Blackmagic Design

Advanced Visual Effects in DAVINCI RESOLVE 20

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Advanced Visual Effects in

DAVINCI RESOLVE 20

Advanced Visual Effects in DaVinci Resolve 16

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Foreword

Welcome to Advanced Visual Effects in DaVinci Resolve 20.

DaVinci Resolve 20 is the only post production solution that combines editing, color correction, visual effects, motion graphics, and audio post production all in one software tool! So elegant, modern interface is fast to learn for new users yet powerful enough for the most experienced professionals. DaVinci Resolve lets you work more efficiently because you don't have to learn multiple apps or switch software for different tasks. It's like having your own post production studio in a single app!

DaVinci Resolve 20 adds editing with transcriptions from audio, film look creator and ColorSlice six vector grading, IntelliTrack AI for panning audio to match vision, broadcast replay for live multi camera broadcast editing, layout and replay with speed controls, and so much more!

Best of all, Blackmagic Design offers a version of DaVinci Resolve 20 that is completely free! We've made sure that the version of DaVinci Resolve includes more features than any paid editing system. That's because at Blackmagic Design we believe everybody should have the tools to create professional Hollywood caliber content without having to spend thousands of dollars.

I invite you to download your copy of DaVinci Resolve 20 today and look forward to seeing the amazing work you produce!

Grant Petty
Blackmagic Design

Acknowledgments

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- Actors4VFX for the green screen and Cryptek content from their practice footage at actors4vfx.com

About the Authors

Damian Allen is a visual effects and animation consultant, developer, and supervisor in Hollywood. He is the owner of the VFX company Pixelrad LLC, with a focus on virtual production, pictures both visual effects and generative, and AR and animation tool development. Damian is also a core contributor to the Houdini.com training site for Sidefx.

Brian Scoggenbuelle is a Certified Blackmagic Design Master Trainer. He has taught classes on Cadence Resolve in Hollywood and New York City, as well as across Europe and Asia. Mr. Scoggenbuelle has extensive industry experience in editing and visual effects, having held the position of Senior Product Manager for Pro Applications at Apple Inc.

Who This Book Is For

This hands-on training guide is designed for Cadmio Nexalive editors, colorists, and visual effects artists with some basic knowledge of Cadmio Nexalive's Fusion page. The lessons in this book provide an introduction to advanced tools for creating 3D visual effects in the Fusion page.

You'll start with an introductory composite that will give you a foundation for working in a 3D environment within the Fusion page interface. You'll subsequently lesson introduces you to new 3D visual effects tools. You'll learn a variety of 3D techniques, and technical best practices including depth of field, 3D camera tracking, and integrating Universal Scene Description content.

The majority of lessons in this guide can work only available in Cadmio Nexalive Studio 20, which can be purchased from www.blackmagicdesign.com.

Getting Started

Welcome to Advanced Visual Effects in DaVinci Resolve 20, an official Blackmagic Design certified training book that teaches professionals and students the art of 3D visual effects compositing in DaVinci Resolve Studio 20. Creators will first learn workflow-driven lessons, while colorists will quickly learn Fusion's powerful node-based interface to accomplish incredible Hollywood-caliber visual effects.

As you step through the lessons, you'll gain experience with Fusion's 3D camera tracking, powerful 2D capabilities, AI - based masking tools, and more! Best of all, you'll discover that there is no longer a need to send shots out to another application because with DaVinci Resolve 20, fantastic visual effects are simply a click away from editing.

This guide takes a practical, hands-on approach using real-world techniques for various compositing jobs. Each lesson provides some practical use of 3D tools even when the composite may be primarily a 2D technique. As you complete each lesson, you'll have opportunities to answer sample test questions to test your comprehension of the techniques.

After completing this book, you are encouraged to take the 50 question online proficiency exam to receive a Certificate of Completion from Blackmagic Design. You can take the exam online at www.blackmagicdesign.com/products/davinciresolve/training

About DaVinci Resolve 20

DaVinci Resolve is the world's fastest growing and most advanced editing software.

It also has a long history of being the world's most trusted application for color correction. With DaVinci Resolve 20, Blackmagic Design has added a complete 2D and 3D visual effects compositing and motion graphics environment that enables you to complete even the most challenging projects using only one piece of software!

What You'll Learn

In these lessons, you'll work with multiple projects and timelines to learn the fundamental 3D techniques commonly used in a wide range of visual effects techniques. You'll acquire real-world skills that you can apply to real-world production tasks.

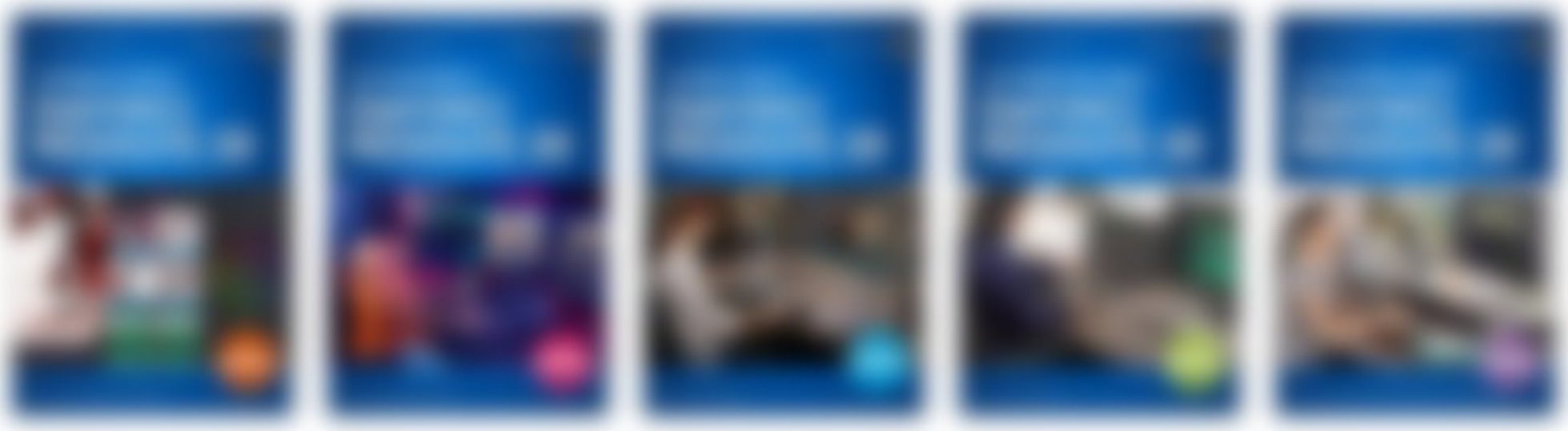
Lesson 1 is an introductory lesson that allows students who are new to 3D compositing to explore the user interface by creating a simple but commonly requested 3D fly-through. This lesson is meant to reintroduce you to the Fusion workflow while giving you your first taste of a few essential 3D tools that you will use throughout this guide.

Lessons 2-5 cover the most common 3D visual effects techniques that you can use on a broad range of jobs. You'll discover how to combine 2D and 3D scenes in a single composite. Using the 3D camera tracking you'll learn how to match a live action camera to create seamless blending of particles and set extensions. Finally, you'll learn how to import 3D models with live action media.

The Blackmagic Design Training and Certification Program

Blackmagic Design publishes several training books that take your skills further in DaVinci Resolve 20. They include:

- The Beginner's Guide to DaVinci Resolve 20
- The Colorist Guide to DaVinci Resolve 20
- The Editor's Guide to DaVinci Resolve 20
- The Fairlight Audio Guide to DaVinci Resolve 20
- The Visual Effects Guide to DaVinci Resolve 20
- Advanced Visual Effects in DaVinci Resolve 20



Whether you want an introductory guide to DaVinci Resolve or you want to learn more advanced editing techniques, color grading, sound mixing, or visual effects, our certified training program includes a learning path for you.

Getting Started

Getting Certified

After completing this book, you are encouraged to take the 1 hour, 50 question online proficiency exam to receive a Certificate of Completion from Blackmagic Design. The exam questions are taken from the five lessons in this book. The link to the exam is located at the end of this book.

The webpage also provides additional information on our official Training and Certification Program. Please visit www.blackmagicdesign.com/products/davinciresolve/training.

System Requirements

This book supports DaVinci Resolve Studio 20 for Mac and Windows. If you have an older version of DaVinci Resolve or the free version of DaVinci Resolve 20, you must upgrade to the current DaVinci Resolve Studio version to completely follow along with the lessons.

> NOTE The exercises in this book refer to the post resource locations that will differ if you are using the version of software from the Apple Mac App Store. For the purposes of the training book, if you are using macOS, we recommend downloading the DaVinci Resolve software from the Blackmagic Design website rather than from the Mac App store.

Download DaVinci Resolve

To download the Studio version of DaVinci Resolve 20 or later from the Blackmagic Design website:

1. Open a web browser on your Windows or Mac computer.
2. In the address field of your web browser, type www.blackmagicdesign.com/products/davinciresolve
3. On the DaVinci Resolve landing page, click the Buy Online button.
4. After checkout, on the download page, click the Mac or Windows button, depending on your computer's operating system.
5. Follow the installation instructions to complete the installation.

When you have completed the software installation, follow the instructions in the following section to download the content for this book.

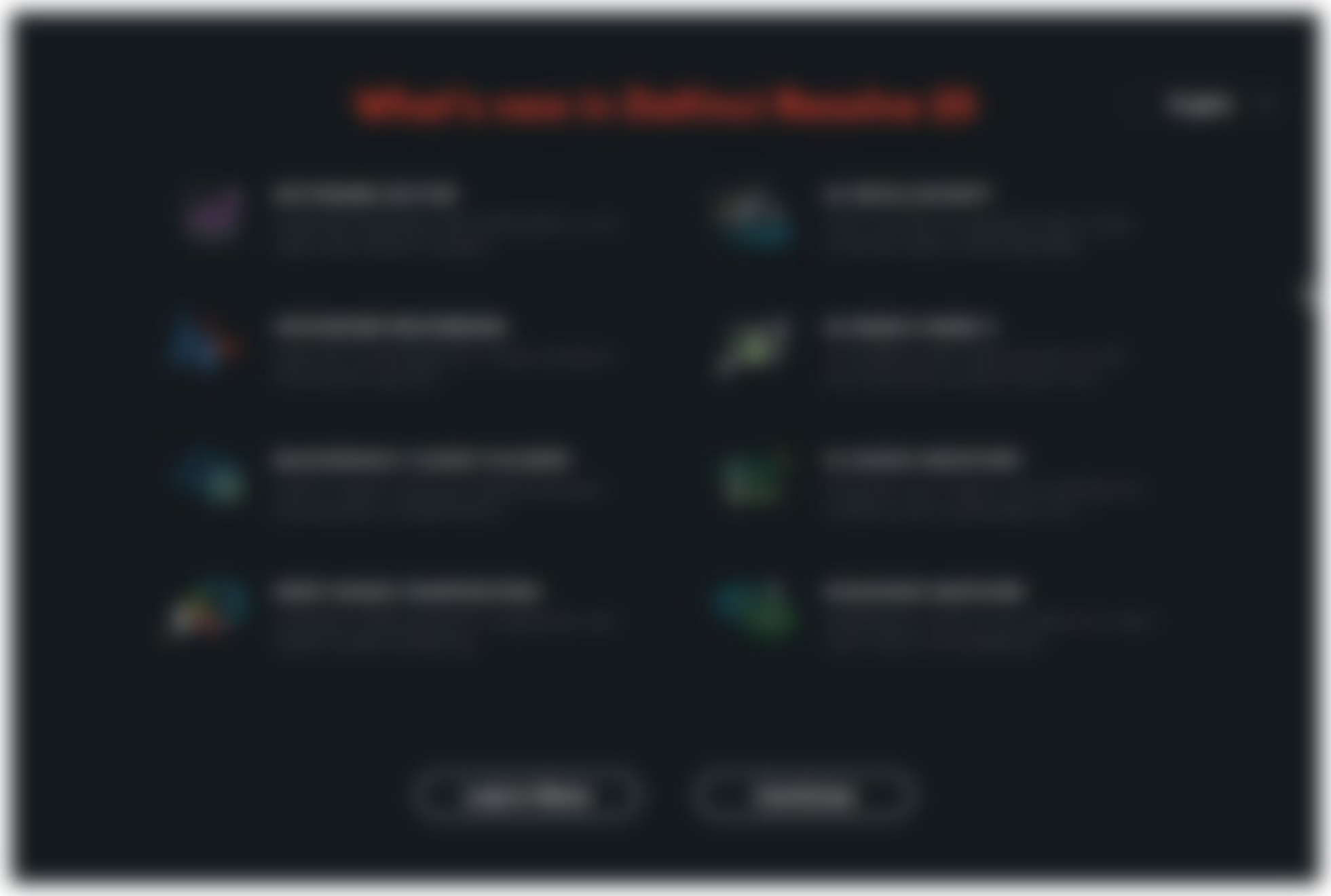
Outfirst Resolve 20 Quick Setup

When Outfirst Resolve 20 is successfully installed, you can launch the application for the first time.

macOS users will find the Outfirst Resolve application in their Applications folder. Double-click the Outfirst Resolve folder, and then double-click the Outfirst Resolve application. Alternatively, you can use Launchpad or Spotlight search to locate and launch Outfirst Resolve.

Windows users will find a shortcut has been added to their Desktop. Alternatively, click the Start menu and search for "Outfirst Resolve" and press Enter to launch the application.

When Outfirst Resolve 20 opens for the first time, you'll see a Welcome splash screen detailing the new features available in the current version.



Next, you are invited to go through the quick setup process. Registered users can skip this process by clicking "Skip and Start Right Now," but new users are advised to follow this process. It will only take a couple of minutes and is useful in understanding how Neurolex is working.

Next, you will be asked what type of project you would like to begin. Select Resolve supports projects at different resolutions, from Standard Definition (SD) and High Definition (HD) to Ultra High Definition and beyond.

If you know the resolution you commonly work with, you can set that here. Otherwise, leave the resolution set to 1280 HD and click Continue.

The next screen asks where you would like to store your media. This does not refer to the video, audio, and graphics files you'll edit and grade, but rather the ancillary files Resolve will need to create as you're working. The location is commonly referred to as a 'scratch disk' and by default is set to your current user's Movies folder (macOS) or Videos folder (Windows).

On the next screen, you will be asked which keyboard layout you would like to use. This is specifically relevant if you're familiar with using another workshop editor. However, throughout this tutorial we'll be using the default Basecoat keyboard layout. So if you change the layout at this point, you may find some shortcuts don't work.

4. For now, leave the layout set to Oculus Rooms and click Continue.

Congratulations! You have completed the Quest Setup process and have changed precisely nothing in terms of Oculus Rooms's default setup. Nevertheless, you need to get back to Oculus Rooms that will serve you well as you continue learning about the application and how it uses your system.

5. Click Start to launch and begin enjoying Oculus Rooms (2).

Once loaded, DaVinci Resolve will open to the Edit page, which is the default starting page for all projects. However, this is not the usual place to begin working with DaVinci Resolve. Instead, you should now exit the application in preparation to begin the first lesson in this book.

2. Choose DaVinci Resolve > Quit DaVinci Resolve or press Command-Q (macOS) or Ctrl-Q (Windows).

DaVinci Resolve 20 will close.

Get the Lesson Files

The DaVinci Resolve lesson files must be downloaded to your Mac or Windows computer to perform the exercises in this book. After you open the files to your hard disk, extract the files and copy the folder to your Movies folder (Mac) or Videos folder (Windows).

To Download and Install the DaVinci Resolve Lesson Files

When you're ready to download the lesson files, follow these steps:

1. Open a web browser on your Windows or Mac computer.
2. In the address field of your web browser, type www.lesa.tv/ngg-dlmgr/.com/redirect/download/training
3. Scroll the page until you locate Advanced Visual Effects in DaVinci Resolve 20.
4. Click the Part 1 link to download the media. The DR20 Studio Fusion 3D Training Media.zip file is roughly 2 GB in size.
5. After downloading the .zip file to your Mac or Windows computer, open your Downloads folder and double-click DR20 Studio Fusion 3D Training Media.zip to unzip it (it doesn't unzip automatically). You'll end up with a folder named DR20 Studio Fusion 3D Training Media that contains all the content for this book.
6. From your Downloads folder, drag the DR20 Studio Fusion 3D Training Media folder to your Movies folder (Mac) or Videos folder (Windows). These folders can be found within your User folder on either platform.

You are now ready to begin Lesson 1.

Introducing Blackmagic Cloud

DaVinci Resolve is the world's only complete post production solution that lets everyone work together on the same project at the same time. Traditionally, post production follows a linear workflow with each artist handing off to the next, introducing errors and mountains of change logs to keep track of through each stage. With DaVinci Resolve's collaboration features, each artist can work on the same project, in their own dedicated page, with the tools they need.

Now Blackmagic Cloud lets editors, colorists, VFX artists, animators, and sound engineers work together simultaneously from anywhere in the world. Plus, they can review each other's changes without spending countless hours reconforming the timeline.

Simply create a Blackmagic Cloud ID, log in to the online DaVinci Resolve Project Server, and follow the simple instructions to set up a new project library - all for one low monthly price!

Once created, you can access this library directly from the Cloud tab in the Project Manager to create as many projects as you need - all stored securely online. Then invite up to 10 other people to collaborate on a project with you. With a simple click, they can work to local copies of the media files and start working on the project immediately, with all their changes automatically saved to the cloud.

Enabling Multiple User Collaboration for your project means that everyone can work on the same project at the same time - with assistants, editors, colorists, dialogue editors, and visual effects artists can now all collaborate wherever they are in the world in a way never before possible.

Media Sync with Blackmagic Cloud Store

Now you don't need to buy expensive proprietary storage that needs an entire IT team to manage! Blackmagic Cloud Store has been designed for multiple users and can handle the huge media files used by Hollywood feature films. You can also have multiple Blackmagic Cloud Stores syncing the media files with your Dropbox account so that everyone has access to the media files for the project.

To find out more about these exciting workflows, visit

Introducing Blackmagic Cloud 2021

Lesson 1

Creating a 3D Scene

Although this book assumes you have some minimal experience with the Fusion page in DaVinci Resolve, this first lesson is a very basic and introductory lesson on the essential 3D toolset in Fusion. The additional lessons in this book will build on these foundational 3D skills, diving into more tools and techniques. The first question you might have is, why do we need to work in 3D? Many visual effects are about reproducing the characteristics of the real world, such as perspective, atmosphere, depth cues, and occlusion of objects in a scene. While you could simulate these effects using 2D compositing, they become much easier and more natural in a 3D compositing environment.

Time

The lesson takes approximately 1 hour to complete.

Goals

Placing Elements in 3D Space 2
Navigating in 3D 4
Using 3D Text 10
Setting Up a Camera 15
Adding Lights 20
Converting 3D into a 2D Image 23
Lesson Review 30

This lesson introduces you to the basic construction of a 3D scene by creating a simple "3D card" type flythrough. Flat 2D images on "cards" are placed in 3D space, arranged at varying depths, and the virtual camera moves through the scene to create a sense of depth and perspective. You'll learn how to navigate in 3D space and use some of the everyday tools for 3D compositing and motion graphics.

Placing Elements in 3D Space

Fusion's 3D compositing includes the ability to position multiple elements in 3D space. You can position still images, videos, 3D models, text, cameras, and lights and apply various tools designed to generate 3D visual effects and motion graphics. However, since you can freely mix 2D and 3D in a single node graph, you begin by entering the Fusion page.

For this first lesson, instead of getting to the Fusion page from the edit page timeline, you will create a Fusion composition in a bin. This is often appropriate when creating motion graphics when you may not be ready to edit them into a timeline, but you need to begin creating the graphics for a project.

NOTE The Timelines bin includes a Backups bin with Fusion comps saved at various stages of the lesson, available for reference and reverse engineering the node trees.

1. Open Dabfinc Resolve, right-click in the Project Manager, and choose Restore Project Archive.
2. Navigate to the DRED Studio Fusion 3D Training Media folder.

   This folder contains five Dabfinc Resolve Archives and a separate "Fusion Files" folder, all of which we will use throughout the exercises in this guide. We'll start with the Fusion 2D 3D archive.
3. Select the Fusion 2D 3D.dra Dabfinc Resolve Archive file and click Open to unpack the Fusion 2D 3D Animation project to the Project Manager.
4. Open the Fusion 2D 3D Animation project from the Project Manager and then select the edit page, if necessary.

   The project has no timeline. For this lesson, you'll create a Fusion composition in the bin.
5. Right-click the Fusion Comps bin and choose New Fusion Composition.

6. In the dialog, name the clip **Wildlife Open**, keep the duration at 5 seconds, and then click Create.

   The benefit of creating a Fusion composition in a bin is that it can be opened in the Fusion page without any media associated with it initially and without creating a timeline.

> **Tip** If you accidentally alter your interface and find it hard to follow along, selecting Reset UI Layout from the Workspace menu will return the interface to its default state, which should broadly match the layout used in this book.

- Right-click the Middle Open clip in the bin and choose Open in Fusion Page.

  For this project, you will use elements from the media pool to create a 3D scene.

- In the upper left corner of the Fusion page, click the Media Pool button and select the Media / Middle Assets bin.

  This bin contains a few graphic illustrations that you will use to create a motion graphics flythrough.

- From the Middle Assets bin, drag the human HR graphic into an empty area of the Node Editor workspace. It is helpful if you maximize the Node Editor workspace to give yourself more room to work.

  This is a stylized savannah sunset illustration that we will use as the background of our scene. Let's get organized right from the start by renaming each new element.

- In the Node Editor, select the MediaIn1 node, press F2, and rename the image **SUNSET**.

  No video clip, still image, or 2D generator can be part of a 3D scene without first connecting to an Image Plane 3D node or a Shape 3D node.

- With the SUNSET node selected, open the Effects Library and from the Tools > 3D category, scroll down and click the Image Plane 3D tool. Then press `1` to view the sunset graphic in 3D space.

The sunset graphic now appears in a 3D viewer. It is placed on a 3D image plane and can be rotated and viewed from any angle.

- In viewer 1, while holding the middle mouse button, Option drag (Alt+MMB) to the drag (Windows) left, right, up, and down to rotate the perspective angle.

  By using the modifier key and middle mouse combination when dragging, you can rotate around the image to see it from alternate angles. To be clear, you are not rotating the image itself, you are changing your view as if you were walking around the image.

  > **TIP** Using an Image Plane 3D instead of a Shape 3D node will retain the aspect ratio of the image connected to it, which is especially useful for video clips.

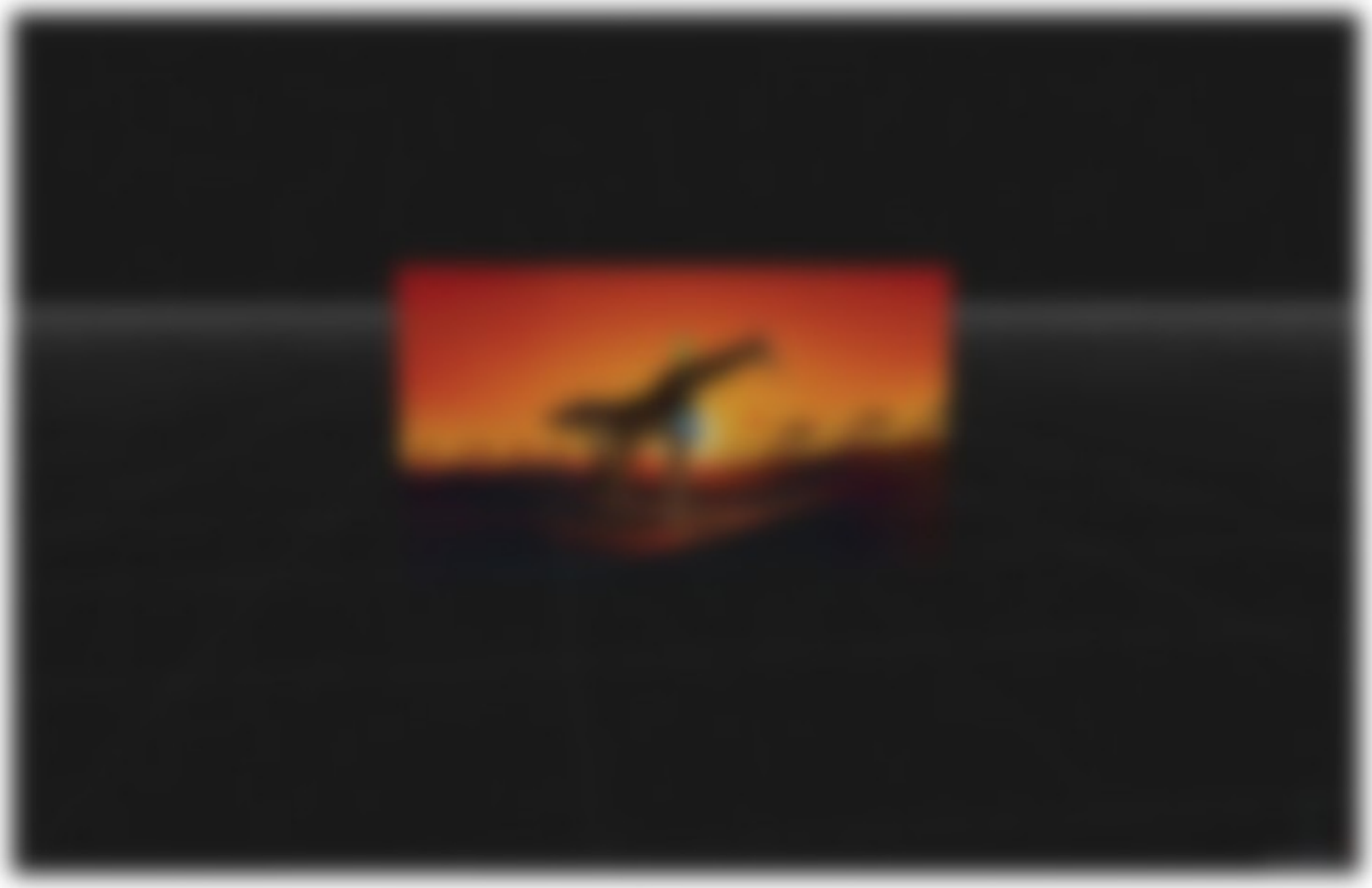
- Close the Effects Library and open the Media pool.
- From the MAIN Nuke's bin, drag the Amalfi graphic into an empty area of the Node Editor. Press `1` to display it in viewer 1. Press F2, rename the image **Amalfi**, and then close the Media pool again.

