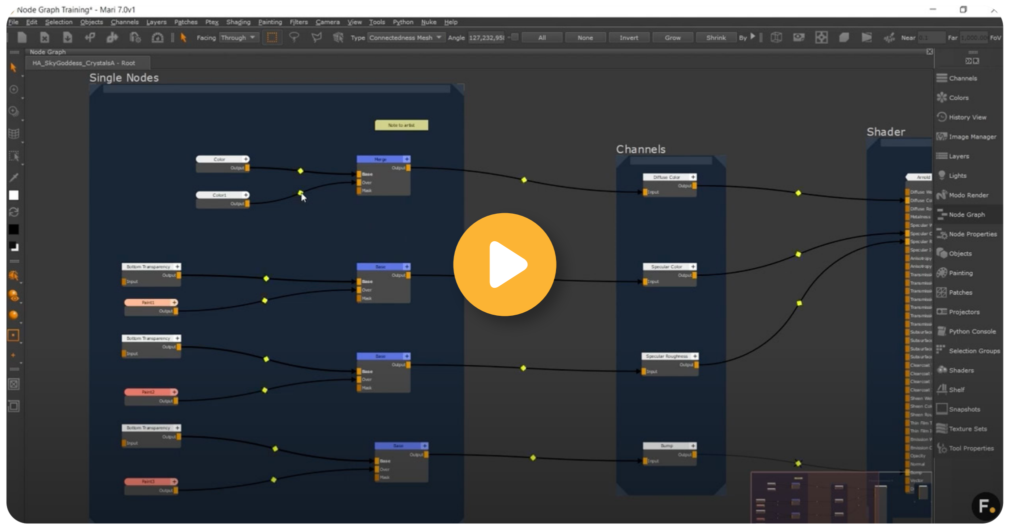
Nowadays, most VFX studios and texture artists have moved away from the layer-based workflow and instead have adapted the Mari node graph.

To get started. What is the node graph? The node graph is another way of viewing and managing your channel's layers and shaders. You can set up a node graph for ordering different sets of paint and combining effects in a non-destructive manner. Though similar to layers, the node graph gives you a clear step-by-step overview of what is happening within your texture streams so you can micro-manage the various components as individual nodes.

Node graph: Workflow efficiency



Node graph: Basic UI



2. Understanding the difference between node-based and layer-based texturing

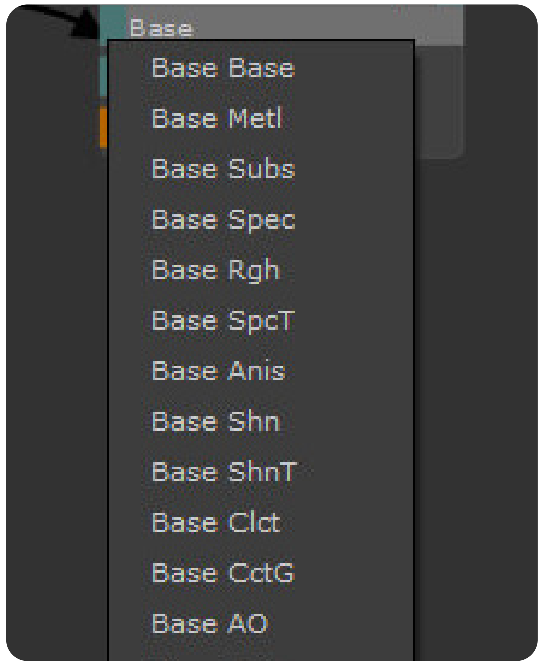
Node graph workflows offer several advantages over layer-based workflows, especially for complex projects:

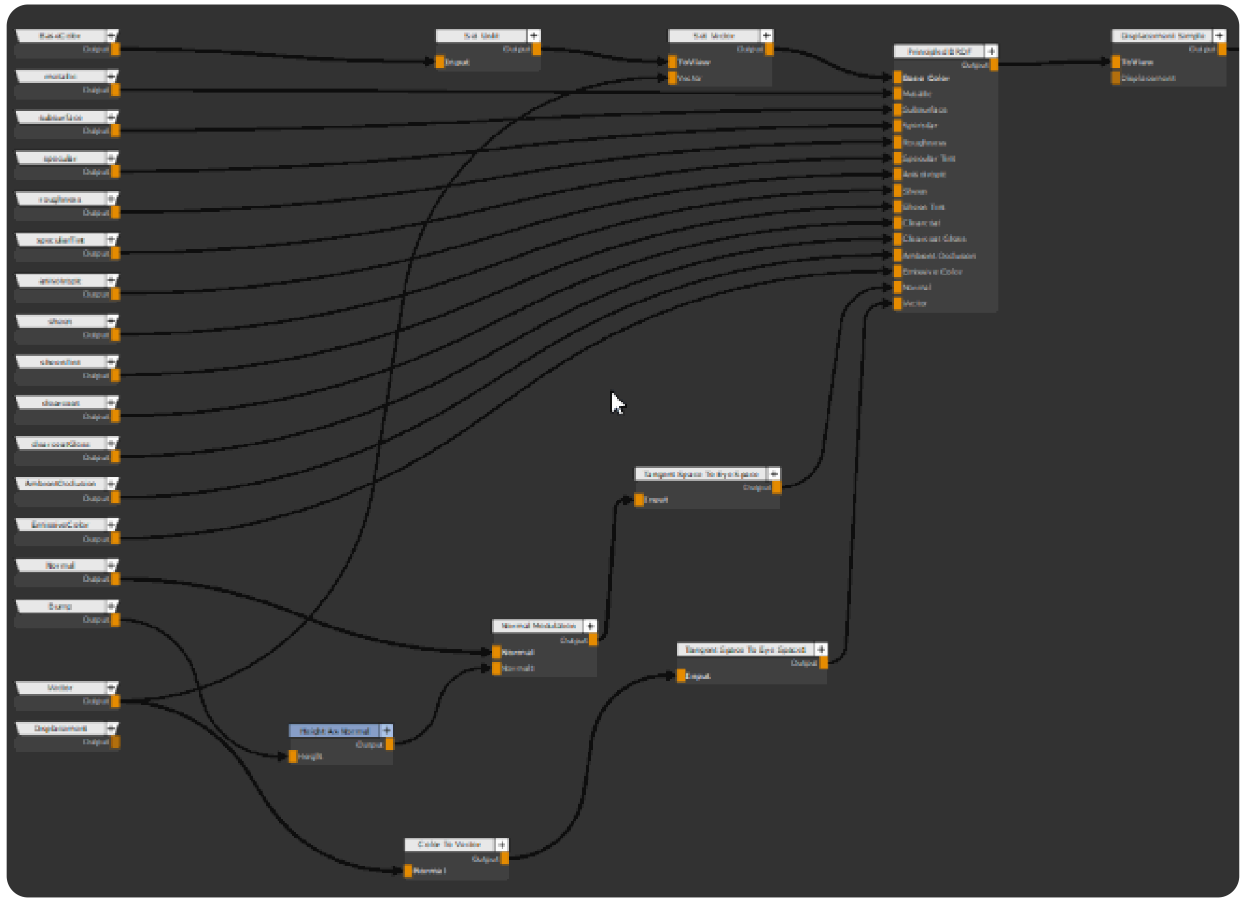
- **Flexibility and non-destructive editing:** Nodes represent specific operations, allowing for easy reordering and modification without affecting the underlying image data. Unlike layers, that can become destructive when adjustments are made directly, the node network keeps all of your data live and editable.
- **Clarity and reusability:** Complex edits can be broken down into reusable node networks, making the workflow more transparent and easier to share with collaborators. Layer stacks can become cluttered and opaque, especially in large projects, making it difficult to pick up work from another artist.
- **Procedural workflows:** Nodes can be used to create procedural patterns based on adjustable parameters, allowing for dynamic changes on the fly. Layers are typically static representations of image data meaning they can't easily be edited.
- **Advanced compositing:** Node-based software often offers a wider range of tools and effects specifically designed for compositing tasks, which can be cumbersome or limited in layer-based workflows.

Node graphs offer a powerful and flexible approach for complex projects but can have a steeper learning curve and require more effort to master. Layer-based workflows remain a good choice for simpler tasks or when ease of use is a priority, however the future of texturing lies in nodes.

3. Working with nodes:

Nodes are the basic building blocks used to represent layers, channels, and shaders in Mari. Nodes can exist individually, within Backdrop nodes, or as part of a Group (including graph layers) in the node graph. The Learn page linked is a guide to working with nodes in Mari. It covers how to add, delete, bypass, and disable nodes, as well as how to select, rename, and edit them. It also explains how to use the Image Manager palette to add images to the node graph, and how to bake to a Bake Point node. Finally, it shows how to customize node colors and behavior.