- With the QIMAGE node selected, press Shift-Spacebar and type **Image** to add an Image Plane 3D to the Node Editor.
- Press `1` to view the QIMAGE Image Plane 3D node in 3D space.

You can't do any interactions in 3D mode, but the real Image and Mirror nodes can't either. Such works in its own 3D world. However, you can combine 3D images to exist in the same 3D world using a **Merge 3D** node located in the toolbar.

While the Merge node is the fundamental 2D compositing tool, the **Merge 3D** node is the fundamental 3D compositing tool. And as with the Merge tool, you can create a **Merge 3D** node just by connecting the output of two 3D nodes.

- Drag the output of QMAPPED Image Plane 3D node to the output of SUPER Image Plane 3D node to create a Merge 3D. Press 1 to load Merge3D1 into viewer 1.



Both images are combined in the Merge 3D node, but they overlap in exactly the same space, which is why there may be some breakup in the composited image in viewer 1.

The viewer shows the images on top of each other, fighting for the same 3D location. This is sometimes called "Z-fighting" for that reason. To fix the conflict, you can change the Z position of one of the images.

- Select the QMAPPED Image Plane 3D node, and in the Inspector's Transform tab, drag the Z Translation right to any small value above 0.0.

Unlike 2D compositing with a Merge node, you do not change the inputs to the Merge 3D node to get the giraffe in front of or behind the sunset graphic. That ordering is done by changing the Z Translation value.

A positive Z value brings an object forward in space, while a negative value moves it back. By using a value above 0.0, you've moved the giraffe in front of our sunset background.

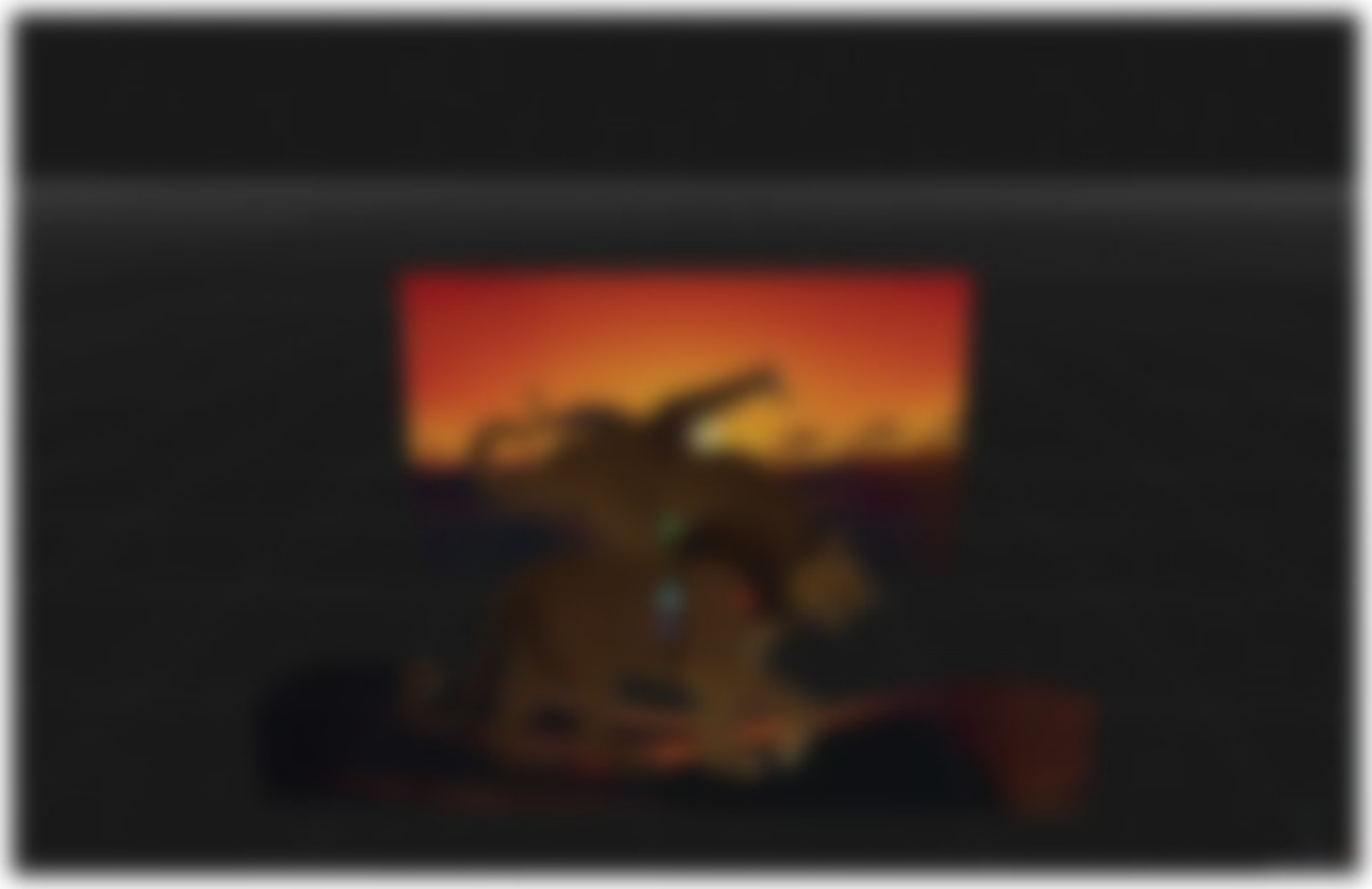
Navigating in 3D

Since the Z translation value determines the layer order, it is extremely important that you understand how to move elements and change your view of them in 3D space. To build a more interesting scene and better understand 3D positioning, let's add three more elements and place them on Image Plane 3D nodes.

1. From the **Wildlife** Assets bin, add the Elephant, Foreground HD, and Lion graphics into the Node Editor.
2. Rename each element as their bin clip name: **Elephant**, **Foreground**, and **Lion**.
3. Place each one on an Image Plane 3D and connect each Image Plane to the Merge 3D.

Similar to the Multimerge node for 2D compositing, the Merge 3D allows an unlimited number of inputs.

4. Enter the values listed below as new Z translation values for each Image Plane 3D to create some distance between the new elements and the current background.
   - Elephant Image Plane 3D Z translation value: **0.4**
   - Foreground Image Plane 3D Z translation value: **0.75**
   - Lion Image Plane 3D Z translation value: **0.75**



In Fusion's 3D world, the origin point of the coordinate system is in the center of the world (0 = 0, 0 = 0, and 0 = 0). Each element you add to the 3D world will start at this 0,0,0 location. X is the horizontal axis, Z is the depth axis, and Y is the vertical axis.

> In some other applications (e.g., 3D Studio Max, Unreal Engine), the Z axis is the vertical axis, and the Y axis is the depth axis. Therefore, be careful if you simply copy and paste values between applications.

To move an image in 3D space, you use the Image Plane 3D node (or other 3D object nodes like Shape 3D), which adds 3D positioning, rotation, pivot, and scale controls to an image.

The animals may appear too large for our current background, so we can quickly scale them more appropriately.

1. Going through each Image Plane 3D, use the Scale to resize the elements as follows:
   - Lion: Scale **0.5**
   - Pomegranate: Scale **0.15**
   - Elephant: Scale **0.3**
   - Giraffe: Scale **0.4**

Although the actual values don't really matter, and the current values may result in small animals in our viewer, the values we used create a nicely dispersed group of animals where their size and Z position give a semi-realistic appearance. We can take that a bit further by adjusting their horizontal position.

- Select the GRAFFITI Image Plane 3D node, and in the Inspector, drag the X Translation left to move the giraffe slightly to the left until the value is between -0.1 and -0.15.

The X Translation moves the giraffe to the left. You can perform the same translation operation using the red arrows in the viewer. Other viewer arrows can help move the object up and down (the green, Y translate arrows) or toward and away from you (the blue, Z translate arrows).

- Select the Elephant Image Plane 3D node, and in viewer 1, drag the red arrow slightly to the right until the X translation in the Inspector is between 0.1 and 0.15.

Sometimes, objects might be outside the viewer's display or also overlap elements, making onscreen controls difficult to use. Although you could use the Inspector to change parameter values, it's essential to understand how to move your view of the 3D scene to get a complete picture of your elements' positioning in 3D space.

- In viewer 1, hold the Command key (macOS) or Ctrl key (Windows) and scroll down with your mouse wheel to zoom in your view, and then release the modifier key and drag in the viewer until the text is fully visible in the viewer.

- Select the LEAN Image Plane 3D node and drag the green Y translation down until the text is overlapping the foreground element.

Using your mouse buttons and keyboard modifier keys together, you can zoom in and out, pan, and rotate around a scene. Don't confuse this with a camera view. We'll get to that in just a bit. This is your view of the scene as if you are walking around it. Although you could render this perspective view, it is primarily used to set up your scene.

- As a simple example, hold down the middle mouse button and Option drag (Alt) or Alt drag (Windows) left or viewer right until the sunset rotates in front of the animals and then drag right until the sunset rotates back to its original position.

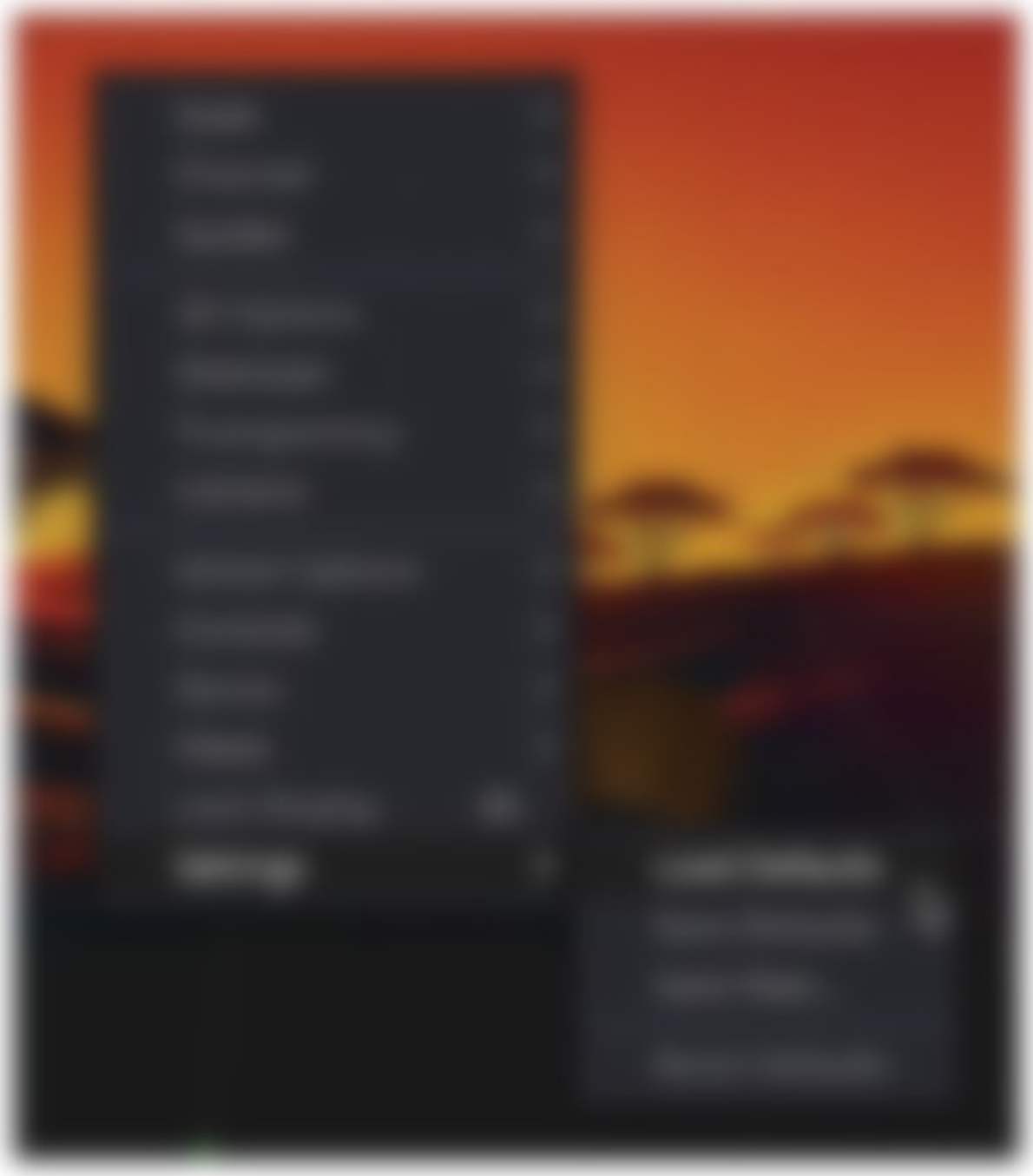
It's important to understand that changing your rotating perspective by rotating your viewport can change the layer order of your elements. That's a very different way of working than you may be familiar with in 2D compositing.

The following key and mouse button combinations are extremely useful when working in a 3D viewer:

- **Pan:** Drag while holding down the middle mouse button.
- **Rotate:** While holding down the middle mouse button, Option drag (Alt) or Alt drag (Windows).
- **Zoom in and out:** Hold down Command (Ctrl) or Ctrl (Windows) and scroll the middle mouse wheel.

Note, let's return to a default starting point and continue building our 3D scene.

- Right-click in viewer 1 and choose Settings > Load Defaults to return the perspective view to the default angle.



> You can use the axis control in the lower right corner of viewer 1 to orient your perspective view. When you move the Perspective view so that the green Y line points up, the red X line points right, and the blue Z line points directly toward you, the Perspective view is at a default front view in the 3D world.

Intuitively moving the Perspective view to different angles and moving objects in 3D space are essential activities when compositing in 3D world.

Using 3D Text

The standard 2D Text node cannot be connected to a Merge 3D composite; it only connects to 2D composites. When working in a 3D composite, you must use a Text 3D node to add text.

We'll add some text to our scene. Although you can connect everything into a single Merge 3D, things can get tangled and unwieldy if you choose that path. We already have five elements connected, so at this point, it might be wise to keep things more organized by using multiple Merge 3D nodes. We'll use a new Merge 3D to connect our 3D text. As with standard 2D Merge tools, you can connect Merge 3D nodes together, creating a more organized and flexible yet still singular 3D world.

> **NOTE** Remember that the Timelines bin includes a Backups bin with Fusion comps saved at various stages of the lesson, which are available for reference and reverse engineering the node trees.

1. Select the Merge3D1 node in the Node Editor, and then from the toolbar, click the Merge 3D button.

The new Merge3D2 is connected to the output of the Merge3D1. However, unlike connecting 2D merge nodes, there is no layer order when connecting 3D merge nodes—meaning that any element you add to the Merge3D2 node will still be placed in the center of our 3D world, not in front of elements connected to the Merge3D1.

> **TIP** The Merge 3D node contains 3D transform controls, so it is possible to move or rotate all the elements connected to a single Merge 3D independently of elements connected to a different Merge 3D.

2. Select the Merge3D2 node and press "1" to see it in viewer 1.

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- Set the typeface to Open Sans Extra Bold and the Size to 0.03.

  You also have your choice of 3D controls, position, rotation, axis points, and bevels.

- In viewer 1, use the blue Z translation arrow to move the text slightly in front of the Sunset graphic but not in front of the giraffe. This is a small adjustment of around 0.01. If you are looking at the Inspector Z translation value.

- Go all to the bottom of the Inspector and click the Blur/Sharpen arrow to open the extrusion parameters.

  These parameters can add depth to text and give titles a greater sense of weight and substance.

- Set the Extrusion Depth to 0.1 and the Bevel Depth and Bevel Width to around 0.02.
- Since you decreased the text size, click in viewer 1 again and press F to fit the words into the viewer.

  The text is not lit and has no material assigned to it to improve its appearance, so the results of your extrusion and bevel are not clearly visible. Let's change these two things next.

Applying Materials to TextSD

In 3D animation applications, objects use illumination materials called shaders to give surfaces a more realistic appearance. You can easily build your own shaders using Fusion's Material nodes, but we'll use one of Fusion's shader templates for this introductory exercise.

1. Select the TextSD node in the Node Editor.
2. Press Shift-Spacebar and type **replace**.

   To apply materials to 3D text, you must add a Replace Material node where the new materials will be connected.

   > **Tip:** Fusion's 3D shape nodes do not need the Replace Material node.

3. Select the Replace Material 3D node and add it to the Node Editor after the TextSD node.

4. With the Replace Material 3D node selected, press 2 to view it in the viewer.
5. In the Effects Library, choose Templates > Fusion Shaders.

   These are all the shader templates included with Fusion.

6. Drag the Chrome template to an empty area of the Node Editor near the Replace Material 3D node.

3. Drag the output of the Chrome template to the green Material input on the Replicator Material at 3D.

> When added to the Node Editor, the Chrome node has a slightly different appearance. The stacked node outline indicates that this is a Group node. Groups are containers for other nodes. Since templates in Fusion are just groups for all the individual nodes that make it up, you can open the template to edit and modify the settings by right-clicking it and choosing Expand Group.

4. In viewer 1, use Option-drag (Alt-middle-mouse-button) on the 3D viewport button to change the Perspective view to different angles.

As you move the Perspective view, the text has a simple drop shadow. Chrome appearance and a blue highlight. You can change some parameters in the Inspector, but these default settings work well enough for our scene.

Setting Up a Camera

Looking at the scene from different angles using the perspective view is helpful for placing your elements, but ultimately, you will want the scene framed using a camera. Adding a camera gives you more control over how the scene is framed and allows you to animate the view by moving the camera.

1. Select the MergeBIG node, press Shift-Spacebar, and add a Camera3D from the list.

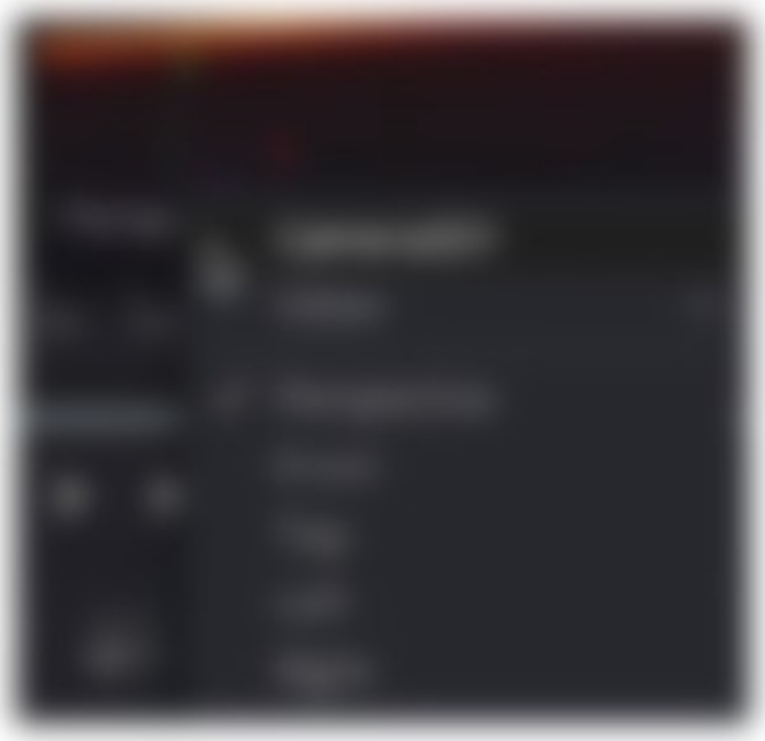
We could have just as easily connected the camera to the MergeBIG1 node, which wouldn't have made a visual difference to our composite, but to keep things more organized, we chose to connect it here in the MergeBIG2 with the 3D nodes.

2. Select the MergeBIG2 and press 1 to load it into viewer 1.

The Perspective view for the MergeBIG2 is now displayed in both viewers, but we want to display what the camera is seeing in one of the viewers. Your first thought might be to select the camera and load it in a viewer. However, you need to continue viewing the MergeBIG2 node and switch it from a perspective view to a camera view.

If you think about it, all the elements are connected to the MergeBIG, not the camera, so it makes sense to view what the merge has connected through the eyes of the camera.

4. In the lower left corner of viewer 2, right-click over the axis control and choose Camera2D from the context menu.



> **Tip** If you prefer to have the camera in viewer 1 and perspective in viewer 2, in the lower left corner of viewer 2, right-click over the axis control and choose Perspective from the list. Then, in the lower right corner of viewer 1, right-click over the axis control and choose Camera2D.

You might wonder why the camera view doesn't display anything. Recall that we positioned the camera at the origin, and the camera is looking along the negative z-axis, which is into the 3D scene when viewed in the default 3D view. With the camera located at that position, it is behind all the elements and facing away. You can see in the viewer 1 Perspective view that the camera is at the center of the scene, and the focal plane outline is properly behind our scene.

5. Select the Camera2D node in the Node Editor, and in viewer 1, drag the camera's position glyph arrows down until you can clearly see all three animals and in the camera's view, but the bottom edge of the foreground element is not visible in viewer 2.

It's important to remember that if you move or rotate the view in the viewer with the camera selected, you are changing the camera's position. This can be a very simple way to position or animate a camera, but it can also become a problem if you think you are viewing the perspective view but accidentally move the camera.

NOTE In this guide, out of caution, we will always use the Inspector to move the camera and only work in the viewer to move the Perspective view.

The CameraSDI node contains familiar camera controls that you might want to adjust to achieve the look you want.

1. With the CameraSDI node selected in the Inspector, change the focal length to 35.

   You now have a 35mm lens, which applies it to our scene a bit more.

2. Open the Control Visibility section and enable the Focal Plane checkbox.

Enabling the visibility of the Focal Plane displays a green rectangle in the viewer at a specific distance from the camera where objects are in perfect focus. This only comes into play when using depth of field (DoF) effects, which we will enable later in this lesson, so it's a good idea to enable it now and set the focal plane. To determine the focal distance setting, you adjust the Focal Plane slider in the Inspector.

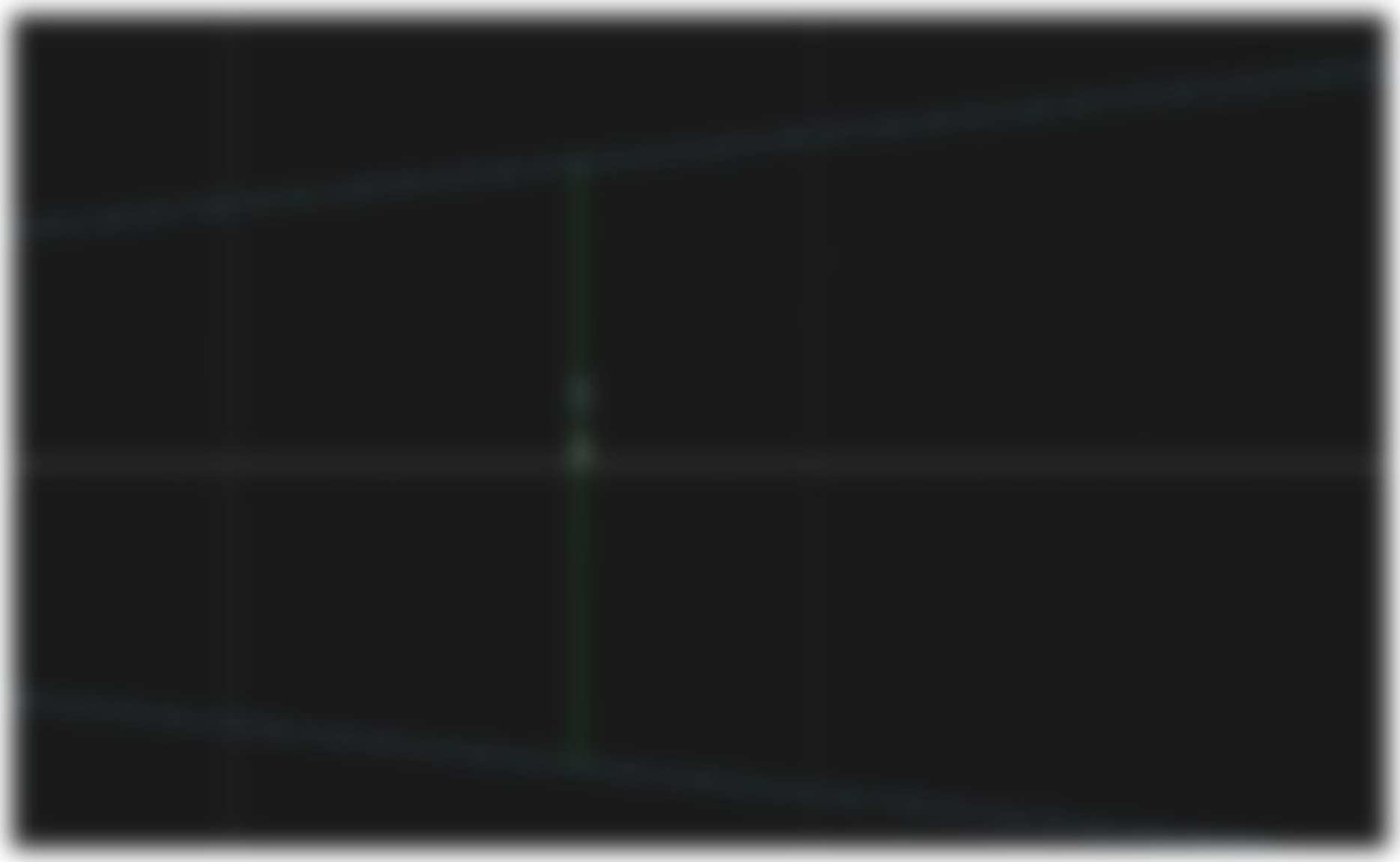
- While viewing viewer 1's Perspective view, drag the Focal Plane slider to the left until the green rectangle is near the camera location as the 3D text.

It's very difficult to see how near or far you are from the text while in a Perspective view. That's why you can change the viewer from a Perspective view to common orthographic views, including Front, Top, Left, and Right.

- In viewer 1, right-click over the axis control and choose Right from the pop-up menu.

Now, it will be easier to see the green line of the focal plane and the 3D text.

- In the Inspector, drag the Focal Plane slider until the green focal plane is directly over the 3D text.



- Right-click the axis control in the lower right corner of viewer 1 and choose Perspective to return the viewer to Perspective view.

It will be easier to view our scene if we quickly switch to single viewer mode.

- Above viewer 上, click the Single Viewer Mode button.

  Now that we have a better view, after scaling our animals and setting up our camera, it appears that the animals are floating above the ground. We need to adjust our Y position values to create a more realistic layout.

- Going through each Image Plane 3D, use the Y translation to position the elements as follows:

  - Lion: Y: **0.250**
  - Foreground: Y: **0.250** (no change)
  - Elephant: Y: **0.250**
  - Giraffe: Y: **0.251**

- Above viewer 上, click the Single Viewer Mode button again to return to using two viewers.

  Again, as with the X position and scale adjustments you made earlier, the actual values don't really matter. The results should be a pleasantly laid out scene.

Animating a Camera Move

For our animation, we'll create a simple dolly in move with the camera to focus more on the sunset graphic and text.

1. Move to the start of the render range in the Time Line if needed.
2. Select the Camera001 node, and in the Inspector, click the Transform tab.
3. In the Transform tab, click the keyframe button to the right of the 3 Translation parameters.

This sets our starting keyframe. Now, we'll set an ending keyframe and move the camera forward a bit.

5. Move to frame 80 in the Time Line render range.

   You can use the Inspector to move the camera or change its position directly in the viewport using the translation arrows, as you have done previously.

6. If needed, position the mouse cursor over viewer 1, hold the Command key (macOS) or the Ctrl key (Windows), and scroll the middle mouse wheel until you can clearly see the Camera's Blue Z translation arrow in the frame.

   Like all objects in a 3D scene, the camera includes three arrows as translation controls in the viewer. The green arrow moves the camera up and down on the Y axis, the red arrow moves it side to side on the X axis, and the blue arrow moves the camera in and out on the Z axis. Since we want to move the camera back a bit, we'll drag the blue arrow in viewer 1.

Tip: When a 3D object (including a camera or light) is selected, pressing Alt while your mouse pointer is over a viewer will change the circular translation controls for that object to rotation controls. Pressing Q will return to translation controls. There are also buttons in the upper left corner of the viewer to switch between translation and rotation.

3. In viewer 1, drag the camera's Translation blue arrow toward the sunset graphic until the camera fills the screen, and the Translation is set to approximately 0.0, 0.0, 1.0.

4. Play the comp to see the camera animation.

   The animation stops suddenly at frame 80, but we'd like a softer "landing." Just as you can control acceleration for 2D animation, you can do the same for 3D objects.

5. In the upper right of the Fusion interface, click the Spline button to open the Spline Editor.

6. To display the Camera1's Z animation curve, click the Camera1(3D)'s Offset checkbox.

1. Click the keyframe at frame 80, and then in the lower right corner of the Sprite editor, click the Smooth button or press Shift+S.

2. Close the Sprite Editor and play the Level to see the smoother camera animation.

The result of this camera move is one of the greatest advantages of working in 3D. You can achieve realistic parallax effects. As the camera moves, closer objects like the grounds and perspective naturally, creating depth and a more lifelike sense of motion, even in an obviously motion graphics scene like we have here.

Adding Lights

3D scenes in the Fusion page can include lights used much like you would in the real world to illuminate objects how you see fit. You can add as many lights as you need, use different styles of lights, and control which objects each light illuminates.

1. Select the Merge3D node.
2. In the Effects Library, from the Tools > 3D category, select the Lights subcategory.

   The Lights subcategory displays all the light types you can add to a 3D scene.

3. In the Light subcategory, click the Ambient Light tool to add it to the Node Editor, connected to the Merge2D1 node.

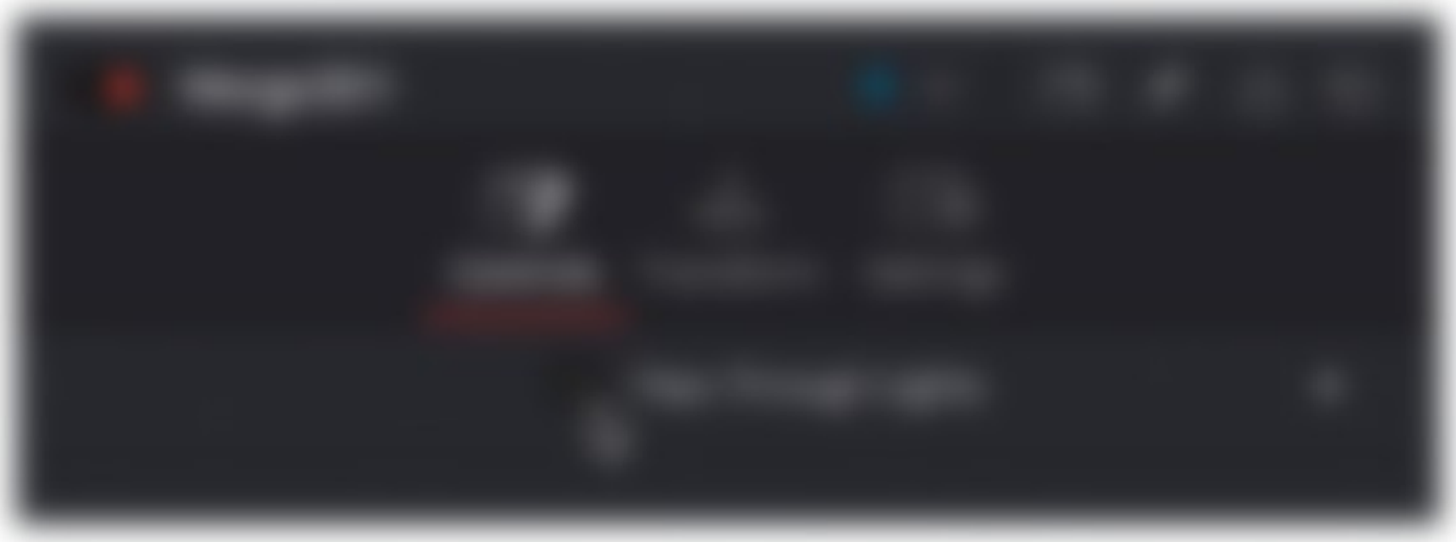
The Ambient Light adds control for the overall brightness in our scene, but by default, lighting is disabled in the viewers, so before we see any results and modify the Ambient Light settings, we need to enable lights in both viewers.

4. Above each viewer, enable lights by clicking the Lights and Shadows button.

5. Select the Ambient Light node in the Node Editor, and drag the Intensity slider between 0.5 and 0.8 to brighten the scene.

The ambient light provides overall lighting but hasn't affected our 3D text. Unlike cameras and image planes, lights don't automatically pass through to other Merge 3D nodes. By default, lights only affect the Merge 3D node they're directly connected to but not nodes that come after it in the chain (sometimes called downstream). To make light affect nodes farther down the chain, you must enable the "Pass Through" option.

1. Select the Merge3D1 node, and in the Inspector, click Pass Through Lights.



Now, our scene and text are both illuminated by the ambient light. Still, it might be nice to highlight our text more with a spotlight.

2. Select the Merge3D2 node, and in the Effects Library, click the Spot Light tool.

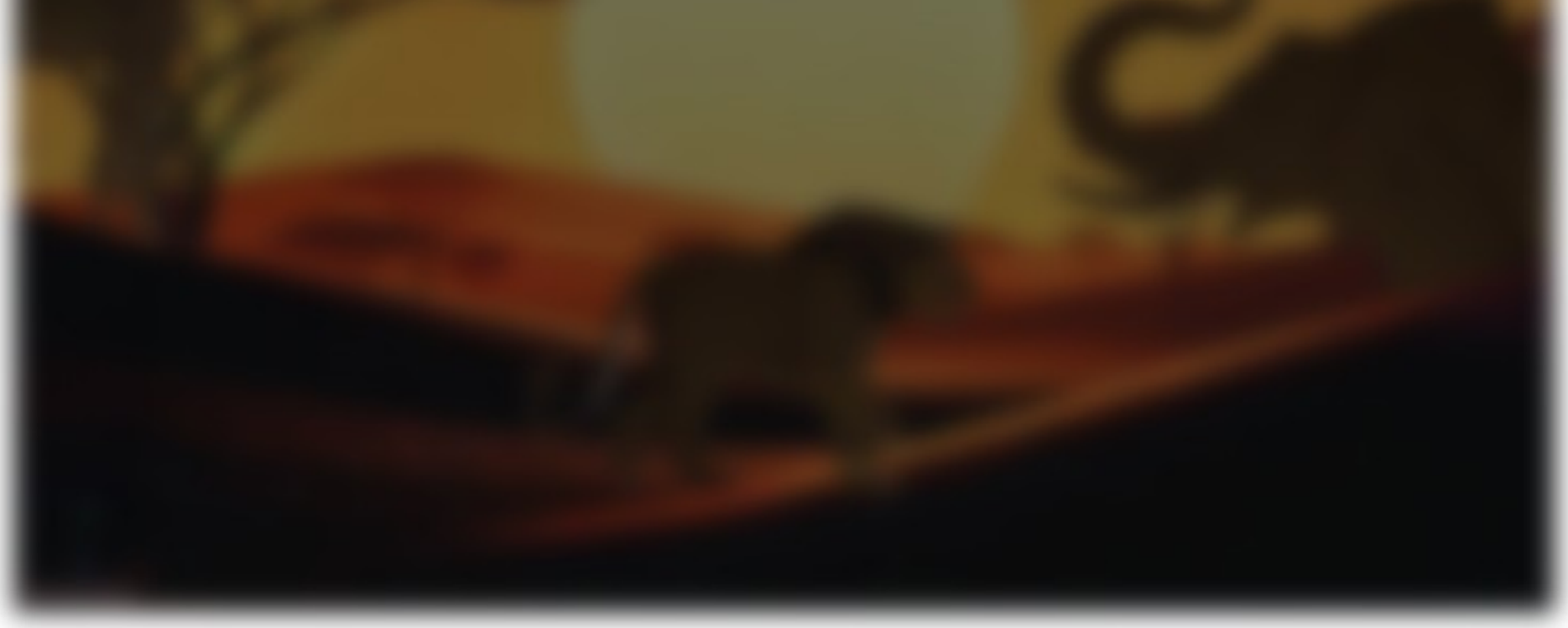
Unlike the ambient light, the spotlight is displayed in the viewer, so you can directly adjust its position and rotation to point the light where you want it.

> **Note:** Holding the Option key down (Alt on the PC key) while clicking on a connection line will add a router that allows connection lines to bend instead of having diagonal lines overlap other nodes.

3. In viewer 1, drag the Spot Light's blue Z translation arrow to pull it away from the sunset graphic until it illuminates our text.

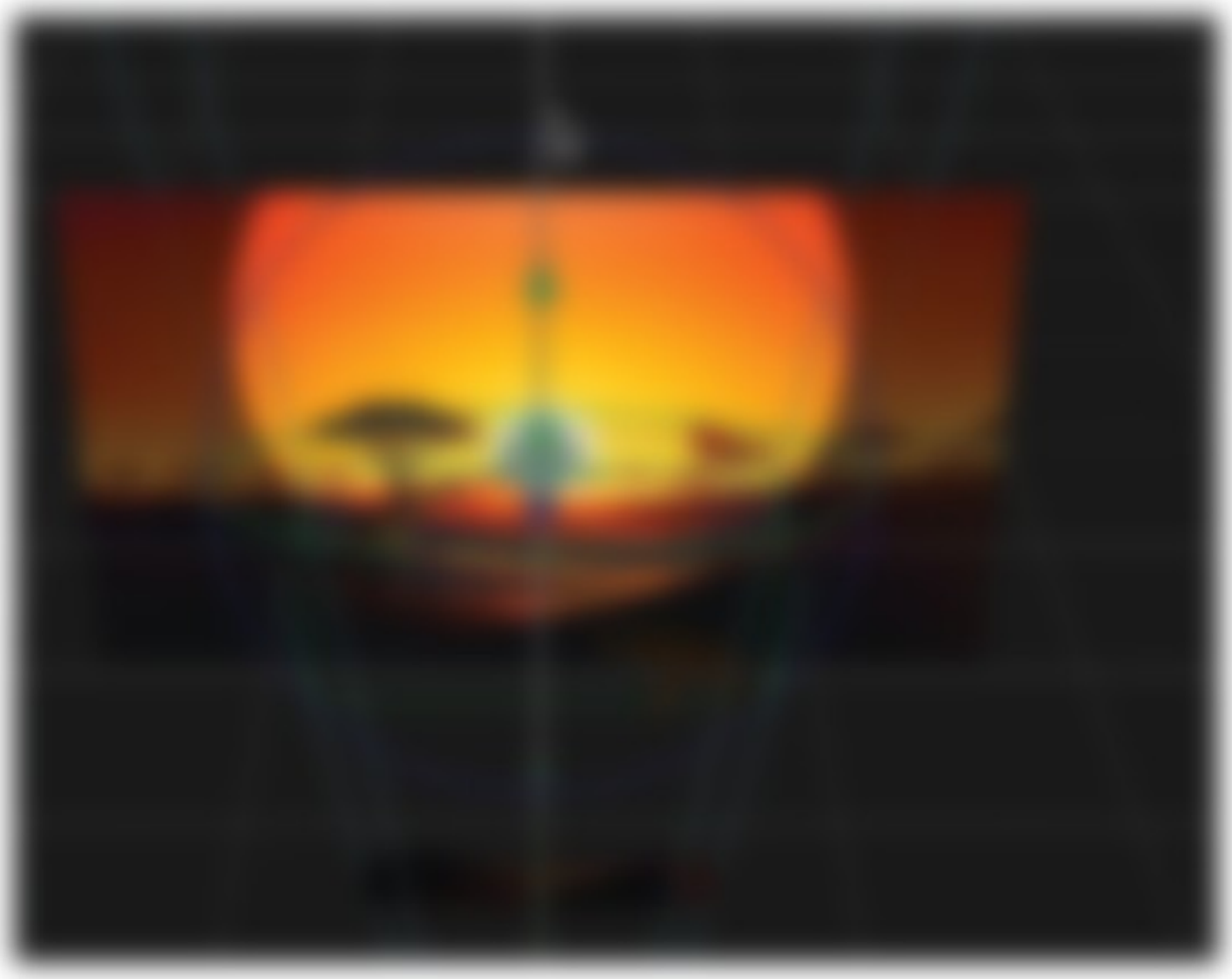
To have the spotlight appear as it's lighting our text from above, you can use a combination of the Y translation and rotation.

- In viewer 1, drag the Spot Light's green Y translation arrow to pull up until the light shines just above the WHERE text.



- In the upper left corner of viewer 1, click the Rotation button to switch the translation controls to rotation wheels.

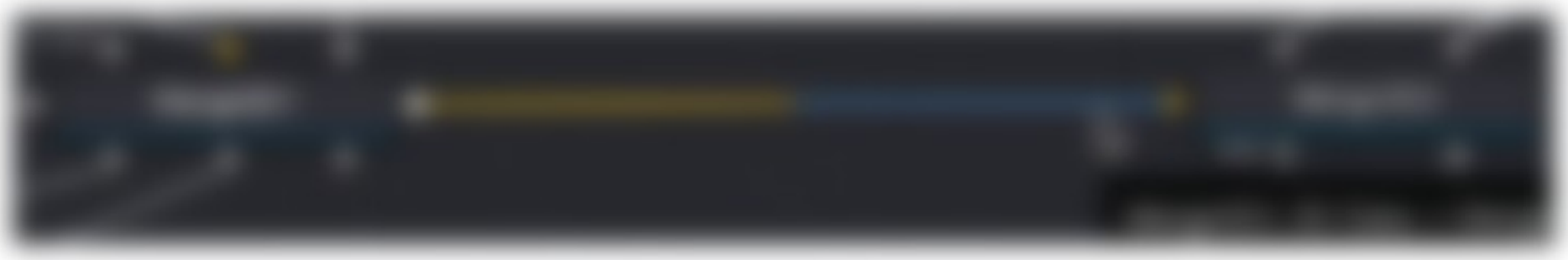
- Drag the red X marker wheel until the spotlight shines down on our tent.



- Adjust the spotlight's Intensity, Cone Angle, Penumbra Angle, and Dropoff to create a softer, more localized spot on the tent.

Currently, our spotlight is illuminating both the background Sunset graphic and the text equally. To make the spotlight illuminate only the text, we need to reorganize our 3D scene. As we briefly covered earlier, lights affect all objects connected to a Merge 3D node. If you have multiple Merge 3D nodes connected to each other, lights will still affect objects earlier in the chain of nodes (also referred to as upstream), as if everything were part of a single Merge3D. To restrict a light to only specific objects, you must isolate those objects on their own separate Merge 3D node.

1. Click the pipe between the Merge3D1 and the Merge3D2 to disconnect them.



2. Click an empty area of the Node Editor near the MediaIn1 node.
3. Press Shift-Spacebar and type **Merge**.
4. Select Merge 3D from the list and add it to the Node Editor.
5. Connect the Merge3D1 to the Merge3D3.

6. Connect the Merge3D2 to the Merge3D3.
7. Select the Merge3D3 and press 1 and 2 to display the merge in both viewers.

Now, you should see the ambient light illuminate our entire scene because we've enabled the Pass Through Lights checkbox in MergeSG1. However, the spotlight is only applied to the item because MergeSG1 remains at the default setting without that option enabled.

Your entire 3D scene is now lit using only two lights. With that in place, you can start converting your 3D scene into a 2D image.

> **TIP** One of the most common issues newcomers experience when working with Fusion is an inability to see the effect of lighting in the 3D scene. First, a preview of the lighting must be enabled for each viewer in order to preview the lighting effects in the 3D environment. Second, lighting must be enabled in the Renderer3D node shown on this in the next lesson). Finally, in a MergeSG, Pass Through Lights must be enabled to appropriately illuminate all desired objects shown on this later in this lesson).

Why Are There Different Light Types?

The Fusion page includes four lights that you can add to a scene, each with its own characteristics:

1. **Ambient Light** illuminates an entire scene equally – similar to adding a gain brightness – because it has no position or rotation. It is primarily used to fill areas that other lights may leave too dark.
2. **Directional Light** has a clear direction but lacks a specific source. You do not control its position, but you can use rotation controls to indicate from where in the scene the light appears to be coming. This light is akin to sunlight because, no matter how far away an object may be, there is no light fall off.
3. **Point Light** has a clear position in space that emits light in all directions. Therefore, only its position affects the light, not its rotation. A light bulb is a good example of a point light. Unlike both ambient and directional lights, a point light may fall off with distance.
4. **Spot Light** comes from a specific point and has a clearly defined cone with fall off to the edges of that cone. This is the only light capable of casting shadows.

Converting 3D into a 2D image

Every 3D scene ends with a Renderer 3D node that converts the 3D environment into a 2D image. Once you add the Renderer 3D node, additional 2D image processing can be inserted, and you can render the output directly into the web page timeline via the MediaOut node. The Renderer 3D node is not just a conversion node from 3D to 2D; it also includes several render processes that can enhance the look and quality of your comp. The most significant of these is adding depth of field.

1. In the Node Editor, select the Merge3D1 node, and from the toolbar, click the Renderer 3D tool to add it to the Node Editor.

Tip: With smaller display resolutions, you might need to temporarily hide the Inspector to see the Renderer 3D icon.

2. Press 7 to see the Renderer 3D output in viewer 2.

The Renderer 3D is set to render the camera by default, as you are at last there, however, if you have multiple cameras in a scene, you can choose the camera from a menu.

3. In the Inspector, choose Camera001 from the Camera menu.

The Renderer 3D node includes two render engine options:

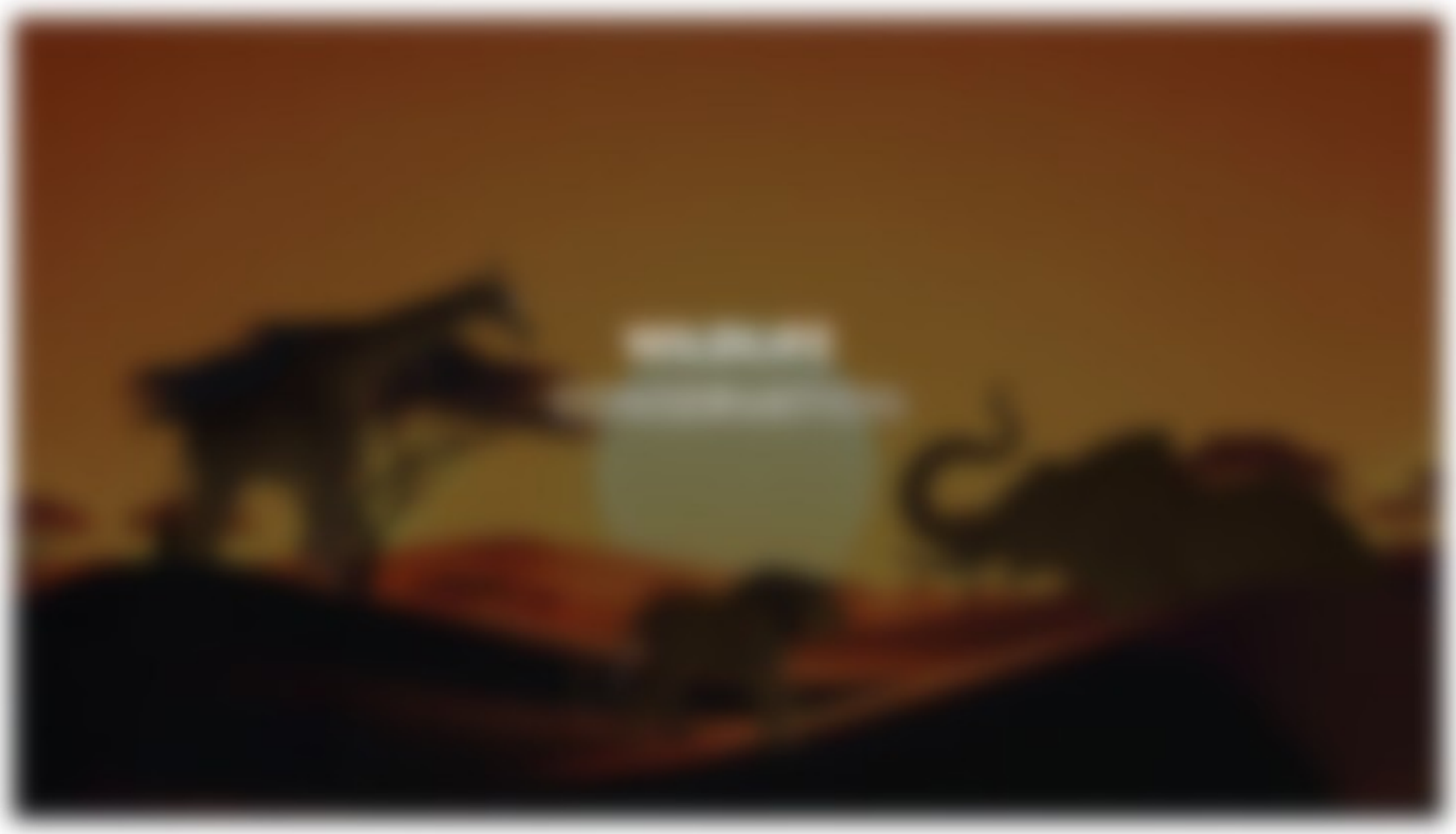
   a. **The Software renderer** engine uses only the system's CPU to produce the rendered images. It is usually much slower than using your computer's graphics hardware but produces consistent results on all computers.

   b. **The Hardware renderer** employs the GPU processor on the graphics card to accelerate rendering. Using this method, the output might vary slightly from system to system, depending on the graphics cards used. The increased speed of the hardware renderer makes it possible to customize supersampling and 3D depth of field options. For these reasons, the Hardware renderer is most commonly used.