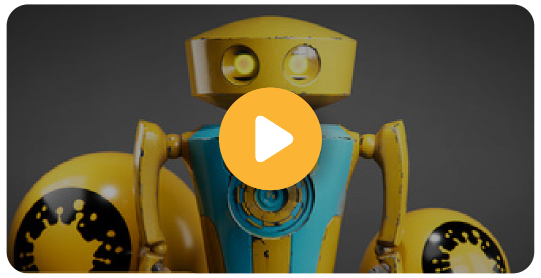




4. Creating and connecting nodes:

The Mari user guide linked explains the process of connecting and managing nodes within Mari's node graph. It covers basic techniques for connecting nodes, including clicking on output and input ports, using the Teleport Broadcaster and Receiver for distant connections, and using Dot nodes to bend connections for better organization. It also discusses methods for disconnecting and reconnecting nodes, as well as specifics on handling multi-channel nodes and the types of inputs different nodes accept.

5. Setting up a project and importing assets



In this video, you'll learn how to get a model from a 3D package like Maya, prepped and imported into Mari to begin texture painting.

- What's more, students can also reference our Mari user guide: Setting up a project. This provides a step-by-step guide to creating and managing a new project in Mari. It covers essential aspects like naming the project, setting texture options, and loading geometry, along with saving and reopening the project for future work. The user guide also highlights how to specify project parameters, such as resolution and color depth, and offers tips on handling various project elements like shaders, projectors, and the project shelf.

- Students will also need to understand 'setting the view' in Mari. This user guide explains how to open a Mari project and adjust the view and lighting on geometry before painting. It details techniques for orbiting, zooming, panning, and viewing from different directions, as well as how to use split views. It also covers selecting lighting modes and adjusting light properties to enhance the visual setup of the model.

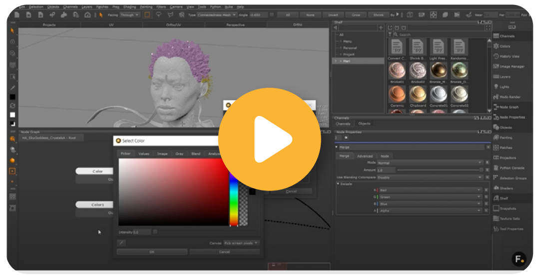
6. Painting textures with brushes and stencils

The Mari user guide provides an overview of the painting tools and features in Mari. It covers the basics of painting, including selecting and customizing brushes, painting with different tools, and working with images and layers. Students can also learn more about Mari's painting tools.

7. Color assignment and simple painting with nodes

(single video here covers the topics below)

- Color node
- Merge node
- Paint node



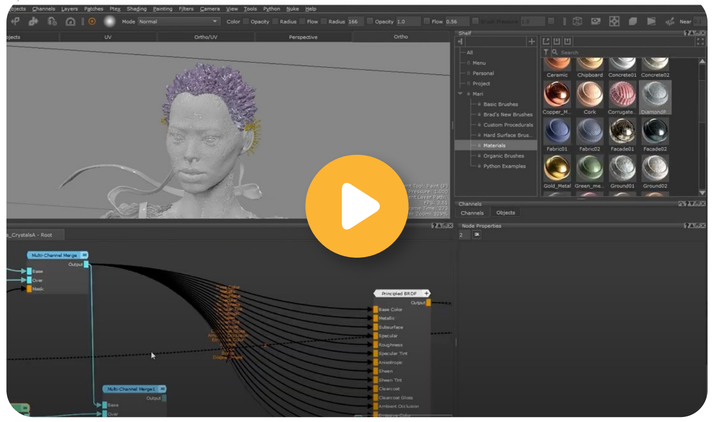
8. Using channels and layer nodes:

This video from Meshmen Studio covers the basics of channels in Mari, explaining that these are containers for layers and procedural nodes, and can be used to organize and export texture data. The video demonstrates how to create a channel, add layers and nodes, and export the channel using the export manager. It also shows how to import existing textures into channels using the channel presets feature.

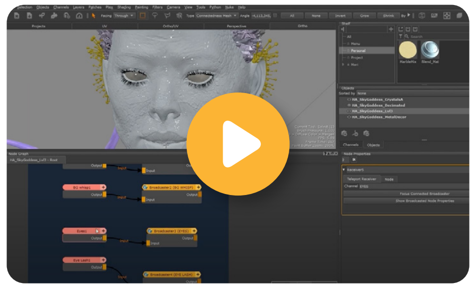
9. Channel and material approach

- Node graph reference guide:
  The page provides an overview of the different types of nodes available in Mari. The nodes are categorized into several groups, including Basic nodes, Filter nodes, Geometry nodes, Layer nodes, Math nodes, Misc nodes, Procedural nodes, and Projection nodes. Each category serves a specific purpose, such as making adjustments to paint, positioning textures, combining nodes, performing calculations, customizing node networks, adding texture patterns, and projecting images onto objects.