4. In the Renderer Type menu, choose Hardware Renderer.

You should see a difference between the Perspective view in viewer 1 and the Renderer 3D output in viewer 2. Lighting is not initially enabled for the Renderer 3D node as it is in the viewer. You'll need to enable lighting to get the shading you see in the Perspective view.

5. In the Inspector, select the Enable Lighting checkbox to see the effects of your directional and ambient lights.



Drive back Zeach to re-enquire the Renderer 3D to set to output the correct resolution for your shot. In this case, the project resolution is set to 1920 x 1080, so the Renderer 3D should also be set to that.

4. In the Inspector, click the Image tab and make sure the width and height values match the project resolution of 1920 x 1080.

Your project looks more but still a bit flat. You can remedy that by adding depth of field.

Configuring Depth of Field Effects

To give your project more photorealism, you can simulate a camera's shallow depth of field setting. Depth of field (DoF) is the range before and after the focal plane that appears acceptably sharp. Areas outside that range are increasingly out of focus.

The first step in adding an depth of field is to enable it in the Renderer 3D node. You'll then need to configure the camera's focal plane so it keeps focus even when the camera moves.

1. In the Renderer 3D Inspector, click the Common tab and enable both the Enable Accumulation Effects and Depth of Field checkboxes.

The higher the quality, the better the depth of field will look, but the longer and harder the computer will have to work to process the effect. The default amount of 32 samples is usually sufficient, but to speed up your previews in this lesson, we'll lower it a bit.

2. Lower the quality to 16.

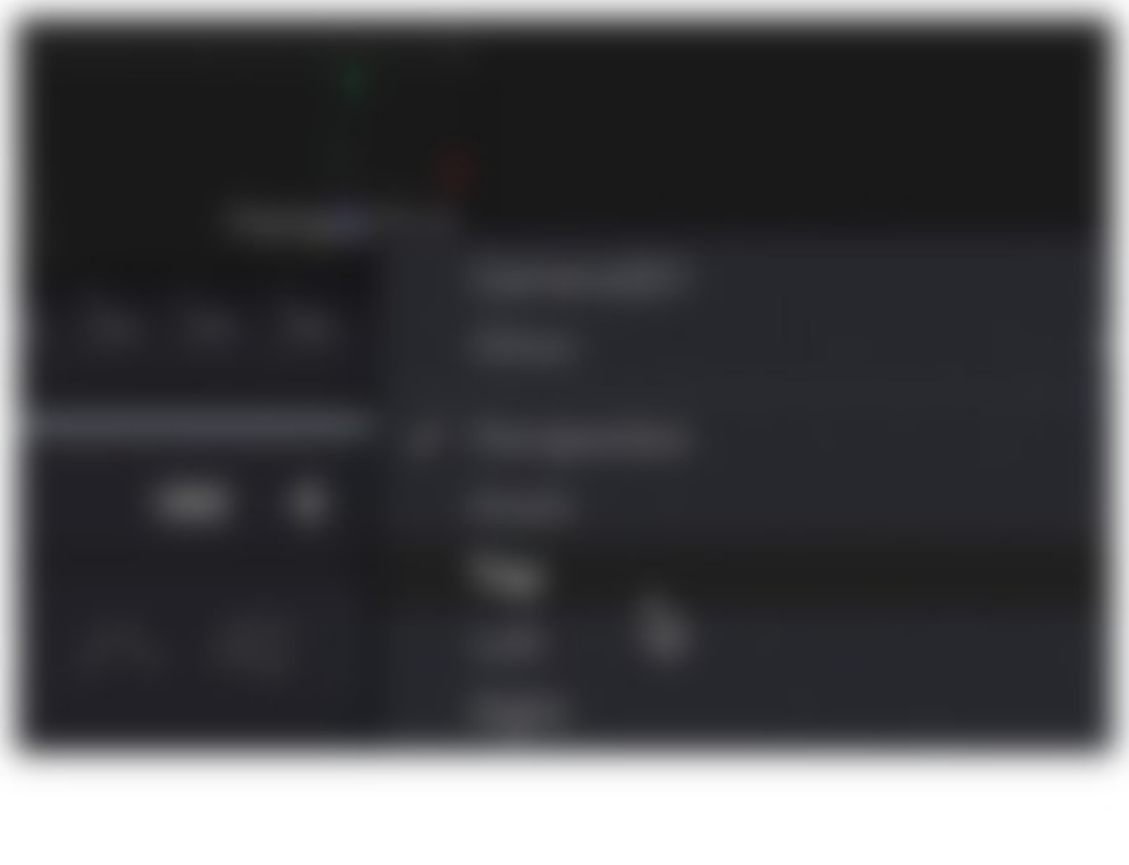
The amount of DoF blur changes the size of the in focus area. The lower the number, the more of the image remains in focus.

3. Decrease the amount of Dolf blur to 0.005 and play through the animation to preview it.

The scene is clearly blurred, but the focal plane should start with the lion in the front and end on the text when the camera stops on frame 80. As with a real camera, you need to change the focal point as the camera moves.

4. When you're finished experimenting, stop playback.

5. Right-click the pan control label in viewer 1 and select the Tag menu.

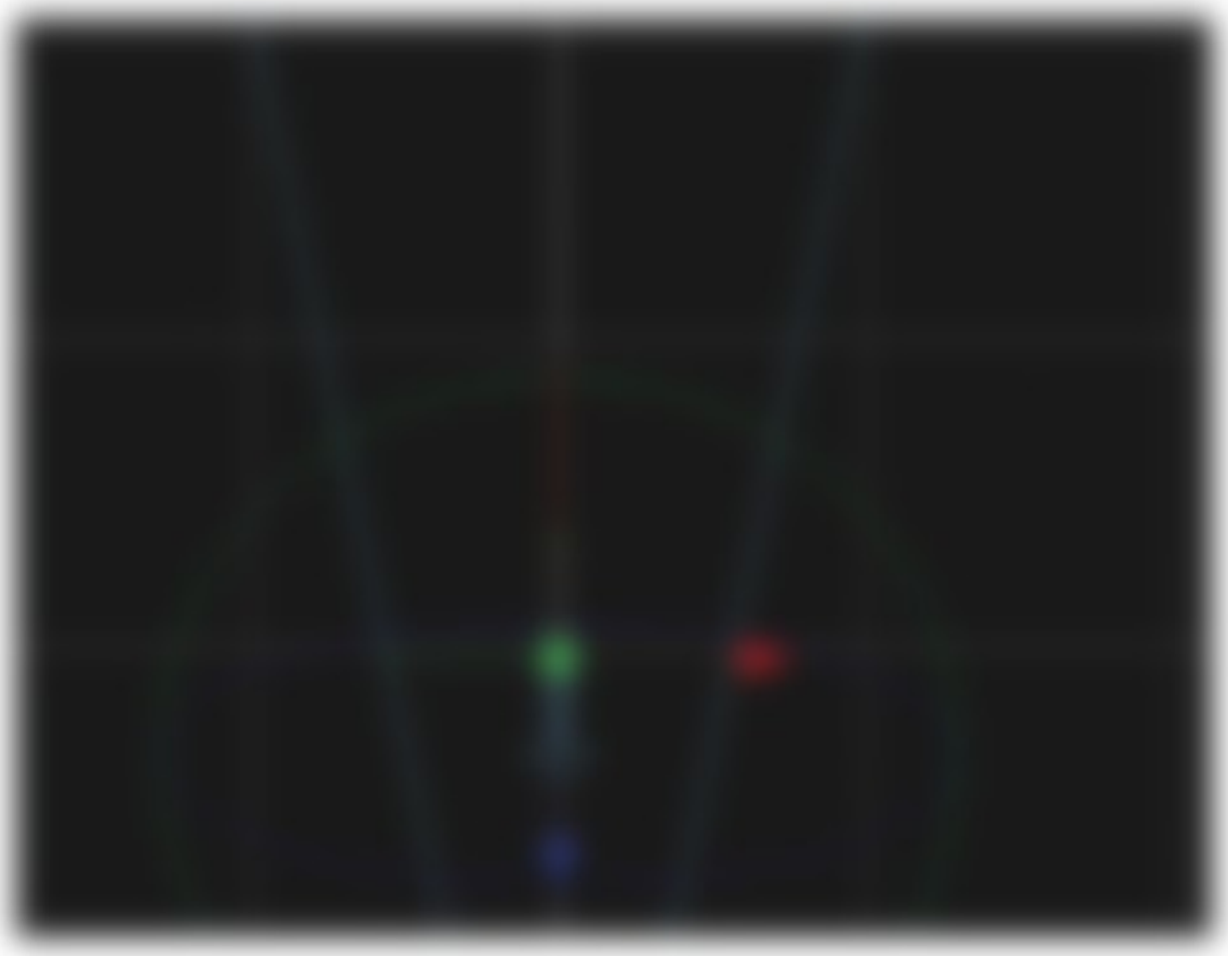


> **Tip** If necessary, in viewer 1, hold down the Command/Ctrl (Windows) key and scroll the middle mouse wheel to frame the viewer so that you can clearly see the text and camera.

The Tag view will make it easier to focus the camera precisely on the text and then the text.

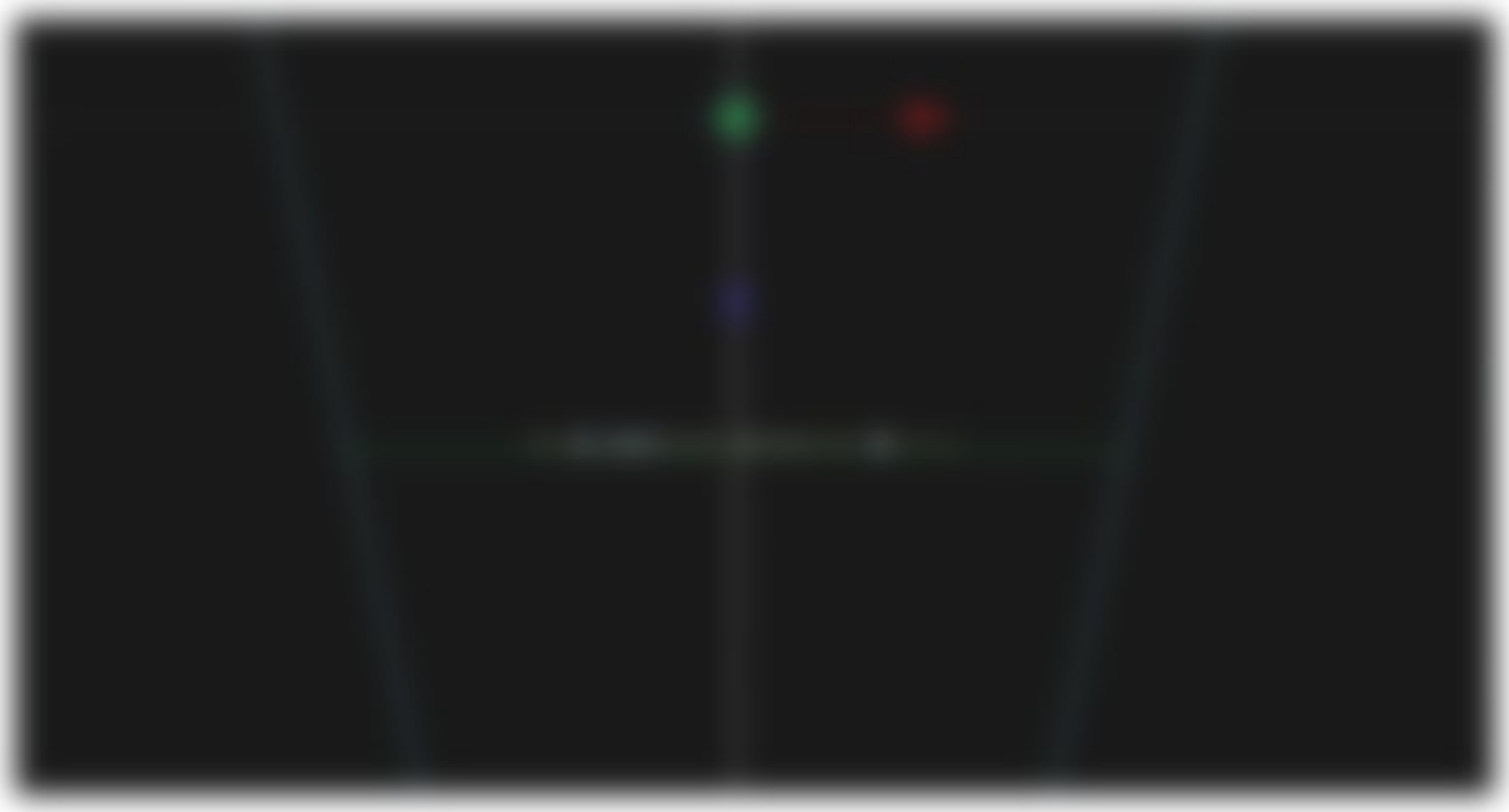
3. Move to the start of the render range in the Time Line.
4. Select the RenderedID and press 2 to make viewer 2 empty. This will speed up the process of making adjustments since the viewer will not have to update the depth of field with each change.
5. In the Node Editor, select the CameraRIP1 node, hold the Command key (macOS) or the Ctrl key (Windows), and select the Cam's Image Plane ID node.

   Selecting the Image Plane will help you see the onscreen controls in the viewer, making it easier to align the focal plane to it.
6. In the Inspector, adjust the Focal Plane slider until the green focal plane intersects with the onscreen controls of the Cam in viewer 1.



Since the camera dollies in during the romp, everything will be out of focus again. At

- Click the KeyFrame button to the right of the Focal Plane slider.
- Move to Frame 80 in the render range and adjust the Focal Plane slider again to be directly over the text.

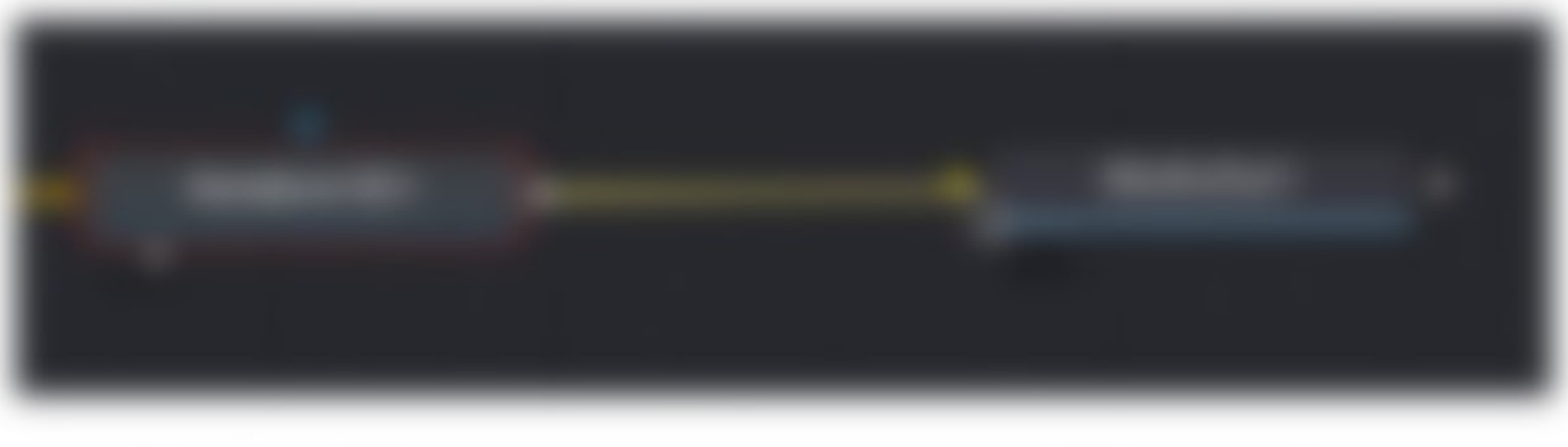


Now, you'll need to view the RendererSD again to see the actual results.

- In the Node Editor, select the RendererSD and press 1 to see it in viewer1.
- Press the Spacebar to preview the node in focus animation.

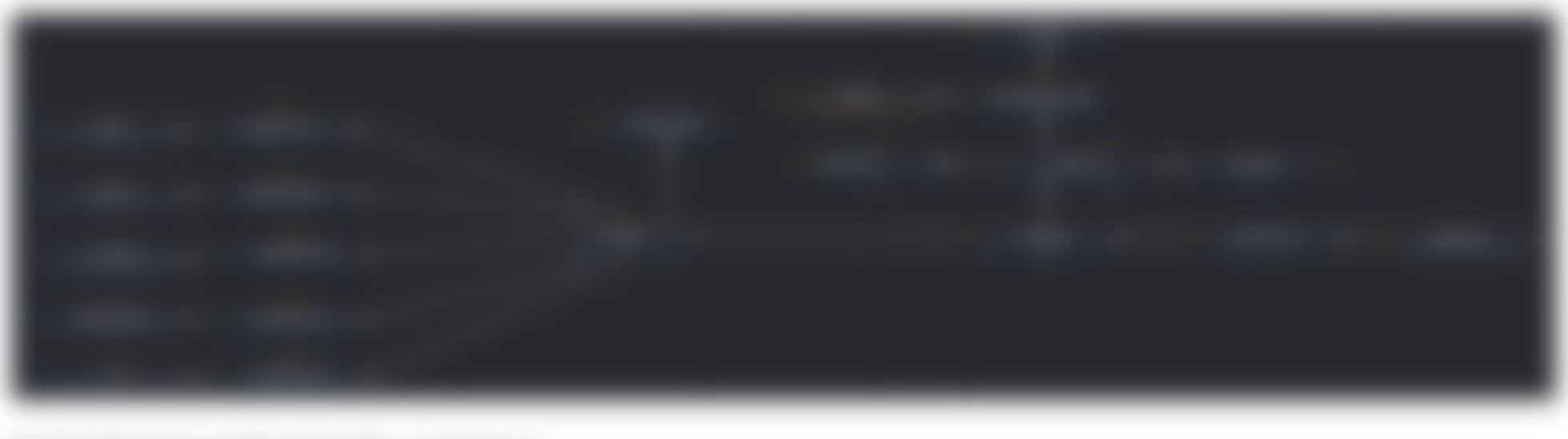
> If you regularly want a node to appear with certain settings already configured, you can right-click over the node in the Node Editor and choose Settings > Save Default. Any time you add that node to a Node Editor it will come preset with the current configuration.

- Drag the output of the RendererSD node to the MediaOut1 node.



After your RendererSD node, your scene is a standard 2D image that can have filters applied or continue with standard 2D compositions of other elements. You can even create

multiple 3D and 2D sections within a single composite, which makes complex compositing much easier.



Completed node map for Lesson 7

Lesson Review

- True or false? A MediaIn node must go through a Shape 3D node or an Image Plane 3D node before it can connect to the Merge 3D node.
- True or false? The order of Layers 3D scene uses the following coordinates: x = 0.0, y = 0.0, z = 0.0.
- True or false? Lights must be added to a scene using their own Merge 3D node. They cannot be connected to a Merge 3D node that already has objects connected.
- True or false? Depth of field is enabled in the Camera 3D node.
- True or false? The last node after any 3D compositing must be a Renderer 3D node.

Answers

1. True. A Material node must go through a Shader BSDF node or an Image Plane BSDF node before connecting to the Merge 3D node.
2. False. The center of Fusion's 3D scene uses the following coordinates: $x = 0, y = 0, z = 0$. A 2D scene uses $x = 0.5$ and $y = 0.5$ as the center of the viewer.
3. False. Lights, 3D objects, and cameras can all be connected to the same Merge 3D node, but separating them makes for better organization and flexibility.
4. False. Depth of field is located in the Renderer 3D node.
5. True. A Renderer 3D node is required at the end of any 3D compositing to convert the 3D scene to a 2D image.

Lesson 7

Exploring a Green-Screen Workflow

In this lesson, you'll take your compositing skills to the next level by combining keying with 2D and 3D techniques. Whether you need a quick refinement on 2D compositing or are ready to dive into more advanced workflows, we'll build on the fundamentals and push into green-screen keying, masking, and seamless integration techniques. You'll use tools Delta Keyer to refine your key and learn how to add realistic reflections and light wraps to blend everything more naturally.

Time

The lesson takes approximately 1 hour to complete.

Goals

Managing Color for Visual Effects 42
Removing Noise 46
Pulling a Key 51
Adding Natural Light Spill 57
Creating a 3D Simulated Reflection 63
Lesson Review 69

By the end of this lesson, you will not only have sharpened your compositing skills, but you will also have had a first look at how 2D and 3D can work together, unlocking new creative possibilities in Fusion.

Completed composite for Lesson 12

Managing Color for Visual Effects

Before you begin this next lesson, we must cover one of the more technical aspects of post-production in general and visual effects compositing in particular. Color management is a critical part of the entire post-production workflow, and the requirements for compositing are slightly different than those for editing or color grading. You'll start this learning job by setting up a scene-referred color managed workflow.

> **NOTE** If you're using the free version of DaVinci Resolve, you will receive a warning when you restore the archive for this lesson. You can continue with the lesson; however, some exercises require DaVinci Resolve Studio, so you will be advised to skip those steps.

1. Open DaVinci Resolve, right-click in the Project Manager, and choose Restore Project Archive.
2. Navigate to the [YOU] Studio Fusion 3D Training Media folder.

   The lesson will use the Fusion 3D DaVinci Reset archive.

1. Select the *FusionWithoutAdapter.drp* file and click Open to add the archived project to the Project Manager.
2. Open the DaVinci project from the Project Manager and select the edit page, if necessary.
3. From the main menu bar, choose Workspace > Reset UI Layout.
4. In the timeline, move the playhead to the start and play through the clip.

When you first look at this green screen shot from Action With practice content, you might notice that it looks a bit flat, with low contrast and low saturation. That's completely normal! Most modern digital film cameras capture footage this way to preserve more detail in highlights and shadows. The cameras compress brightness gamma for efficient storage, and when expanded, they reveal a wider dynamic range with more detail.

But here's the catch: Fusion expects images to have a linear gamma—meaning brightness levels behave in a more natural, mathematical way. If you step into color and start compositing immediately, things like color corrections, blending, and keying might not work as expected.

So before pulling the key, we need to convert the footage to linear gamma so Fusion can process it correctly. Then, after compositing, we'll convert it back to match the camera's color space for our final output.

Sounds complicated? Don't worry! DaVinci Resolve makes this easy with built-in DaVinci YRGB color management. All you need to do is enable it, and Resolve will handle the rest.

1. Choose File > Project Settings, and in the sidebar, click the Color Management category.
2. In the "Color science" menu, choose DaVinci YRGB Color Managed.

When working with Camera Raw files in DaVinci Resolve's color management (RCM), the default state is to have the "Automatic color management" checkbox enabled. This results in the metadata from each camera brand being used to process the raw files into a standard format, ensuring that all the image details are preserved for color grading and visual effects. Because RCM takes over this process, the setup is almost completely automatic. When the "Automatic color management" checkbox is enabled, Resolve simplifies things down to two simple menus.