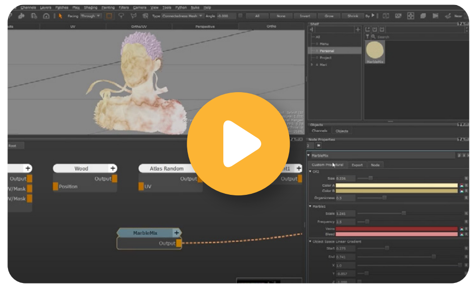
We'll dive into some of the different nodes in the videos below:



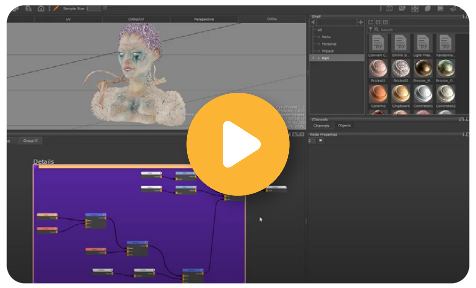
- Material node and Multi-Channel Merge node



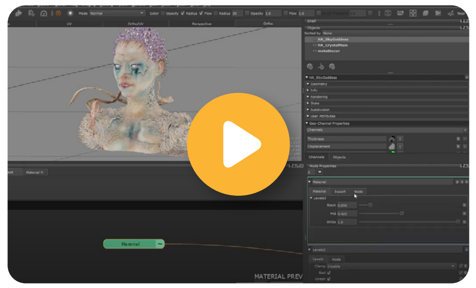
- Teleport nodes



- Procedural nodes



- Grouping nodes



- Geochannel nodes

10. Applying procedural textures with nodes:

Procedural nodes enable you to add texture patterns, grid patterns, environments, and masks to your scene using a variety of parameter settings.

11. Create your material

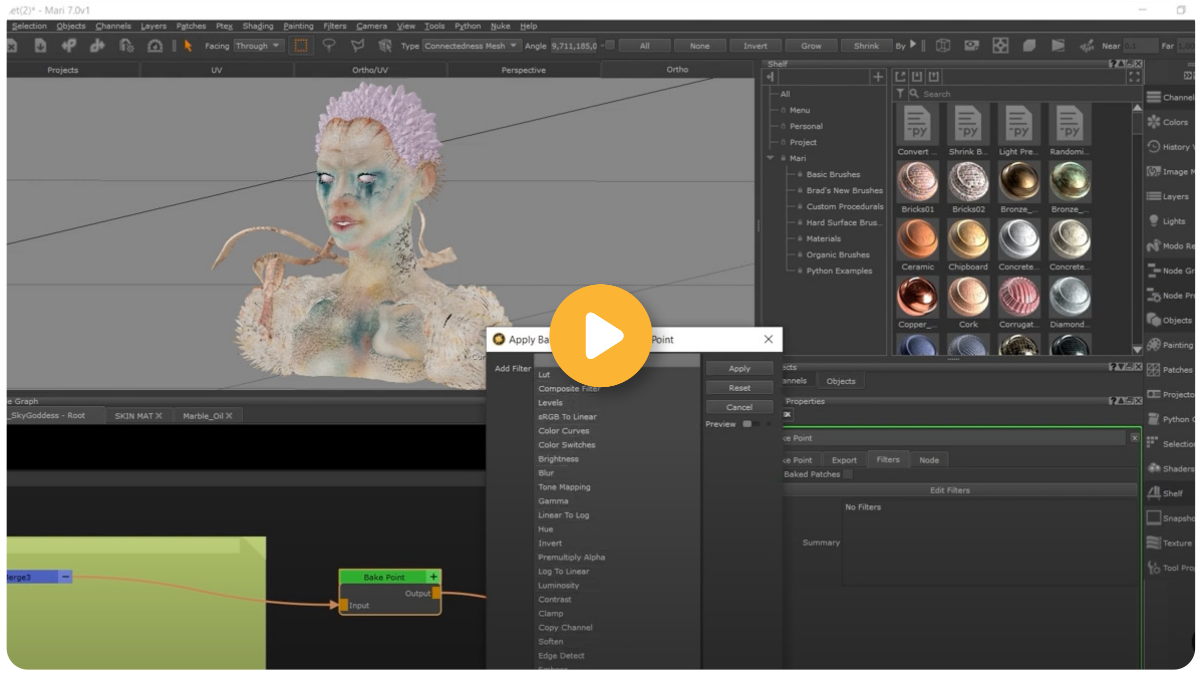
In this video, Johnny Fehr will show you how you can create your own smart materials to create your own high-quality material library.
12. Using Geometry nodes
This user guide will help students become familiar with Mari's Geometry nodes.