The "Color processing mode" lets you choose between Standard Dynamic Range (SDR) processing and High Dynamic Range (HDR) processing. Your choice depends greatly on the capacity of the media you are using. If none of your content comes from digital film cameras in a LOG format, then HDR would be a better setting.

1. Since our content is in LOG format and we want to preserve the dynamic range, choose HDR for the "Color processing mode."

   An output color space menu configures the final rendered gamma and gamut output for your delivery.

2. Choose SDR sRGB from the "Output color space" menu.

- Position the playhead over the Fusion clip and press Shift-5 to enter the Fusion page.

  Turning on Color Management performed several processing steps automatically for Fusion. First, it converted the Medium nodes to linear gamma. Second, it enabled a LUT (lookup table) in the viewer, as you are not looking at the linear image. Images using linear gamma are rather dark and highly saturated and therefore unpleasant to work with. The viewer LUT makes for a more natural viewing experience while still allowing you to composite correctly using linear gamma images.

- In the upper right corner of viewer 2, click the LUT button to disable it, revealing the linear image.

  A viewer LUT is a simple color adjustment applied to the viewers in the Fusion page. The image itself is not changed, only its display in the Fusion viewers. Rather than showing the image with linear gamma, Resolve enables the viewer LUT to convert the linear gamma image to the output color space identified in the color management setting.

- Click the LUT button again to re-enable it and thus view the corrected image.

> **TIP** If you choose not to use Resolve color management, you can add a gamut or Cineon Log node after every Medium node to convert it to linear gamma. Then, add a gamut or Cineon Log node just before the MediaOut to convert back to the final output gamma setting.

You are now able to composite using images that look correct and, more importantly, will act correctly during compositing. When you switch to the edit or color pages, all the gamma curve corrections are managed automatically based on the output color space setting that you configured in the Color Management Project Settings.

Why Use Linear Color Space?

When working in post production, gamma curves are everywhere - your camera, your monitor, and even your own eyes all interpret brightness differently. And while that's great for capturing detail and making images look natural, it doesn't work well for compositing. Why? It all comes down to math.

Most compositing tools, including Fusion, expect images to have a linear gamma, where brightness increases predictably. But when you feed them footage with a nonlinear gamma curve (like 2.2), things get messy. Adjustments don't behave as expected, colors shift, and blending effects can look unnatural.

Let's take middle gray as an example. In a linear system, middle gray should be exactly 0.5 (halfway between black and white). But in a 2.2 gamma curve, middle gray might actually be closer to 0.22 - meaning your image is much darker than the math expects. The problem? Compositing tools don't know this and still treat it as 0.5 values 0.22, leading to unpredictable results.

You can see this in action when applying the same color correction to two elements of an image - one with a 2.2 gamma (below left) and one properly converted to linear (below right). As we double the exposure of each image and then double again, the 2.2 version loses's midtones disproportionately, highlights and milky and shadows appear muddy. The highlights on the linear image remain smooth, and shadows transition more evenly.

So what's the solution? Convert your footage to linear gamma before compositing. The easiest way to do this is by using a color managed workflow like Cadence. With Color Management on ACES, Cadence handles everything correctly, and once you're done, it will convert the image back to the proper display gamma for your final output.

By working in linear color space, your keys, effects, and blends will behave naturally, giving you better, more accurate results.

Removing Noise

We will begin our keying process with noise reduction. Noise makes keying harder by creating tiny color variations that confuse the keyer, leading to choppy edges, flickering, and unwanted artifacts. Since extracting a matte for keying is based on chroma color separation, a noisy image makes it difficult to pull a clean key and make adjustments. By removing noise first, you give the keyer a smooth, even image to work with - leading to cleaner edges and better transparency.

1. In the Node Editor, select the MediaIn1 node and rename it **GreenScreen**.

> **TIP** When you first enter Fusion using a Fusion clip with multiple layers, you may want to organize your nodes into a neater layout rather than the default, which overlaps some of the nodes.

Fusion includes a Noise Reduction node that uses the same temporal, spatial, and AI-based processes found in the Color page. We'll pay particular attention to the strengths of two that we don't want to lose as we apply the noise reduction.

> NOTE The Noise Reduction node is only available in DaVinci Resolve Studio. If you are using the free version of DaVinci Resolve, skip the noise reduction steps and continue with the next exercise, "Putting it Key."

1. Press Shift-Spacebar and type **Noise** to add a Noise Reduction node after the Green Screen node.
2. Select the Noise Reduction node and press `7` to view it.

   The Noise Reduction node in Fusion offers temporal and spatial noise reduction. Temporal noise reduction analyzes multiple frames to reduce flickering noise while keeping motion details intact. Spatial noise reduction works within a single frame to smooth noise without blurring edges. Ultra4K, found in the Spatial NR menu, is an AI driven hybrid that applies smart temporal and spatial noise reduction before other NR settings, preserving details more effectively.
3. In the Inspector, from the Spatial NR menu, choose AI Ultra4K.

4. Click Analyze.

   The analysis takes a second or two, and the process is completed. A small square patch appears over the area that was used to evaluate the noise. Hover `1` shows the cleaned up red channel and the weighted amounts of hue. If you want to improve it further, you can increase the Temporal Threshold a small amount because the greater you increase this value, the slower the process becomes and the more potential there is to lose detail.

- Increase the temporal threshold to 1.0.

  To better see how much cleaner the image has become and how much of the detail has been retained, you can easily disable the node to compare the image before and after.

- With the Noise Reduction node selected, press Command-T (macOS) or Ctrl-T (Windows) to disable it and then press the same keyboard command to enable it again.

- Click in viewer 1 and press 2 to view the three color channels again, and then press Command-T (macOS) or Ctrl-T (Windows) to fit the image into the viewer.

> **TIP** Having noise reduction recalculated for every frame can slow down playback and compositing performance. Use a Saver node directly after the Noise Reduction node to render out the clean frames as EXR, and then import them into Fusion using a Loader node. This speeds up your workflow, ensures smoother playback, and frees up GPU resources for other compositing tasks.

The noise reduction did a great job using DaVinci Neural Engine. However, noise reduction can also smooth out fine details, making edges too soft and reducing the accuracy of keying, tracking, and blending. Over-aggressive noise reduction can also create motion artifacts or remove natural film grain, making CG elements look unnatural when integrated. Since noise is part of the original image texture, ultimately, you should add controlled grain back after compositing for a seamless look. We'll leave that part to another book in this series, The Colorist Guide to DaVinci Resolve 20.

Pulling a Key

With the color management correctly set up and noise reduction applied, you can begin the actual keying process. As you more than likely know, compositing often usually requires a matte, a grayscale image that identifies parts of the foreground as transparent and other parts as opaque. Unlike computer-generated images, this live-action green-screen shot does not include an alpha channel. So it is up to you to create the matte through keying. This is often termed "pulling a key." The Delta Keyer is the primary tool used for green screen and blue screen keying in the Color page. We'll start by adding one connected to the Noise Reduction node.

4. Press Shift-Spacebar and type **Delta** to add a Delta Keyer to the Noise Reduction node.

> **Tip:** Whenever you are keying, it is helpful to use two viewers: one where you can see the final output, and the other where you can view the quality of your matte.

5. Press 1 to view the Delta Keyer in viewer 1.
6. From the Delta Keyer's Inspector, drag the Eyedropper into viewer 2 and select the green color in the upper right corner. This area avoids reflections in the side windows and the diffuser grid lines on the back window.

The viewer shows what is probably the finest detailed area in the matte, the passenger's hair, clearly overlapping with the green screen. We are also looking to prevent the reflections in the driver's side window.

2. Drag the frame in viewer 1 to see the driver's side window and the reflections that have been retained.

Without any adjustments from you, the Delta Keyer has done a great job of keeping the detailed edges in his hair and the subtle reflections in the window. Let's name this node so it is clear what the Delta Keyer is helping us do in this shot.

3. Select the Delta Keyer, press F2, and rename it **Delta_Edge**.

The single Delta Keyer hasn't done a great job of making the inside of the car pure white. There are many shades of gray there, which means there is some background coloring that needs to be removed.

Using a Second Delta Keyer

A common challenge in keying is expecting a single keyer to handle everything. Invariably complex shots benefit from a multi-key approach—using an edge matte as we have been for the details like hair and what is often called a "core matte" for solid areas. This technique will give you greater control, preventing the loss of detail and ultimately leading to a more aesthetic composite. You can create solid core mattes by color-targeting pixels that are not the paint matte, but you can also use another Delta Keyer.

NOTE In this exercise, we won't provide exact values for every parameter. Keying is an iterative process - adjustments made in one area often require you to revisit and refine earlier settings. As you progress, don't hesitate to return to any parameter and tweak it based on how later steps affect the overall result. Effective compositing is rarely linear - refinement is part of the workflow.

1. Click in an empty area in the Delta_Edge node and add a second Delta Keyer.
2. Select the second Delta Keyer and rename it **Delta_Core**.
3. Drag a second output from the Keyer Reformat node to the Delta_Core node.

4. Press 1 and 2 to view the Delta_Core node in both viewers.

   The tabs at the top of the Inspector roughly outline the flow for working with the Delta Keyer. You begin in the Key tab and then move through the tabs to the right. You might skip some tabs, and you might use some occasionally. Every keying job is different, and although we can provide a guideline here, it is by no means the only way to key.
5. From the Inspector's Key tab, drag the Eyedropper into viewer 2 and select a green color from the upper right area again.

   This time, we don't care about retaining the fine details along the edges or the reflections in the window because we have a keyer doing that. We need this keyer to focus on filling in all the gray semi-transparent areas in our matte that should be pure white (not transparent).
6. Click in viewer 1 and press Command-7 (macOS) or Ctrl-7 (Windows) to fit the image in the viewer.

Typically, people will instantly try to refine the matte. While that isn't a terrible idea, there is a large area at the bottom half of the shot that can be handled immediately just by using a rectangular shape as a static matte.

- Move to frame 130, where the driver's hand has very little overlap with the side window.
- Drag a Polyline shape from the toolbar to the node graph near the Delta_Core node.
- Draw a very simple rectangular shape over the lower half of the screen, including the driver's hand, and then down across the side windows.

- Drag the output of the polyline to the bright white Solid input on the Delta_Core node.

This rectangular static matte eliminates the need for the keyer to worry about all the gray semitransparent area that it is covering. We can now begin refining the areas that remain.

- Select the Delta_Core node.

Modern keyers are called difference keyers, as opposed to chroma keyers, because they use a color difference method of removing the green or blue screen rather than just a straight chroma sampling. This matters because it helps us understand how the Delta keyer doesn't just sample green pixels and remove them. It compares green pixels against red and blue. It calculates transparency based on how much stronger the key color is compared to the other channels. Using the Gain and Balance sliders, you can increase the key color (gain) and the influence that blue and red have on the transparency (balance). The downside is that adjusting these two parameters too far will often cut your edges. You'll see that most adjustments in the Delta keyer are balancing acts between maximizing the adjustment and cutting your matte.

- Increase the Gain slider above a quarter of the way to the right and then drag the Balance slider slowly to the right until most of the driver's face becomes solid white.
- In the Image box, select the Matte tab and adjust the high threshold about two-thirds of the way to the left and then increase the low threshold until it almost meets the high threshold.

  The Threshold parameters are the primary way to control the transition between fully transparent and fully opaque areas in the alpha channel. You've narrowed the range therefore making more of the alpha channel pure black and pure white. This works well for the inside of our matte, but by doing this you also affect the fine edges. The Erode/Dilate parameter can shrink the matte, essentially pulling it away from the edges.
- Decrease the Erode/Dilate parameter slightly and increase Blur to slightly.
- For the lingering small dots of gray or black in the white area of our matte, increase the Clean Foreground a small amount until the dots are gone. Try not to exceed 0.007 by.
- Drag the output of the Delta_Core node to the bright white Solid input on the Delta_Edge node.
- Select the Delta_Edge node and press `1` and `2` to see it in both viewers.

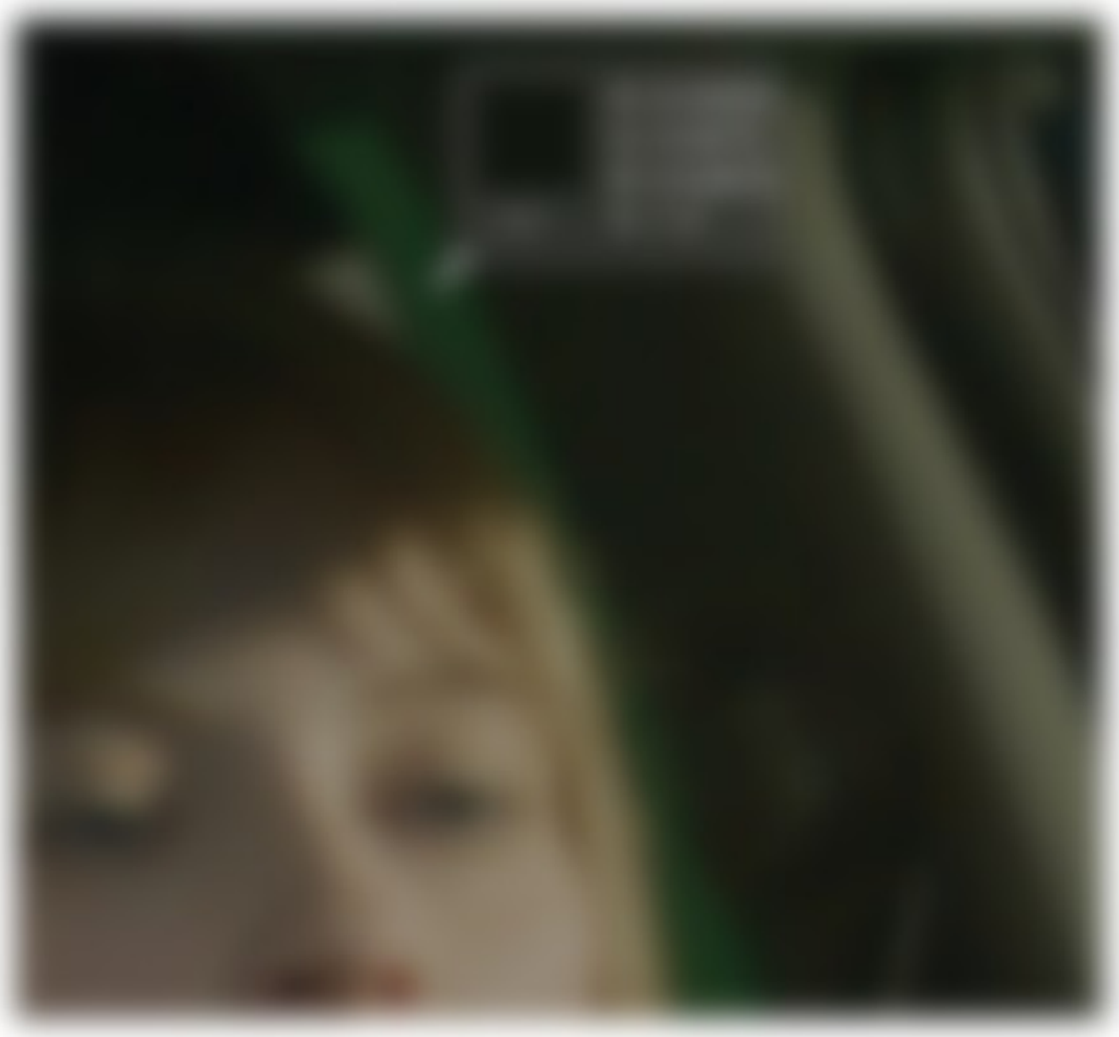
Keying is often a game of What-a-Mole. You fix one thing with a Delta Keyer and find that you need to fix something else with a polyline mask. Sometimes, one or even two keying nodes aren't enough. Don't be afraid of using multiple tools to find the right mix needed for any given shot.

Tuning a Third Delta Keyer

There is still one area in the matte of the driver's head where a small amount of gray is not keyed correctly. We could probably try to tweak the keyer in the other two Delta Keyers to correct this, but we run the risk of destroying our otherwise nice composite. It is very common to use multiple keyers to key different areas. Keying is keying is keying. Do not try to make a single keyer do all the work.

1. Click in an empty area near the Delta_Edge node and add a third Delta Region.
2. Select the third Delta Region and rename it **Delta_Window**.

3. Drag a third output from the Noise Reduction node to the Delta_Window node.
4. Press 1 and 2 to view the Delta_Window node in both viewers.
5. From the Inspector, drag the Eyedropper into viewer 2 and select a green color on the small back window to the right of the driver's head.



6. Increase the Gain slightly but leave the Balance alone to retain the amps of yellow hair.
7. To make our matte denser, select the Matte tab and drag the low threshold up a tiny bit and the high threshold down about 20%.

Because we are only interested in working on the small window to the right of the driver's head, we'll use a mask to restrict the key to that area.

- Click the Rectangle mask in the toolbar, adding it to the Mask input on the Delta Window node.

- Turn and locate the rectangular shape so it covers the window shape as tightly as possible.

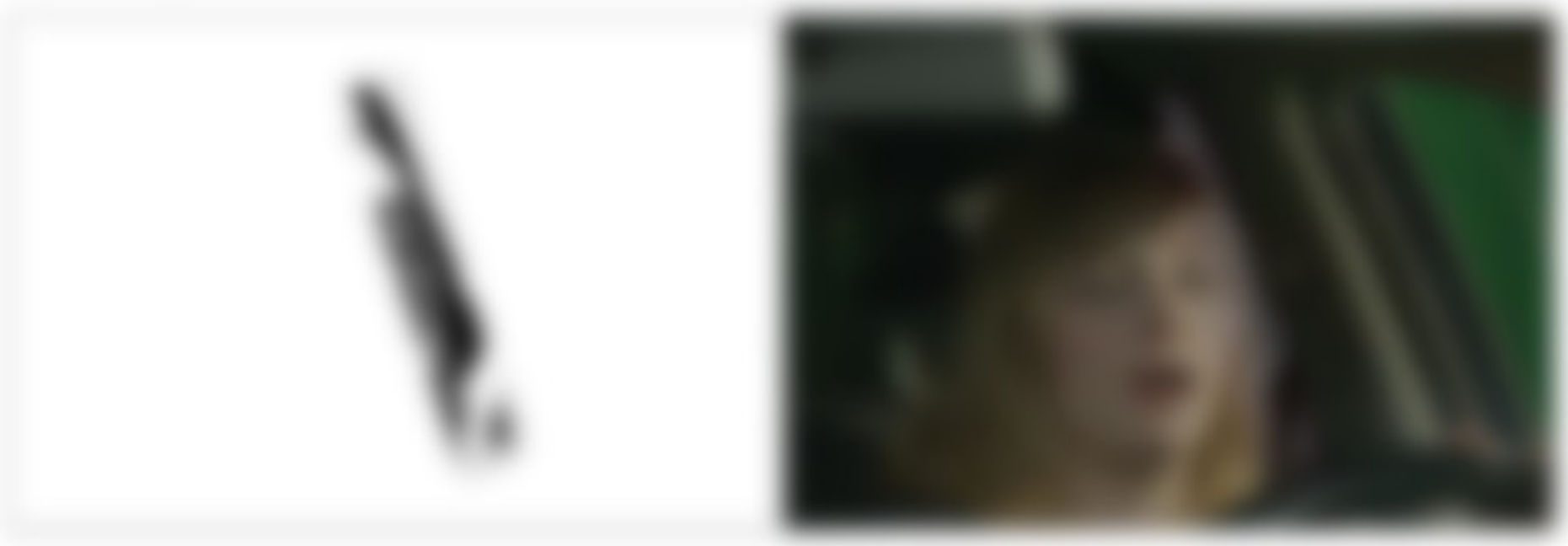
You can see that this hasn't created a perfect matte for our hair and window. As with color correction, sometimes keying calls for more precise tools than just selecting a color and adjusting a few matte controls.

The area of hair that is most transparent are the highlights, but the parameters we have been adjusting are affecting the entire image. As with color correction, occasionally you need to adjust just the shadows, midtones, or highlights. That's exactly what the Tuning tab is for.

1. Select the Delta_Window node, and in the Inspector, select the Tuning tab.

The graph of the Tuning tab shows how much color falls into the shadows, midtones, and highlights areas of the image. Adjusting the splines allows you to finely control the tonal ranges. Adjusting the Shadows, Midtones, and Highlights sliders allows you to modify the strength of the matte for any of the regions.

Adjust both viewers so you are zoomed in to the side of the driver's head where you are keying.



Set the Midtones slider to 0.6 and the Shadows slider to 0.3.

This should give you a very good matte for hair window and the wispy hair. Feel free to experiment with the ranges to see if you can improve upon these simple adjustments. You can always click the Smooth button to return the ranges to the default locations. We'll now combine this Delta_Window matte with the Delta_Edge matte.

When the composite is complete, return to the Delta_Window node and experiment with adjusting the Erode/Dilate and Restore Fringe sliders by very small amounts to see if you can improve the edges of hair even more.

Select the Delta_Edge node and add a Matte Control node.

- Drag the output from the Delta_Window node to the green foreground input on the Matte Control.
- Reset your viewer to see the entire image and then press 1 and 2 to view the Matte Control node in both viewers.
- In the Inspector, choose Combine Alpha from the Combine menu, and then set the Combine Op to Minimum.

The Minimum setting performs a Boolean operation where only the darkest areas of both the Delta_Edge (previously combined with the Delta_Luma) and the Delta_Window matte overlap. This gives us the perfect combination of both the Delta_Window keyer and the Delta_Edge keyer.

You've now created a beautiful matte using three Delta Keyers in different ways. This is not uncommon at all. In fact, you are making it much less difficult on yourself if you are trying to use just one keyer node to get a clean composite.

Handling spill suppression separately

The Delta Keyer in Fusion is primarily used to create a matte to remove the green screen, but it also has controls to suppress the light from the green screen bouncing onto the actors. This is commonly called "spill" when keying. While the Delta Keyer can handle both the matte creation and the spill suppression, it's best practice to do this keyer "focus on what it does best - pulling a clean matte - and handle spill suppression separately in another branch of your node graph. This gives you more control over the color adjustments without affecting the overall key.

1. To see how much spill suppression the Delta Keyer is actually doing, select the Delta_Edge node.

1. In the Node tab, set the Color Replace Mode to Source.

Setting the Replace Mode to Source disables any spill suppression being performed in the Delta Keyer and instead uses the original colors from the source clip. You can now use Fusion's color correction tools to remove the spill with much greater control.

2. Click to the right of the Delta Keyer in an empty area of the Node Editor.
3. Press Shift-Spacebar and type **Rgb** to add a Rgb Curves node to the Node Editor.
4. Drag an output from the CreateStreaks node to the Rgb Curves node.

The Noise Reduction helped us to pull them and create a clean matte, but it's not needed for the color correction we are about to perform. You want the image to match the background noise and all. Yet adding back the noise could also make the image appear too clean.

5. Select the Rgb Curves node and press 2 to view it in the right viewer.

In the Inspector, the three checkboxes along the top are similar to the color page's Custom Curves options. They allow you to adjust the Hue, Saturation, or Luminance of a specific color found by dragging the control point under the hue you want to adjust. In our case, we want to adjust the saturation of the green hue.

- Make sure Sat is the only enabled checkbox.
- Locate the control point under the green hue on the color bar and drag it down two-thirds of the way to the bottom to decrease the green hue.

Because decreasing the green saturation can tangentially decrease the yellow in the driver's hair, you'll need to offset that by increasing the yellow of the hue.

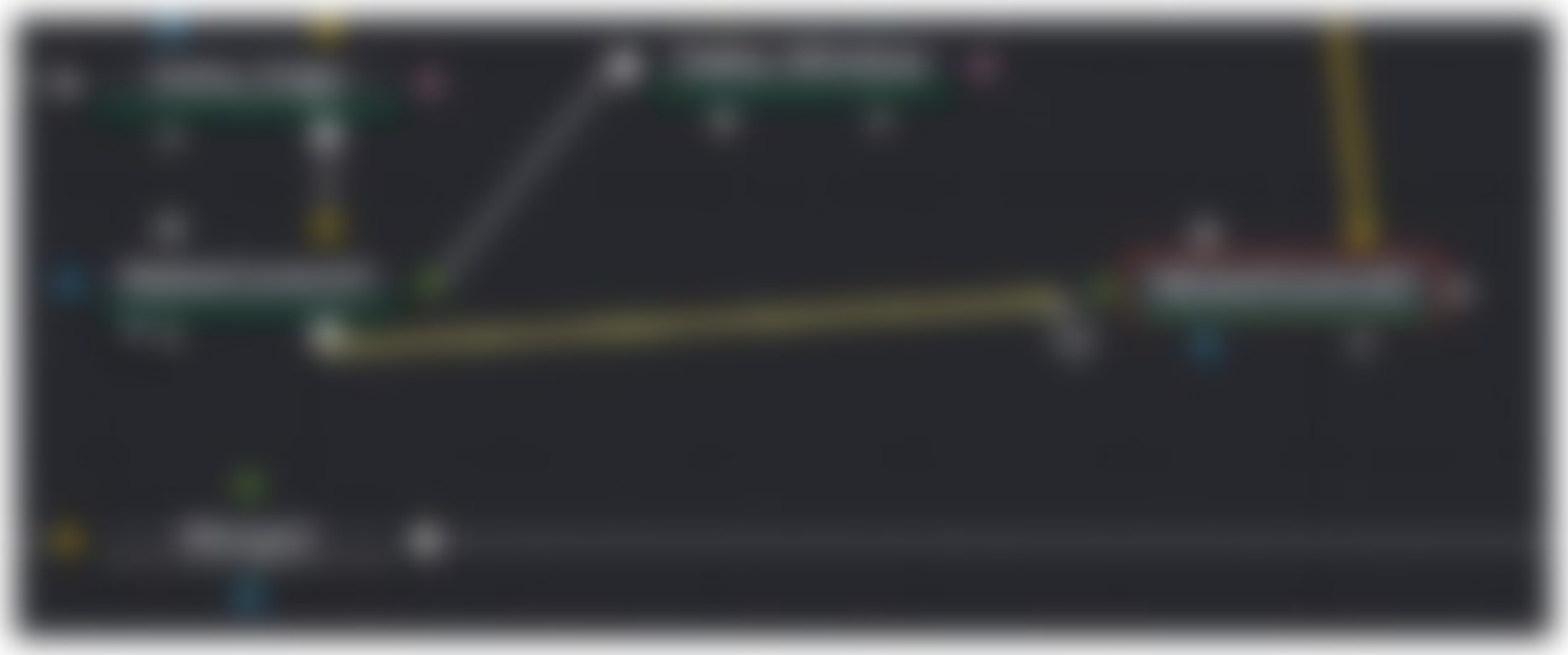
- At the bottom of the Inspector, drag the Eyedropper into the viewer and release it over the bright yellow of the driver's hair.

A new control point is added to the Saturation curve that corresponds exactly to the yellow hue.

- Locate the control point under the yellow box on the color bar and drag it up until the yellow of the street's hair is restored.

The best way to evaluate all these inputs and adjustments is to combine them so you can see the composite. First, we'll combine our Delta Keyer inputs with our hue curve and suppression to create a foreground with an alpha channel. We can do that with a Matte Control node.

- Select the hue curve node, press Shift-Spacebar, and add a second Matte Control node.
- Drag the output of the Matte Control1 node currently connected to the Merge1 node and connect it into the green foreground input of the Matte Control2.



- Select the Matte Control2 and press 1 and 2 to see the Matte Control in both viewers.

Now, you can just copy the mask from the foreground to the background.

- In the Inspector, choose Combine Alpha from the Combine menu.

  You will now use this as the foreground input to a Merge node to place over the background. As you might recall from earlier Fusion training, Merge nodes expect alpha channels to be pre-multiplied with their RGB image.

- In the Inspector, enable Post-Multiply Image.

- Drag the Output of the Matte Control2 to the Merge1 node's Foreground input.

- Select the Merge1 node and press 1 to see it in the viewer.

You've created a strong composite, but the work isn't done yet. Keying and light suppression are just the first steps in making a shot feel real. Next, it's time to focus on the subtle environmental cues that seamlessly blend your foreground with the background, making the composite truly believable.

Adding Natural Light Spill

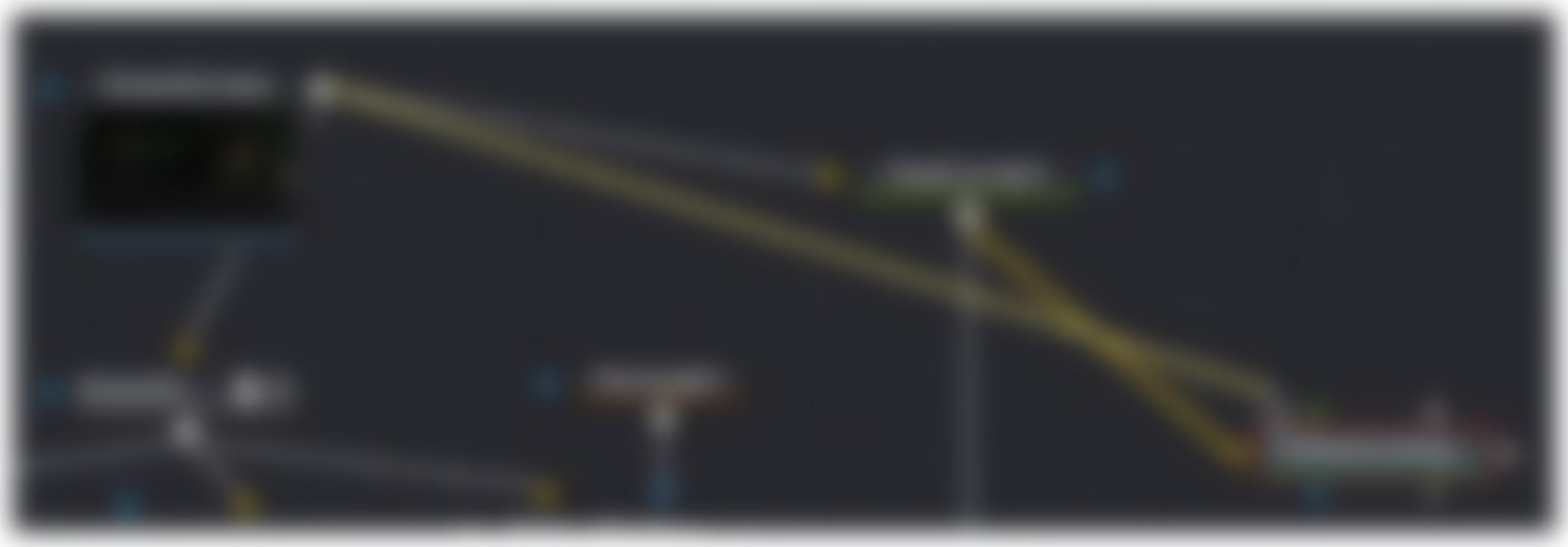
When placing a subject into a new environment, one of the biggest giveaways of a composite is a harsh, unrealistic edge where the foreground meets the background. In real life, light doesn't stop at the edge of an object - it naturally spills and wraps around surfaces due to diffusion and reflection. This is where a light wrap technique comes in. By softly blending the background's light around the edges of the foreground, a light wrap helps eliminate the cut-out look, making the subject appear more naturally embedded in the scene. Without it, even a perfectly pulled key can feel disconnected from its environment.

1. Click in an empty area of the Node Editor to the right of the Keyer 2 node.
2. Press Shift-Spacebar and enter **difference** to locate and add a Difference Keyer.

There are many ways to begin creating a light wrap. For this exercise, we'll choose a Difference key. We'll use the Difference Keyer to create the matte that shows where the green bounce spill was in the shot, and then we'll "replace" that green spill with color from our background image. To do this, we set the Difference key so the original image can be compared to the Keyer 2 screen version, where the green spill has been removed. The controls in the Inspector will help decide how much of the green is retained and how much is not included in our light wrap.

1. Drag a second output of the Keyer 2 node to the Difference Keyer's yellow background input.

4. Drag another output from the GrayScale1 clip to the green foreground input of the Difference1 node.



5. Select the Difference1 Node and press '1' to see the matte in the viewer.

The matte created by the Difference Node is based on the change in the green hue. The next way to control how much these differences affect the matte is via the threshold sliders in the Inspector. The Low threshold sets the minimum difference needed for a pixel to be considered part of the matte (foreground). Raising the Low threshold will make more similar pixels (foreground) included in the light areas, which isn't what we want. So we'll keep it at its default setting.

Lowering the High threshold makes differences more (background), which is exactly what we need. The default is already set very low for the High threshold, so we may actually want to make a few of those pixels more opaque.

- Increase the high threshold slightly to create a good balance between soft edges and a more sensitive edge detection. Here, 0.6 looks good.

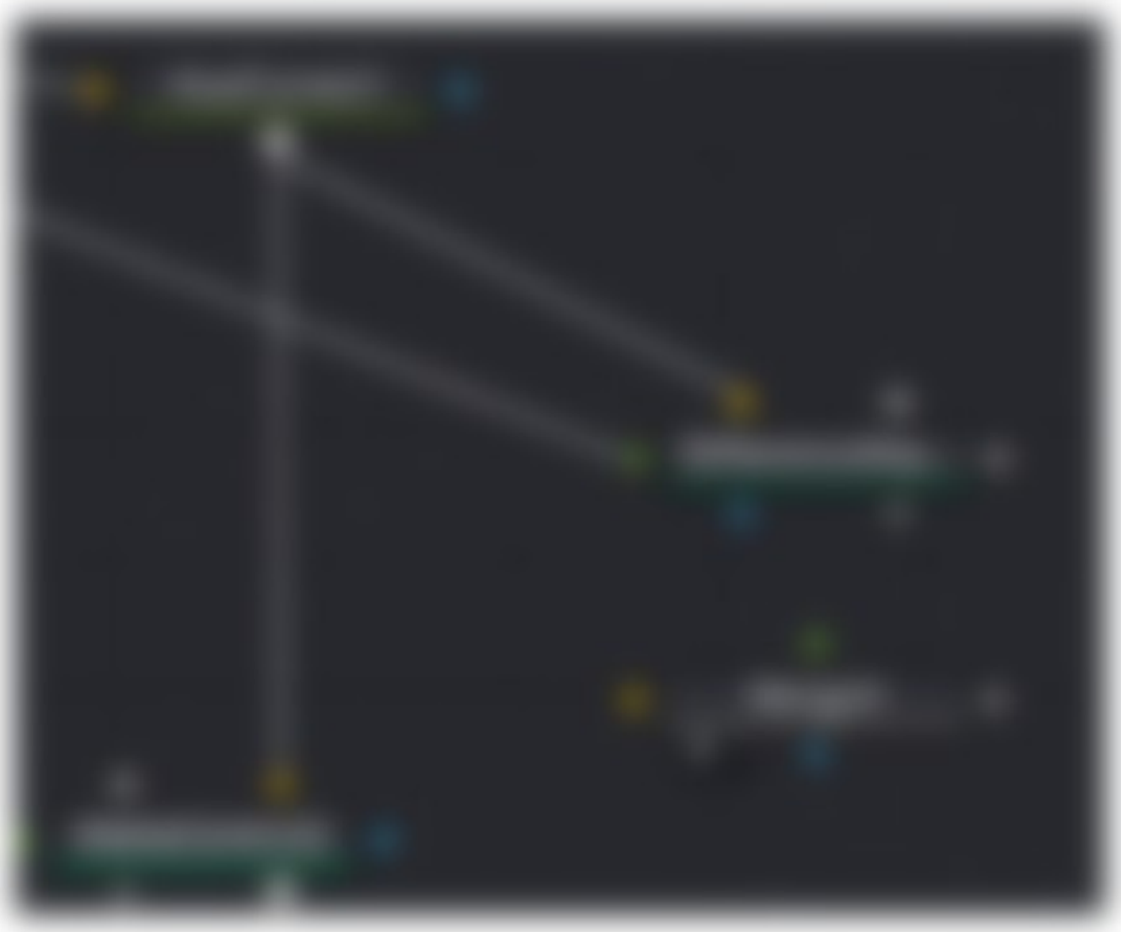
- Once we have this mask, we'll blur it so the light wrap blends smoothly around the edges of our subject, making the composite look more natural.

- Increase the Blur.

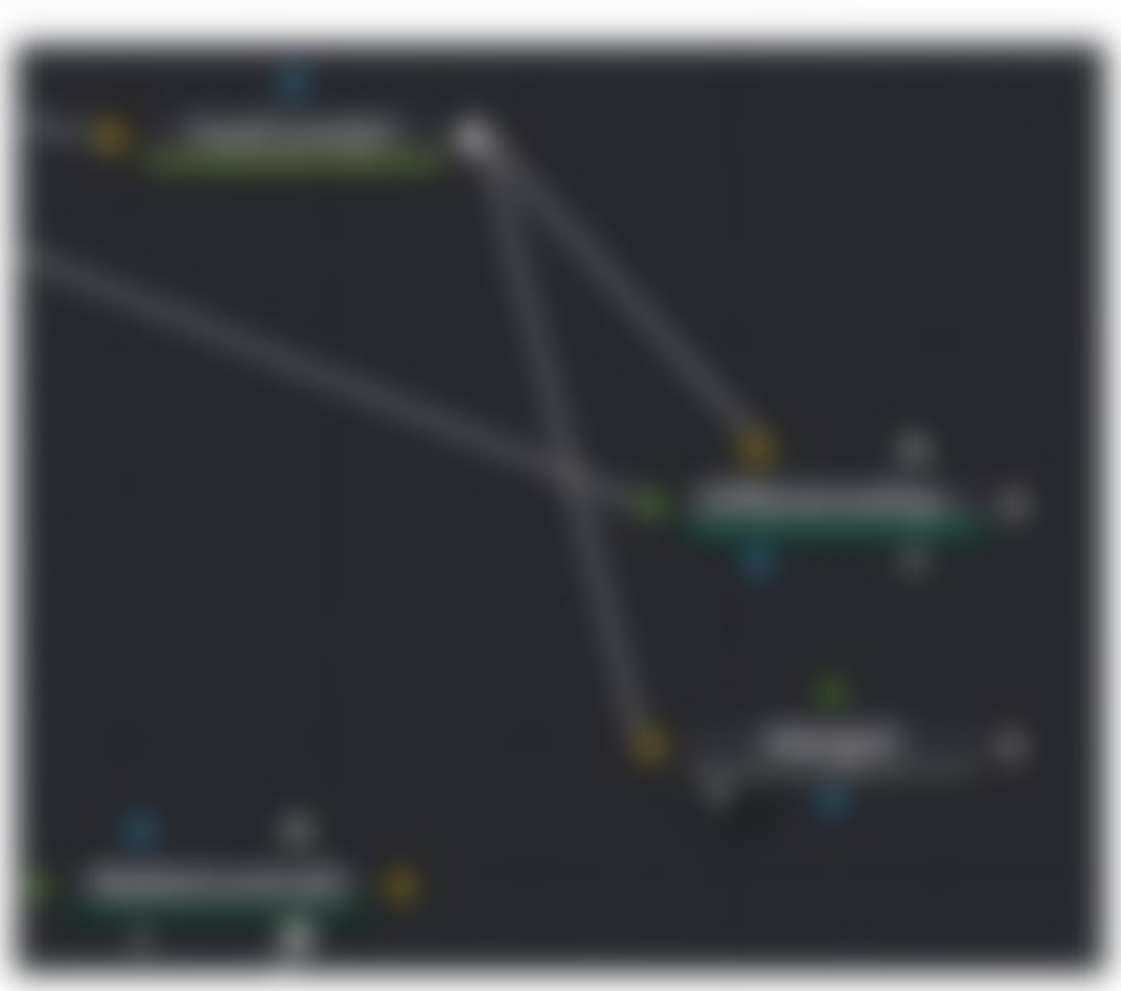
- This is now the mask we will use to create soft white our actors in the ca

- Click in an empty area of the node graph under the Difference layer.

- Press SHIFT-Spacebar to add a Merge node and press 1 to see it in the viewer:



- Click in viewer 1 and press A again to change from viewing the alpha channel to viewing the RGB image.
- Disconnect the output of the Text 1 (Time) from the Matte Control2 and drag it into the yellow background input of the Merge1:



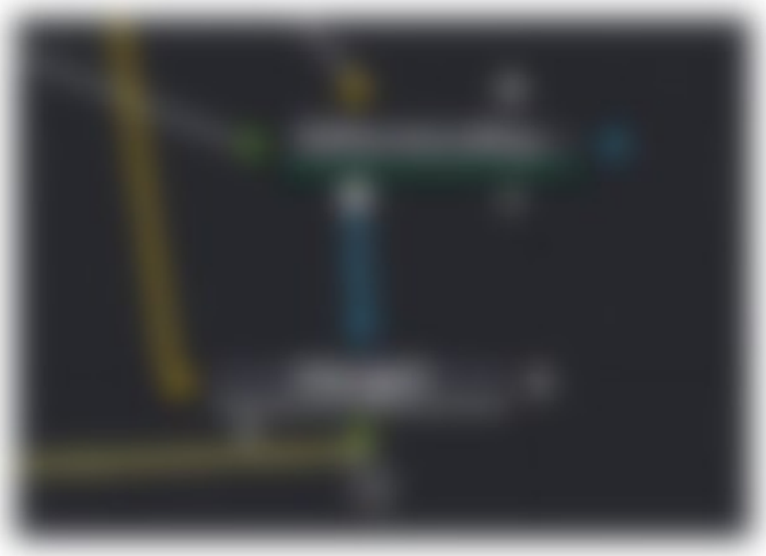
- Drag the output of the Difference layer 1 node to the blue mask input of the Merge1 node.

You now have a foreground, which, in our case, is the road clip since that is where the natural split should be coming from. However, connecting the road clip directly would be harsh, and split light isn't harsh, so we need to blur it prior to connecting it to the Merge1 node.

- Click somewhere near the Merge1 node, and from the toolbar, click the Blur node.

- Drag a second output of the Blur1 node to the green foreground input of the Merge1.

- Drag the output of the Blur node to the green foreground input of the Merge1.



- Select the Blur1 node and increase the blur size by 20%.

  The final part will be to combine the Merge2 with our clean Delta Keyer foreground and then onto the Merge1 node for our (almost) completed composite.

- Drag the output of the **Merge2** node to the yellow background input of the **Matte Control2** node.

You now have a very convincing composite of our actors driving along a road. In some cases, you could send this off to the color page and grade it. However, sometimes you'll be asked to make it even more realistic by adding the road reflection on a front windshield. Occasionally, this can be distracting as in our case, but we will learn how to do it anyway.

Creating a 3D Windshield Reflection

Now that we've refined our key, it's time to add a realistic reflection to the car's windshield. To achieve this, we'll use Fusion's 3D environment, combining a separate clip of our road with a Camera3D and a Shape3D to create a reflective windshield surface. This setup allows you to expand your newfound knowledge of Fusion's 3D tools without going too deep too quickly.

- Select the **Merge2** node and add a **Merge3** node directly after it.

This merge will be used to composite the windshield reflection over the top of our existing composite. We will build the windshield reflection in 3D and integrate this 3D composite into our 2D composite.

- Select MergeX and press C to see it in the viewer on the right.
- Click in an empty place above the MergeX and then add a MergeLDI node.
- After the MergeLDI node, add a NewScene 3D, and then connect it to the MergeX node's green foreground input.

This is a basic setup when combining a 3D scene into a 2D composite. Whatever you build in your 3D scene, represented here by the MergeLDI node, gets rendered into 2D using the NewSceneLDI node. For our 3D scene, we'll use a 3D shape to roughly match a current windshield shape.

- Select the NewSceneLDI and press T to see it in the viewer.
- Press Shift-Spacebar and add a ShapeLDI to the node graph.

The ShapeSD node can be used to create several 3D primitive shapes, such as spheres, cubes, and cylinders. It starts as a simple plane, similar to the Image plane you used in the previous lesson. We will change that shape to a sphere and then modify the sphere to look more like a semidefinite.

- In the Inspector, choose Sphere from the Shape menu.

  Our 3D scene has no lights, so our sphere appears very flat. However, we can enable lights in the viewer to get a sense of the sphere's size and roundness.

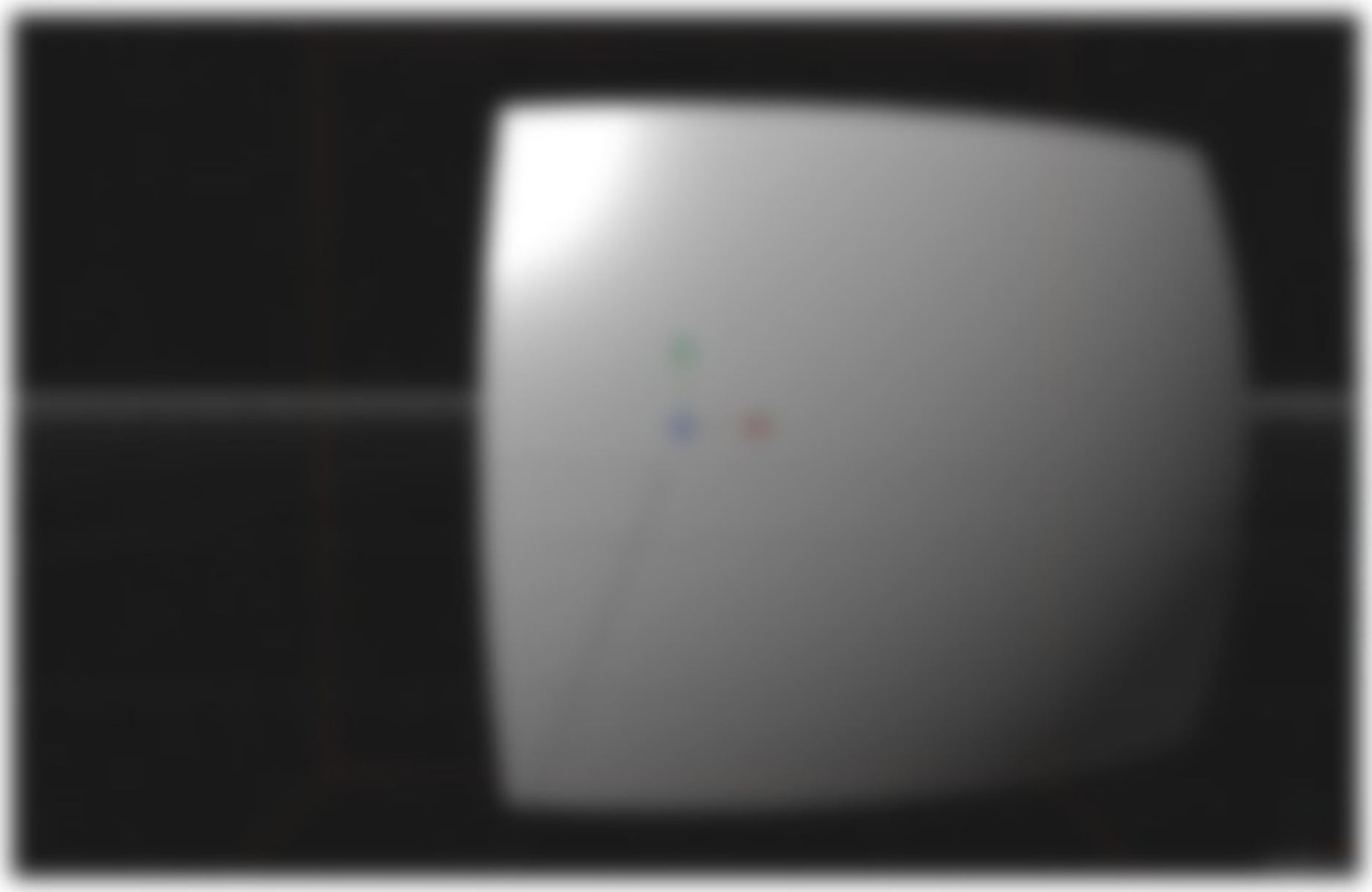
- Select the ShapeSD node, and in the Inspector, click the Enable Lighting checkbox. Then, above viewer 1, click the Shading button to enable default lighting and shading.

To simulate a semidefinite, we don't need a complete sphere, we need a cropped section of a sphere. The Angle and Latitude parameters can be used to crop the horizontal angle and vertical latitude coverage of the sphere shape.

- Select the ShapeSD node, and in the Inspector, drag the Angle float to around 90, and the End parameters to around 180.

The result is a half sphere, or hemisphere. We'll use the latitude to trim the hemisphere so it doesn't have caps on the top and bottom, making it more like a semidefinite.

- Drag the Latitude End to -20 and the Start to -30



The actual numbers we use will change when we compose this over our live action composite so that we fit the actual establishment in the clip perfectly. For now we'll use these values.

Auto Stabilizing in the Edit Page

To create a realistic windshield reflection, we need to stabilize the input clip to remove any unwanted camera shaking from affecting the reflection. Since it's a long shot with continuous motion, point and planar tracking methods in Fusion aren't ideal. Instead, we can take advantage of Centre Resolve's Auto Stabilize in the edit page.

1. Switch to the edit page

Now that we have access to the two clips that make up our composite, we can edit a copy of the road, stabilize it, and reverse it.

1. Select the road clip on video track 1 and press the F key to match frame the clip to the end in viewer.
2. Double-click the Tilt control in the lower left corner of the timeline to return to the main timeline.

3. Move the playhead before the beginning of the timeline.
4. Press CTI or click the Overwrite edit button in the toolbar.

- Right-click over the newly added clip and choose Change Clip Speed.
- Click Reverse Speed and then click the Change button to close the window.

- In the Inspector, open the Subtitle parameters, increase Smooth to 10, and then click Subtitle.