13. Creating a Custom Procedural:

The Custom Procedural node enables you to create textures within the node, which can be exported as a procedural texture and added to the Shelf for use in other projects, the node graph, or layer stack. The node can be exported as a Color Procedural, a Scalar Procedural, or a Procedural Mask.

14. Baking node streams and exporting images using Bake Point node

- Baking with the Bakery user guide
- Bake point node



15. Exercise for students to practice:

Students can revisit the first and second day using the Mari training videos we looked at in the texture theory course. They should now have a good understanding of Mari, its interface, and working in a node-based workflow. The idea behind that training series is a 'spiral learning' concept where students do the same exercise but more in-depth with each video (Day 1, Day 2, and Day 3) so it creates repetition and familiarity. Once students have relooked at Day 1, and Day 2, have them visit Day 3 in Mari to get a feel of how they would texture in a studio environment:

- Day 1: The basics
- Day 2: Detail and procedural painting
- Day 3: Texture in a studio environment
- Robot asset available for download in the course file tab here

Additional training resources students can view:

- Introduction to Mari for complete beginners – 1-hour quick start guide
- Mari rust material creation
- Create your own Mari smart materials
- You've got UV seams in Mari? Get rid of them fast!
- One simple trick – handle Mari colorspace like a Pro
- Mari 7 features overview
- Mari learning paths landing page
- Mari user guide
- Mari keyboard shortcuts
- Meshmen Studio: Become a texture artist playlist
- Exploring the science of texturing with Mari: a practical guide for artists

If you have any questions, feedback or would like to collaborate on future versions of our Mari course, please send us an email at education@foundry.com.

Supplement Training outlines

These sections will be expanded in later versions of our course updates. They are included here, as is, as a general overview and suggested topics to cover.

PBR / Material Theory

Lesson 1 Introduction to PBR and Material Theory

- Understanding the concept of physically based rendering (PBR)
- Overview of material theory and how it relates to PBR
- Introduction to the PBR workflow and its advantages over traditional rendering techniques
- Understanding the importance of accurate material properties in PBR

Lesson 2 Material Properties and Maps

- Introduction to the different material properties used in PBR workflows
- Understanding how different material properties affect surface appearance
- Overview of different material maps used in PBR workflows
- Using software tools to create and edit material maps
- Understanding how to use material maps to create complex surface appearances

Lesson 3 Lighting and Environment

- Understanding how lighting and environment affect surface appearance in PBR
- Overview of different lighting models used in PBR workflows
- Introduction to different environment maps and their uses
- Understanding how to use software tools to create and edit environment maps
- Using environment maps to create realistic lighting and reflections in PBR scenes

Lesson 4 Advanced PBR Techniques

- Introduction to advanced PBR techniques, such as subsurface scattering, translucency, and anisotropy
- Understanding how to use these techniques to create complex surface appearances
- Overview of specialized material workflows, such as hair and skin materials
- Understanding how to use specialized material maps to create accurate surface appearances

Shaders in Mari

Lesson 1 Introduction to Shaders in Mari

- Understanding the purpose of shaders in Mari
- Overview of shader types and their uses
- Introduction to the Shader Tree and its interface
- Creating and assigning shaders to objects in a scene
- Using basic shader settings to adjust surface appearance

Lesson 2 Surface Properties

- Introduction to surface properties and how they affect shader appearance
- Understanding how to adjust surface properties in Mari's Shader Tree
- Using the Gloss, Specular, and Metallic channels to control surface appearance
- Introduction to using Normal Maps to add surface detail
- Using the Displacement channel to add depth and texture to surfaces

Lesson 3 Advanced Shading Techniques

- Introduction to the Material Layer System for advanced shader control
- Understanding the use of Multi-Pass Shading for complex surface appearances
- Introduction to using Procedural Textures in shaders
- Using the Advanced Material Layers for more control over surface appearance

Lesson 4 Procedural Shading

- Understanding the use of Procedural Textures in shaders
- Introduction to the different types of Procedural Textures available in Mari
- Using the Procedural Layer System for advanced control over surface appearance
- Creating custom Procedural Textures in Mari
- Advanced techniques for using Procedural Textures in shaders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