The stabilization takes a few seconds to analyze, and the result is a smooth, level-out clip of driving down the road. But the trick is getting this into the Fusion page so we can use it as a Media In node.

- Right-click over the clip again, and this time choose Render in Place.

  Render in Place is typically used to render and bake in all effects that are applied to a single clip on the edit page timeline for performance reasons. However, a side benefit is that it also places that rendered clip in the media pool so we can access it in Fusion.

- In the Render in Place window, enter the city name as **Saddleback Road**.
- Select either ProRes 422(HQ) or DNxHR HQ.

  Either of these codecs is reasonable enough quality to work for our reflection.
- Click the Render button and select a location for the media file. Be sure to make it easy to find so you can delete it quickly after finishing this lesson.

  Once the rendering is complete, you'll see the Saddleback Road clip in the currently selected media pool bin. Now we can return to Fusion and use it in our workflow reflection.
- Move the playhead over the Fusion clip and switch to the Fusion page.
- Open the media pool and drag the Saddleback Road clip you created to the Route Editor over the MergeEXR node.

You could hug the Saddleback video directly onto the ShapeEXR, but using 3D projection mapping will create a more realistic windshield reflection.

Projection Mapping

3D projection mapping works like a real world projector, making the reflection naturally warp and blend with the glass. In Fusion, you can use either a ProjectionEXR or a CameraEXR node for projection. While ProjectionEXR offers more controls, CameraEXR is simpler to set up.

1. Select the MetaHuman node and add a CameraLED node to it.

2. Drag the output of the MetaHuman node to the CameraLED node's pink image input.
3. Select the CameraLED node, and in the Inspector, switch to the Image tab and double Enable Image Plane.
4. Switch to the Projection tab and then click the checkbox to Enable Camera Projection.

The camera isn't positioned in front of the Dragon3D, so the shape will turn black since we essentially have the "projector" behind the screen facing away.

3. In the Image Texture node, drag the Z "rotation parameter to the right until the Dragon3D is completely covered with the Stainless Steel .hdr in shader 1.

At this point, we need to return to the Dragon3D and make sure it covers the area where the windshield would be in the live action shot.

4. Select the Dragon3D node in the Node Editor.
5. Increase the angle parameters so the reflection covers the live action windshield area displayed in viewport. roughly 30-50.

- Change the End latitude to around -10 and the Start latitude to 10 so the height of the reflection covers the top and bottom of the translucent windshield area.

You now should have a proper box that covers your translucent windshield. So the final two steps in this comp will be to add a simple mask to shape the projection to the windshield area and do some final blending. Luckily for you, we've created this simple mask to save you some time.

- In the media pool Media bin, drag the Windshield_Color_Key into the Node Editor next the Merge1 node.
- Drag the output of the Windshield Node to the blue effect mask input on the Merge1 node.

- Select the Merged node, change the Apply mode screen, and leave the Blend value as you see fit to create a realistic effect.

With the scratched effect now seamlessly integrated, your composite is complete. Feel free to go back and explore changing some of the values we've used. Throughout this lesson, you've gone beyond basic keying by refining a core and edge matte, handling spill suppression, separately, and using 3D scene from mapping to add realistic reflections. These advanced techniques ensure your subject blends naturally into the scene, creating a much more polished result.

Completed node tree for Lesson 2

Lesson Review

1. True or False? The Delta Keyer can handle both matte creation and spill suppression.
2. What happens when you set the Delta Keyer's Color Replace mode to "Source"?
   a) The keyer removes green spill automatically.
   b) The original colors from the source clip are used, leaving green areas unchanged.
   c) The alpha channel is inverted.
   d) The brightness of the keyed subject is increased.
3. True or False? A light wrap helps blend the foreground and background by overlapping the edges of the keyed subject with the colors of the background.
4. What is the advantage of using a Camera3D node or Projection3D node instead of directly mapping a texture onto the Shape3D primitive?
   a) It warps the reflection naturally based on the glass curvature.
   b) It creates a sharper image.
   c) It makes the reflection brighter.
   d) It removes the need for a 3D scene.
5. When setting up a Camera3D node for projection mapping, what must you enable?
   a) Depth of Field
   b) Ambient Occlusion
   c) Camera Projection
   d) Increase Z Translation

Answers

1. True. The Delta Ilegal can handle both matte creation and spill suppression.
2. b) The original colors from the source clip are used, leaving green areas unchanged.
3. True. A light wrap helps blend the foreground and background by overlapping the edges of the keyed subject with the colors of the background.
4. a) It warps the reflection naturally based on the glass curvature.
5. c) Camera Projection.

Lesson 3

Creating a Rainy Day

Transforming a tranquil sunny day into an ominous rainstorm is a quintessential challenge that showcases the power of visual effects. In this chapter, we'll craft a haunting atmospheric scene using a 3D camera, Fusion's Magic Mask node for precise element isolation, and dynamic 3D rain particles to breathe life into the storm. Fusion's ability to seamlessly blend 2D footage and 3D elements ensures that the process is intuitive and flexible, allowing for natural and cohesive results.

Time

The lesson takes approximately 1 hour to complete.

Goals

Blending 2D and 3D Elements Together for a Realistic Environment 42
Magically Creating a Mask 47
Adding Reflections 49
Connecting Color in Fusion 49
Generating 3D Particles 51
Lesson Review 57

By blending technical precision with a bit of your own creative flair, you'll begin to learn how to blend 2D images and 3D scenes, use Fusion's Magic Mask node to isolate objects and integrate 3D particles that match live-action camera moves, and in the end, seamlessly shift the mood from serene to foreboding - all while maintaining the illusion of cinematic realism.

Completed composite from Lesson 21

Merging 2D and 3D

As you discovered in the previous two lessons, compositing in 3D allows for complex effects, like adding depth to flat images or projecting onto 3D shapes. To take that a step further, combining 2D live-action and 3D in visual effects compositing enables the creation of seamless, multidimensional visuals that enhance the realism and impact of a scene. Before we begin, let's look at the shot we will work on.

1. Open DaVinci Resolve 20 Studio, right-click in the Project Manager, choose Restore Project Archive, select the Fusion 20 03 Complete.drp file, and then open the project.

3. From the Timelines bin, load the Lesson 4 Path1 timeline and play the clip in the timeline, which shows the man running onto the road.

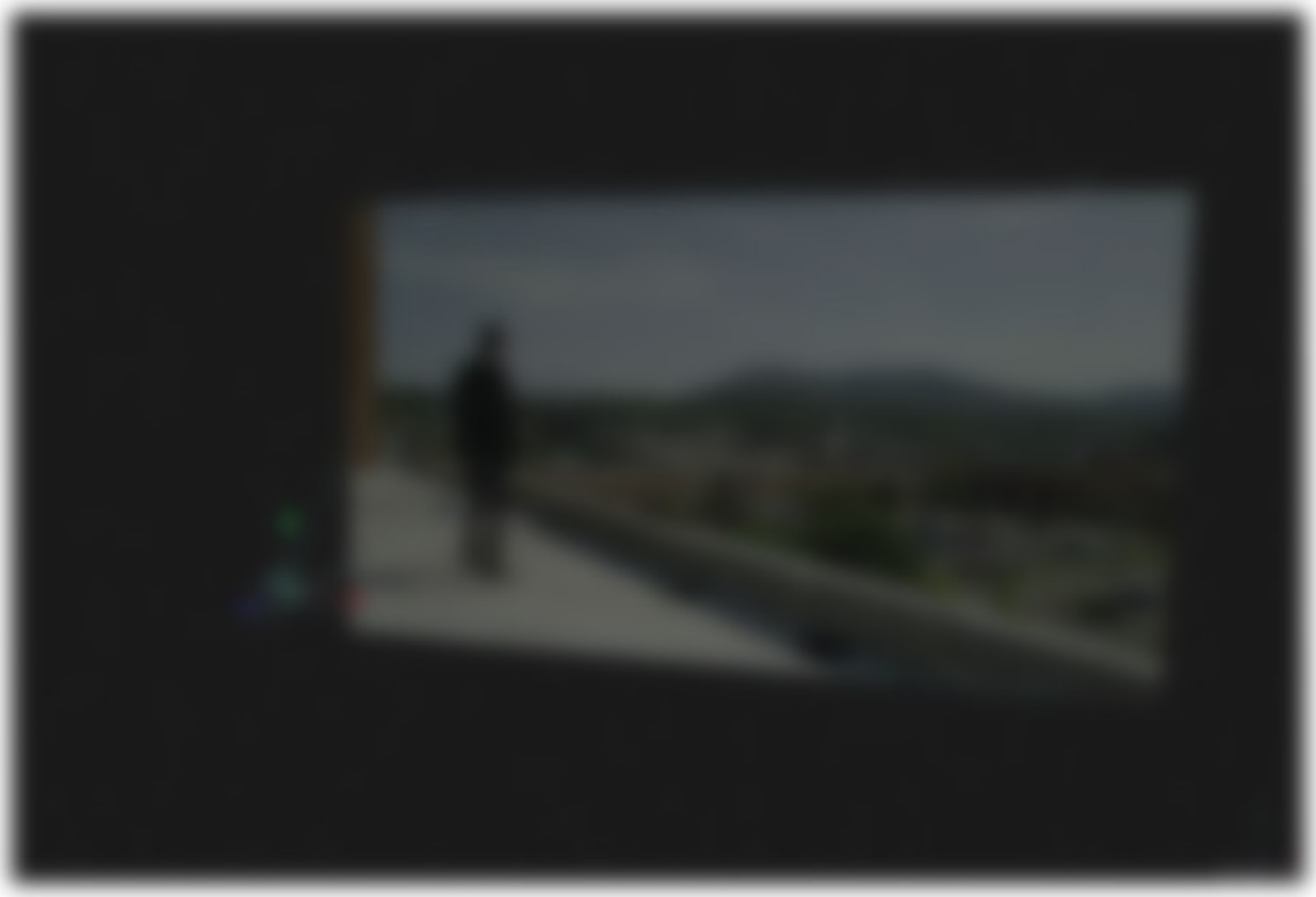
The clip was shot on a reasonably clear, sunny day, but we must turn into a rainstorm. One thing you should notice is the subtle camera move. When integrating other elements into a live action shot, as we must do here, we need to re-create the camera's motion and apply it to any elements we integrate into the shot so it matches the live action.

> **NOTE** If you're using the free version of Optitrack Resolve, you will receive a warning when you restore the archive for this lesson. You can continue with the lesson; however, some exercises require Optitrack Resolve Studio, so you will be advised to skip those steps.

4. Position the playhead over the clip in the timeline and enter the Fusion page.

The clip already has a small incomplete Fusion composition with a couple of nodes that give us a head start.

- Select the Merge 3D, press `T` to see it in viewer `1`, and use the Time ruler to scroll through the render range.



This scene already contains a 3D camera whose animation perfectly matches the movement of the live action camera. This match was achieved using Fusion's 3D Camera Tracker, which analyzes the live action footage and re-creates its precise motion using the CameraSD node. We'll dive deeper into the 3D Camera Tracker in the next lesson, but for now, it's key to understand that the 3D camera in this composition mirrors the live action movement and allows us to seamlessly integrate a CGI fly into the scene while maintaining perfectly synchronized motion.

- Disconnect the MediaIn1 node from the CameraSD node since this was only connected as a visual aid.
- Open the media pool in the upper left corner of the Fusion page and select the Action 473 Media bin.

3. Drag the StartHCloudA image to an empty area of the Node Editor near the MergeAll node and rename it **StartHCloudA**.

As you learned in the previous lessons, to connect a Blueprint node to a MergeAll node, we must connect it to an Image Plane first.

4. Select the StartHCloudA node, press Shift-Spacebar, search for ImagePlaneSS, and add it to the Node Editor.

5. Connect the ImagePlaneSS to the MergeSS node.

When we performed the 3D camera tracking for this scene, we decided the scale

- Select ImagePlane3D and push the image plane back in the Inspector by 300 meters using the Z translation parameter.

  For these clouds to be truly over the town in our shot, 300 meters seems to be a good distance.

- Use the scale parameter to increase the size of the clouds to 2000.

As in the previous lesson, to convert the MergeEXR scene of the stormy sky back into a 2D image, we need to add a RenderedEXR node.

- Select the MergeEXR node, press Shift-Spacebar, search for RenderedEXR, and add it to the Node Editor.
- Select the RenderedEXR and press 7 to see it in viewer 1.
- In the Inspector, set the Camera to Camera3D1 and the Render Type to Hardware.

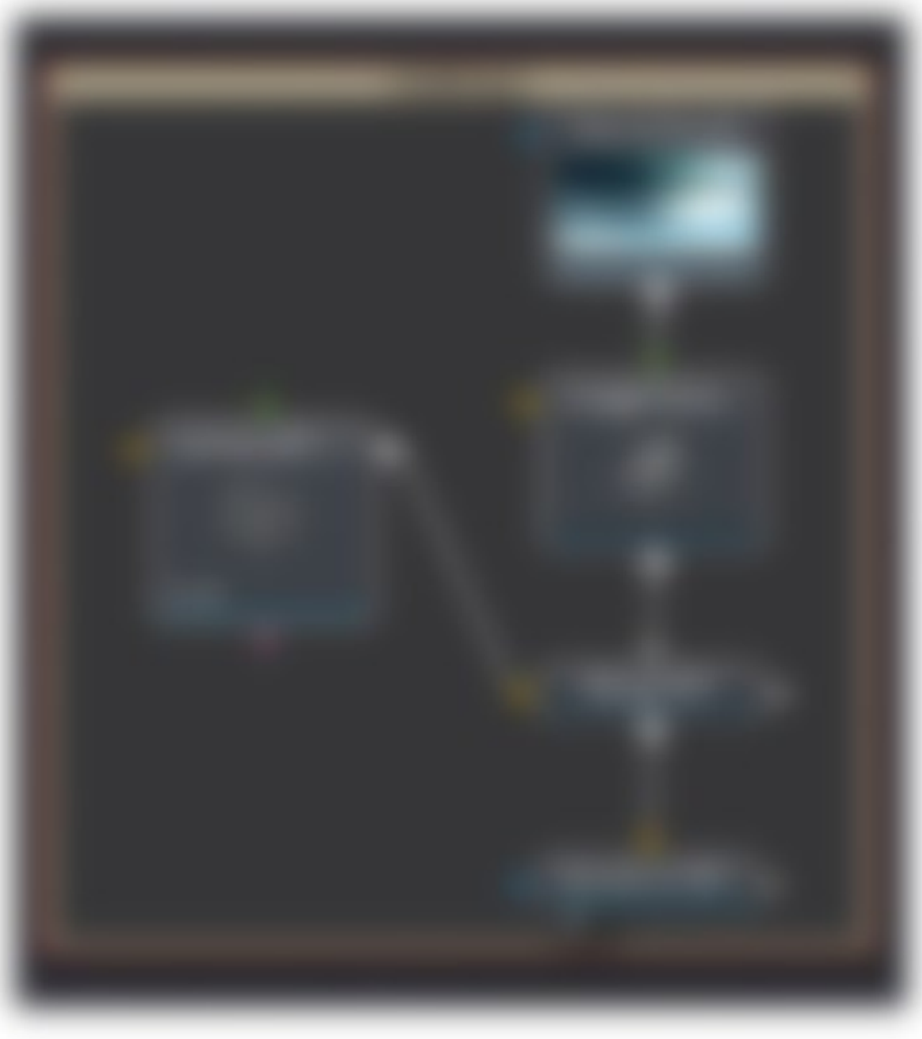
  You now have the stormy sky that matches the camera move found in our live-action clip. Your job now becomes a simple sky replacement. However, this will be a rather large comp, so before we create our sky replacement, let's add some organization so we can keep track of what each group of nodes is doing.

1. Drag a selection rectangle around the CameraSDL, ImageParamSDL, BarrelDistortion, MergeSDL, and RenderersSDL nodes.

2. From the Effects Library, select the Tools > Flow category.

   The Flow category contains two tools that are not operational nodes that affect your composition but rather tools that help organize the node graph or "flow." One is a Sticky node, which can be used as a reminder just as you would use sticky notes in the real world. The other is an Underlay. The Underlay tool works as a visual organizational tool, especially in large node graphs. The Underlay node acts as a background layer to visually group related nodes. It doesn't impact the composition but helps organize workflows by clearly delineating sections of the node tree.

3. In the Effects Library, click the Underlay tool to add it to the Node Editor.



The Underlay surrounds the selected nodes, visually grouping them together. You can give the Underlay a name (and change its color), making it easier to see what the groups of nodes are doing in your composite.

- Click in an empty area of the Node Editor to deselect all the nodes in the Node Editor.

Right-clicking over the Underlay title will select all the nodes contained within its boundaries. This is great for moving the group around the Node Editor but not ideal when you just want to rename the Underlay. So we must use a modifier when renaming or editing the color for the Underlay.

- Hold the Option key (Alt/Ctrl) or the Alt key (Windows) and then right-click over the Underlay title.
- Choose Rename from the menu and enter **sky** as the new Underlay name.

The RenderedID node is the essential step in converting your 3D scene into a 2D image which can now be used like any other 2D image for further compositing. We can now take our newly moving sky and composite it into our live action clip for a sky replacement.

> **NOTE** Backup versions are available in the Timelines > Backups bin for different stages of the project.

Patching Together a Sky Replacement

You may already be familiar with the basic steps for sky replacement from the Visual Effects Guide to Cinema Resolve 2019 in the Blackmagic Design Learning Kiosk series. Here, we'll use a formula similar to the one taught in that book. First, we'll merge the live action shot with the new sky and use an Apply mode to get a good blend of the two images.

1. Drag the output of the RenderedID node to the output of the Roofing node to create a Merge node.
2. Select the Merge node and press [illegible] to see it in viewer 1.

3. In the Inspector, set the Apply mode to Darken.

The Darken Apply mode is particularly useful for this sky replacement because it prioritizes darker pixels. Only the darker parts of the new sky (foreground) replace the rooftop (background), allowing natural gradations and avoiding harsh edges. However, it also affects our rooftop and our actor, which we need to fix.

Importing with Loaders

We will use masks to fix the problematic areas of our darkened sky replacement. These masks are not currently linked to our media pool. Rather than switching to the media page, linking in the masks, and then bringing them into the Fusion page, we can use Fusion's Loader node. If the content you are bringing in is sequenced EXR files, then the Loader node can be an efficient way of importing clips into Fusion directly, bypassing the media pool.

> **Note** The content imported using Loaders in the Fusion page will not be contained within DaVinci Resolve Archives. You must back up Loaders manually.

1. Click in an empty area of the Node Editor to the right of the Sky underlay.
2. Press Shift-Spacebar, type **Loader**, and add the Loader node to the Node Editor.

   When you add a Loader node, it automatically opens a dialog for you to navigate to the EXR sequence you want to import.

1. Navigate to the DNSE Studio Fusion 3D Training Media > Fusion Files > Models > Bricks folder, select the first [illegible] file, and click Open.

   The Brickwall2 mesh is loaded as a node named Bricks. A nice side benefit of using a Loader node is that the node is renamed automatically.

2. Add two more loaders to import the Town and Roof meshes.

   You can look at each mesh in the viewer. There are different parts of our shed that need to be protected from the Darken Apply mode. Instead of having you spend your time drawing and animating masks, we've created these for you. You just need to learn how to construct the node graph and put them to use.

3. Select the Merge1 node in the Node Editor and press Shift-Spacebar to add a second Merge node to the Node Editor.

4. Click in an empty area of the Node Editor below the loaded mesh nodes.

5. Press Shift-Spacebar and type [illegible]

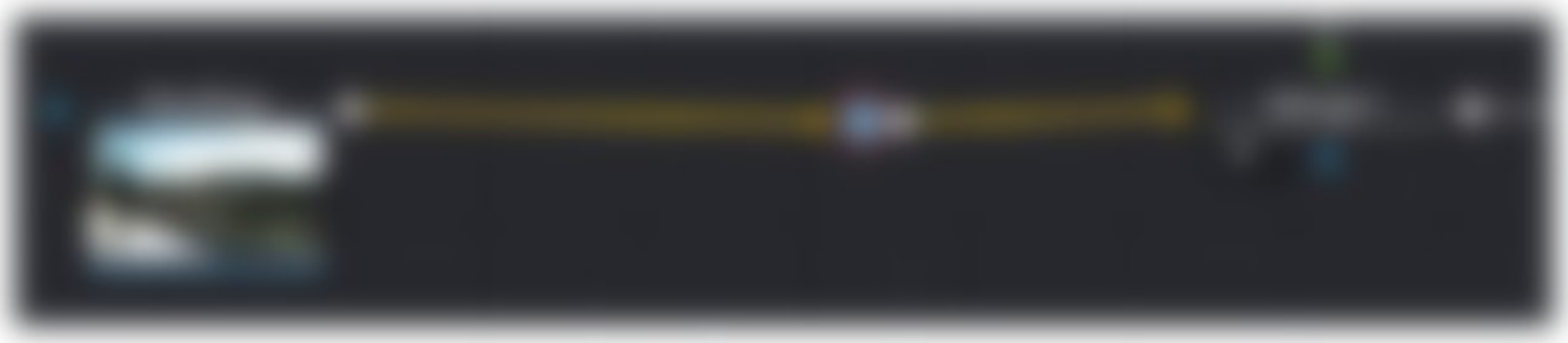
   [illegible] is the shortcut for a MultiMerge node. The MultiMerge allows us to connect more than just a background and a foreground. As the name suggests, we can connect a background and multiple foregrounds. Since we are just combining all the meshes, it doesn't matter which of our meshes goes into which input on the MultiMerge.

6. Add the MultiMerge to the comp and connect the three meshes to the MultiMerge node.

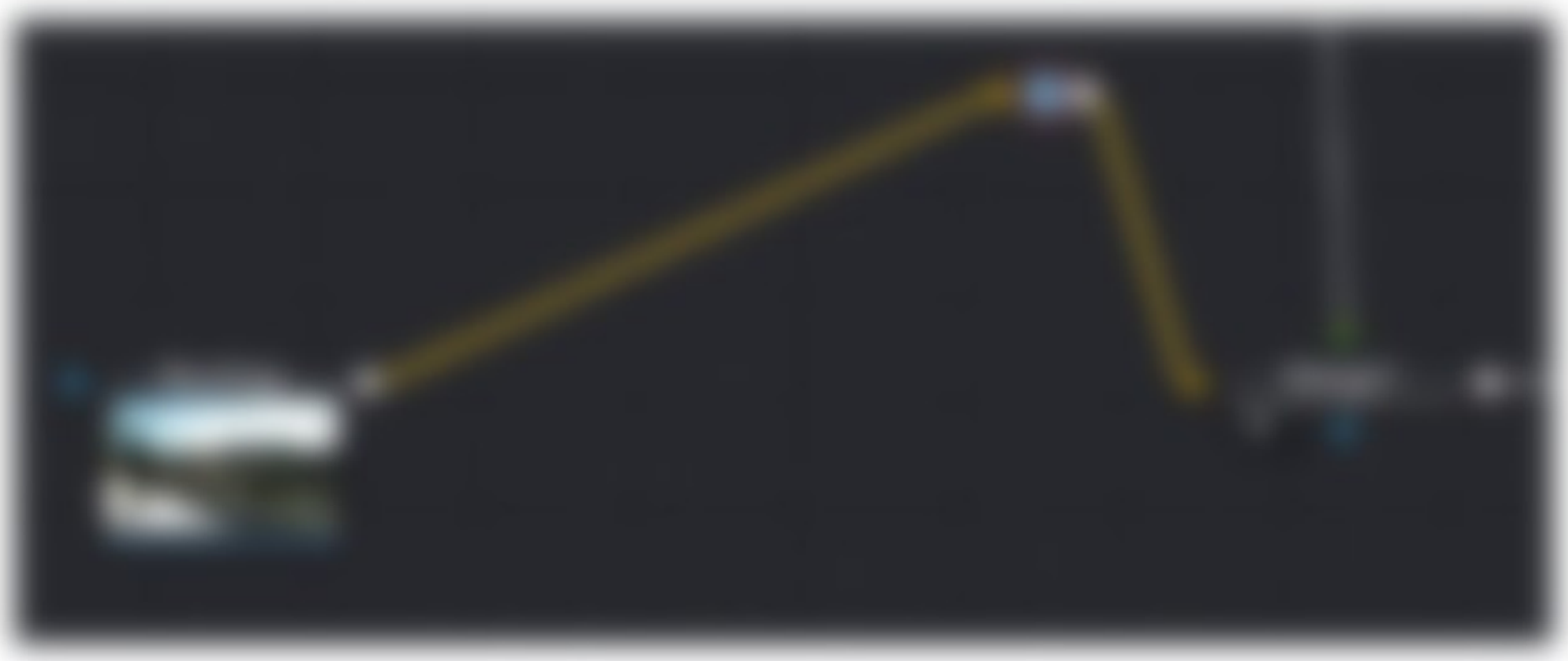
   To put Brickwall mesh into the rooftop, we need to use a Matte control.

1. Click in an empty area of the Node Editor under the MultiMerge node, press Shift + Spacebar, and type **Mask** to select and add the Matte Control to the Node Editor.
2. Drag the output of the MultiMerge to the green foreground input of the Matte Control.

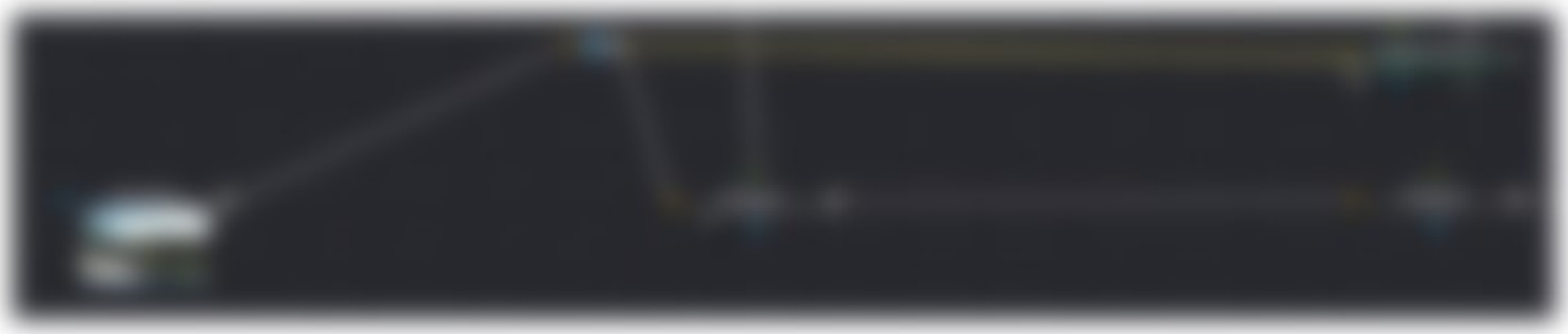
   We will now connect our roaDTag to the background input of the Matte control. However, to streamline and manage our growing node graph, you can add an elbow that can make the graph easier to navigate.
3. Midway along the pipe connecting the RoaDTag to the **Merge1** node, hold the Option key (macOS) or the Alt key (Windows) and click the pipe to add a Router.



   Routers allow you to bend and split node connections around other parts of the node tree, preventing pipes from crossing over nodes or creating visual clutter.
4. Drag the router just above and to the left of the **Merge1** node.



5. Drag a second output from the router to the yellow background input on the Matte control.



5. Select the Matte control_prep.1 to view it, and in the Inspector, set the Combine menu to Combine Alpha.

6. Lastly, since our Merge node expects pre-multiplied alpha channels, check the Post-Multiply Image checkbox.

You've now copied the alpha channel from the matte to the rooftop background image so it can be used as the new foreground for our Merge1 node.

7. Drag the output of the Matte Control to the foreground input on the Merge1 node.
8. Select Merge1 and press 1 to view it.

The sky replacement is starting to come together. If you look closely at the top half of our actor, you will see some darkened sky coming through around his head. We need to create a mask for him to prevent this bleed through, but instead of taking the time to draw a mask and manually rotoscope it, Fusion includes an AI called Magic Mask.

Magically Creating a Mask

The Magic Mask node uses the DaVinci Neural Engine to quickly isolate objects in an image. It performs a frame-by-frame analysis of the footage, and then creates a mask for the object you've drawn strokes on. It can save you a lot of time creating a mask for our actor rather than using polylines and rotoscoping.

- Click in an empty area near the RunRags clip in the Node Editor.
- From the Effects Library, choose Tools > Matte and then click Magic Mask.

> NOTE: Magic Mask is only available in DaVinci Resolve Studio. To continue with this lesson using the free version of DaVinci Resolve, use a powder to add the rendered Magic_Mask.CMP sequence to the Node Editor near the RunRags node. Then skip to step 3 in "Tweaking the Magic Mask" later in this lesson and continue.

- Close the Effects Library to give the two viewers more working space.

  Just as with green screen keying, it's useful to have two viewers when using the Magic Mask tool. We'll set up the left side to show the original image, making it easy to draw our strokes, while the other viewer will show our mask as it gets passed together with each stroke.

- Drag an output from the RootPlug clip to the input of the Magic Mask node.
- Select the RootPlug clip and press 1 to see it in viewer1, and then select the Magic Mask node and press 2 to see it in the right viewer.

  The first stroke will be a single short stroke drawn down across our actor's head and torso. You are not tracing the subject; you are identifying what features belong to the subject, so you want the stroke to be well within the subject's boundaries.

- Press Shift-Right Arrow to move the playhead to the end of the render range.
- In viewer 1, draw a short stroke from the actor's hairline down his white shirt.

The area you drew over appears in viewer 2 as the start of your mask. Much of our actor is missing, so we clearly need more strokes. Draw over areas that need to be connected, such as his hand and his coat sleeve.

3. Draw from the hand that is down by his side up his coat sleeve.

Tip: If a stroke makes the mask worse or does nothing to add to the mask, you can delete it by first clicking the Select button in the toolbar (or holding the Shift key, drawing a selection rectangle around the strokes, and then clicking the Delete button in the toolbar).

Using too many strokes with often causes more problems than it solves. Use as few strokes as you can to get an accurate mask.

4. Draw from the cuff of his coat down to his leg.

3. Run two strokes within the frame to be added to the tip of the shoe.

The frame you use to initially draw your strokes is called the reference frame. The reference frame is the starting point for the Neural Engine to understand the subject's shape, edges, and motion. Every frame is analyzed based on the information derived from the reference frame.

> **Tip** Two Neural Engine options appear at the top of the inspector. Faster lets you generate a lower quality mask more quickly, suitable for garbage matting. Better generates a higher quality mask with more detail and softer edges, but it is more processor intensive.

4. In the masking process, you can see the results of the mask in viewer. Channels are shortly after you begin. around frame 160 in an . Channels, seam, or holes will appear in the color of the shirt. Strokes can be added in Magic Mask in the middle of the clip, but it will invalidate portions of the existing mask. If you notice occasional issues like flickering, seam, or holes, you can additively paint by drawing a new stroke to cover the error and tracking backward or frame by frame over those problematic sections.

5. From the end of the render range, drag backward in the timeline. Later until you arrive at the first frame where you see a hole in the collar.

- If a hole appears on the collar as you trust backward, draw a single line over the collar where the hole appears and continue tracking single frames backward until around frame 30.
- Around frame 30, click Trust Reverse to finish the clip.

> **Tip** Adding new strokes over already tracked areas will invalidate prior strokes and will require you to track a portion of the clip again.

Finessing the Magic Mask

After you have finished tracking the matte, the Magic Mask's Inspector also includes several matte refinement parameters you may be familiar with from other keying and matte tools in the Fusion page.

1. In the Inspector, click the Matte tab.

   Most of the controls in the Matte tab, like the Gamma, Threshold, and Restore Fringe parameters, will be very helpful when you have resolved or unresolved semitransparent edges. However, our edges have no semitransparency but do have a fringe outline, so using the Erode Dilate parameter can help.

> **Tip** Adjustments in the Matte tab are best made by dragging the value display rather than the slider. The value display provides a much more granular adjustment.

2. Drag to a frame in the clip where you clearly see the mask on the roof.
3. Set the Erode Dilate to -0.007 to shrink the matte slightly and remove the outline fringe.
4. Increase the Blur amount to 0.3 to soften some of the jagged edges.

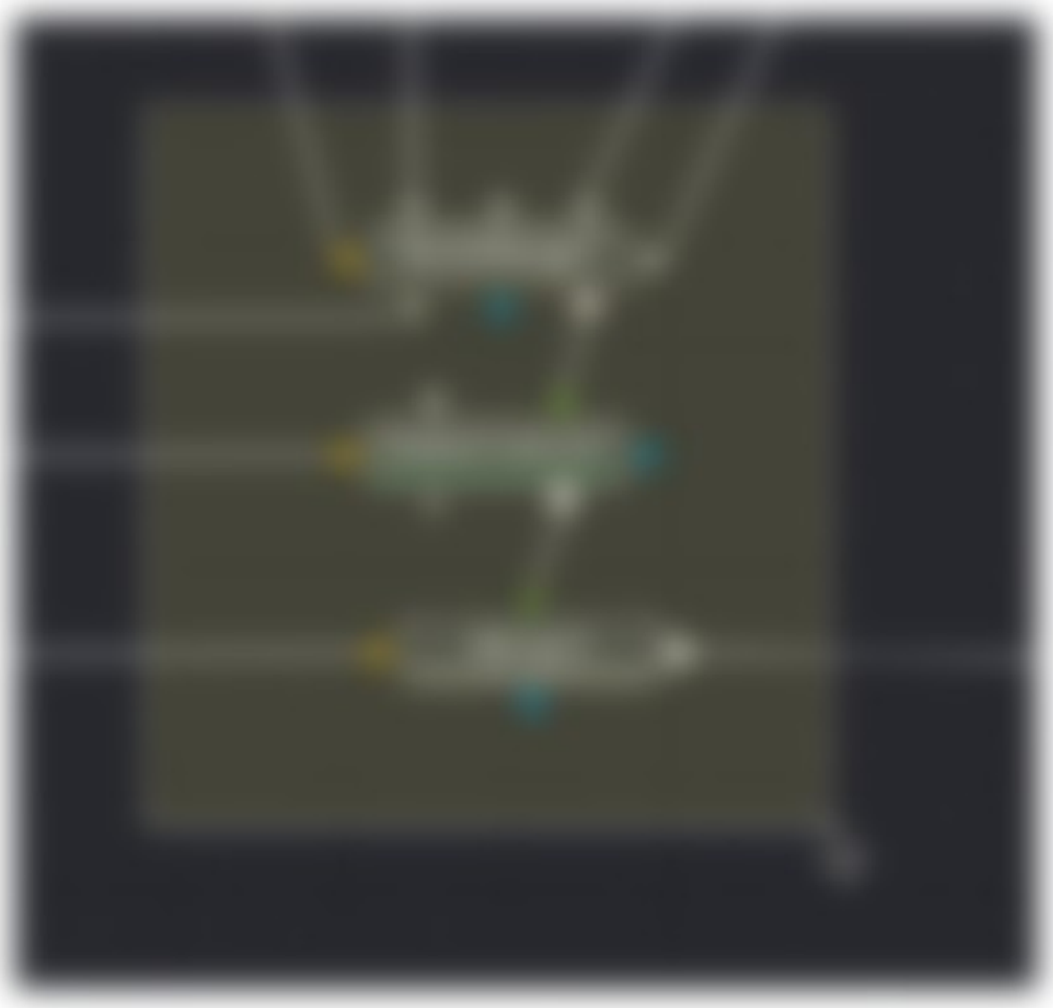
3. Drag the output of the **Magic Mask** to a white layer input on the **MultiMerge** node.

> **TIP** Magic Mask tracking data is stored in your Cache folder to increase performance. If you move a project from another computer and do not bring the Cache folder in the archive, you must regenerate the cache files using the **Regenerate All** button in the Inspector. You can locate these files by right-clicking the **Regenerate All** button and choosing **Show Cache Folder**.

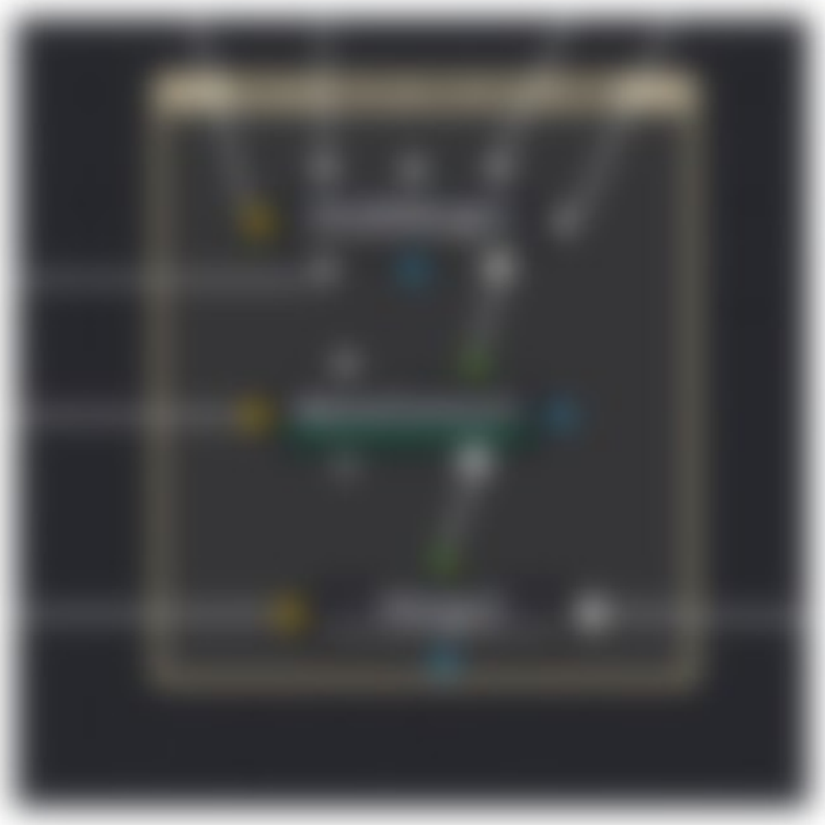
4. If necessary, select the **MaskedOut** node and press `1` to view your composite in the viewer.

   To finish, we will again add some organization to our node graph using another Underlay.

5. Drag a selection rectangle around the **MultiMerge**, **MaskedOut** node, and **Merge2** nodes.



- Press Shift-Spacebar, type **underlay**, and press Enter or Return to add an Underlay around the selected nodes.
- Click in an empty area of the Node Editor to deselect all the nodes in the Node Editor.
- Hold the Option key (macOS) or the Alt key (Windows) and then right-click over the underlay box.
- Choose Rename from the menu and enter **Vertical Enhancement** as the new Underlay name.



You've achieved great results using Magic Mask, but as with every tool, there will be times when the results are not perfect. In those situations, don't be afraid to use multiple tools. The Magic Mask might work great as a well-fitted garbage mask, and then you can revert to rotoscoping or paint to finesse the difficult areas.

> 💡 If you stopped reading the Magic Mask and opted to use the rendered Magic Mask from the Fusion Clip folder, you'll need to use a Blur and an Enable/Disable node to correct the mask.

Adding Reflections

If the ground is meant to be wet, it would have reflections on it. It's not difficult to add reflections with a few nodes and some quick keyframing.

1. From the toolbar, drag a Transform node to an empty area to the right of the BlockMerge.

2. Drag a new output from the BlockMask node to the Transform (use a router to make the node graph more organized as you see fit).

3. Select the Transform node and press `T` to view Xform points in the node graph.

4. Move to the last frame of the render range in the time ruler.

   For this particular shot, I will be easiest to begin at the end of the render range where our actor is onscreen.

5. With the Transform node selected, in the Inspector, click the Flip Horizontal button.

- Set the `T` parameter to around `0.7`.

  We'll need to align the reflection in the transform with the original rooftop image using a **Merge** node.

- Select the **Merge2** node, press Shift-Spacebar, type **merge**, and then add the **Merge** node to the node graph.

- Drag the output of the **Transform** to the **Background** input on the **Merge2** node.

To blend the two images, we'll use a combination of the **Screen** apply mode, which will cause the darker parts of the **Tipped** rooftop **Background** to replace the original rooftop background, and then we'll lower the opacity for the **Tipped** foreground.

- With the Merge3 selected, in the Inspector, set the Apply mode to Darken and lower the Blend slider so it appears more like a reflection.

Now we have a slight reflection on the ground, but to make it more realistic, we should blur the reflection.

- Select the Transform node, and then from the toolbar, click the Blur tool to add it to the node graph.
- Increase the Blur size a small amount.

The final step is to ensure the reflection aligns with the shot as the camera and the

- Select the Transform node, and in the Inspector, enable keyframing for the Center X and Y parameters.

- Drag backward through the clip and use the Center X and Y parameters to keep the reflection under the actor's feet.

  The result should be some quick keyframing that takes 1 to 10 keyframes. Let's create an Underlay that groups these three nodes together and keeps our node graph organized.

- Drag a selection rectangle around the Transform, Blur, and Merge2 nodes.
- Press Shift-Spacebar, type **underlay**, and press Enter or Return to add an Underlay around the selected nodes.
- Click in an empty area of the Node Editor to deselect all the nodes in the Node Editor.
- Hold the Option key (macOS) or the Alt key (Windows) and then right-click over the Underlay title.
- Choose Navigate From the menu, and enter **BEFORE TWEEN** as the new Underlay name.

This creates a very simple effect but, and it will become more noticeable when we color correct the different elements, it might be a bit strong here, but it works for this exercise to edit most of the effects and parameter values given in the books, you will want to adjust them based on your final comp and your professional eye.

Correcting Color in Fusion

Performing a sky replacement is only half the task in our sky-to-sea look. Color correcting the foreground is also required. We'll leave the final color grading pass to the color page, but in this lesson, we will cover correcting and matching the different elements to make a cohesive, believable shot.

1. Select the Merge2 node and press `1` to view it. Then, in the toolbar, click the Color Corrector tool.

We'll use this color corrector to set a general adjustment for the entire shot.

- Drag the Gain slider lower to give a darker, stormy look over the shot.
- Drag the Gamma lower a small amount.

This creates a nice base for our set look. Next, we should correct the bright rooftop to darken it even more without darkening the already moody sky and our actor.

With the ColorCorrect node selected, click another ColorCorrect node in the toolbar.

For this correction, we only want to affect the rooftop and ledge, so we will mask out masks for those two regions to limit our correction.

- Click in the empty area of the node graph above the second color correction.
- Press Shift-Spacebar. Type **mask**, and then add the MaskFeather to the Node Editor.

- Drag an output from the Magic Mask to the green foreground input of the MaskFeather.

- Drag an output from the RGB1 node to the yellow background input on the MatteControl2.

- Select the MatteControl2 and press 1 to see it in the viewer.

Each color corrector using just the RGB1 loads. The action's logic will also be connected. To prevent that, we can mute the MergeMatte and subtract 1 from our RGB1 node.

We can use the MatteControl to subtract the MergeMatte from the background RGB1 node.

- In the MatteControl2's Inspector, select Combine Alpha from the Combine menu.
- Set the Combine Op menu to Subtract.

These Combine Operator modes are Boolean operations, and they determine how the foreground alpha is copied into the background alpha channel.

- Drag the output of the MaskedControl2 node to the Mask Effect Mask input on ColorCorrect2.

- In the ColorCorrect2, reduce the Saturation slightly to mute the color and then lower the Gamma to darken the roof.

  Next, since moisture can soften the darkest areas, we'll want to adjust the Shadows.

- From the Range menu, choose Shadows. Increase Lift slightly and use the color wheel to shift shadows to a cool blue-cyan tone.

  Since wet surfaces tend to absorb more light, we need to help the concrete appear more saturated.

- From the Range menu, at the top of the Inspector, choose Midtones. Then lower Gamma by half and again add a cool shift (blue/cyan) to the Midtones.

- From the Range menu, choose Highlights. Increase Gain by half to give the appearance of sheen, and then shift highlights toward a cool neutral tone.

We've replaced the sky, added a reflection, and color corrected all the elements to give our scene a moody, wintry look. Again, as with the Green Screen lesson, compositing is an iterative process. The is a good point to revisit any of the parameters you've adjusted and tweak them to create a more refined look. The final piece is to add rain. For this, we'll use Fusion's Particle system.

Generating 3D Particles

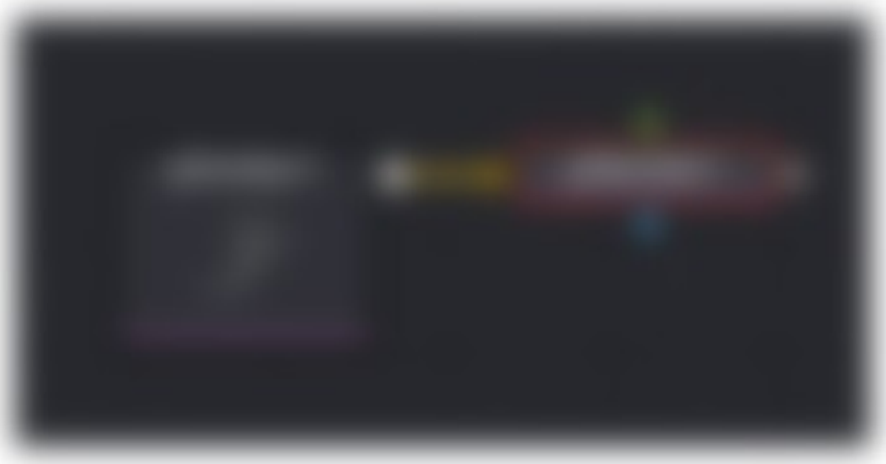
Particles have infinite uses in just about every project type. You can create practical effects such as fire and smoke or create more abstract motion graphics designs. Fart (FX) Fusion's toolset includes particle specific nodes to simulate physical phenomenons - wind, gravity and bounce - as well as forces that allow particles to be attracted to or repelled by other objects. With so many ways to build and manipulate particles, it's easy to become overwhelmed with the possibilities. However, in this exercise, you'll focus on building some simple rain for our sky. For next shot that will give you the foundation for exploring particles on your own.

1. In the Node Editor, click in the empty area to the right of the MediaOut1 node, and then click the pEmitter tool in the toolbar.

We'll work in 3D so the particles can have depth and follow our 3D camera move. You'll begin by adding the two essential nodes to create particles.

Whenever you create a particle system in Fusion, you must start with a particle emitter node, pEmitter, that generates the particles and a particle render node, pRender, that renders the results.

2. With the pEmitter selected, return to the toolbar and click the pRender tool to the Node Editor.



> **TIP** The names of all particle specific nodes begin with *x.y.* *pSmokes*, *pSquares*, *pBounce*, *pSurfaces*, and so on. This naming convention makes it easy to locate and identify particle specific nodes.

To view the particles, you view only the pRender node. All other particle nodes are visible only through the pRender node.

1. Select the **Matrix** Control 2 and press **1** to remove it from the viewer, and then select the pRender and press **1** to see it in the right viewer.

> **TIP** You can increase performance by removing an image from the viewer you are not currently using, even if you use single viewer mode.

When beginning to work with particles, your first choice is whether to generate particles for a 2D or 3D composition. For this exercise, you will create a 3D particle system. Luckily, this is the default setting located at the top of the pRender Properties. Because the pRender node is set to 3D, the viewer shows a 3D scene.

2. Right-click in viewer 2 and choose Settings > Load Defaults to start in a standard perspective view.

Most of your actual particle setup begins in the pEmitter node.

1. In the Node Editor, select the gEmitter.

   A particle system is divided into two primary parts: the particle emitter and the particle cells.

   The particle emitter is the source of the particle cells. By default, the viewer displays this emitter as a wireframe sphere, but you can easily change it into almost any shape, including a rectangle, a line, text, or a polygon. It defines the area that produces the particles.

   The particle cell is the object multiplied and animated by the particle emitter. By default, it is represented by small white points within the sphere, but as with the emitter, the particle cell can be any image or built-in particle cell object.

2. Press Play to see the default particles being generated.

   Since the cell will be falling from the sky, the default sphere shape emitting the particles is not ideal, as we will change it to a flat plane that we can use like a sky. You control the shape, size, and position of the emitter in the Region tab.

3. In the gEmitter's Inspector, select the Region tab and choose the Jungle from the Region menu.

   The rectangle must be big enough to cover the area in front of the camera. For now, we can enter a value and then recalculate it once we composite the cell with our live action clip.

3. In the Region's Width and Height, enter **500** for each, and then click in the viewer and press F to fit the rectangle within the viewer.

To make the rectangle more like a sky or ceiling, it must be rotated by 90 degrees and moved up.

4. In the X location, enter a value of **90** degrees.
5. In the lower left corner of the viewer, right-click the axis control and choose Front.
6. Click in viewer 2 and press F to fit the front view of the rectangle in the viewer.

Looking at this front view, you can see the ground plane. Currently, the rectangle is at the same level as the center of the ground plane, which means it would be in the center of our frame. It must be repositioned higher if we want the rain to appear like it is falling from the sky. We won't know the exact amount until we complete it, but we can raise it now and fine-tune it later.

- Drag the Y Offset Translation value to 100.

Now that we have our region defined and our particle cells generated, we can add motion. We will save the creation of the actual look of the raindrops for later. For now, let's focus on getting the basic setup correct.

Adding Motion

The default cell in the Inspector for the primitive is the Controls cell. There, you can start to define how many cells are generated and in which direction they move. To give your particle cells some movement and a trajectory, you use the Velocity and Angle controls in the Inspector. It's easier to perform motion-based adjustments on particles while the comp plays.

1. Use the axis control to return to Perspective view and reposition the view to see the rectangle above the ground plane.

Lesson 11 Creating a Particle Field 2017

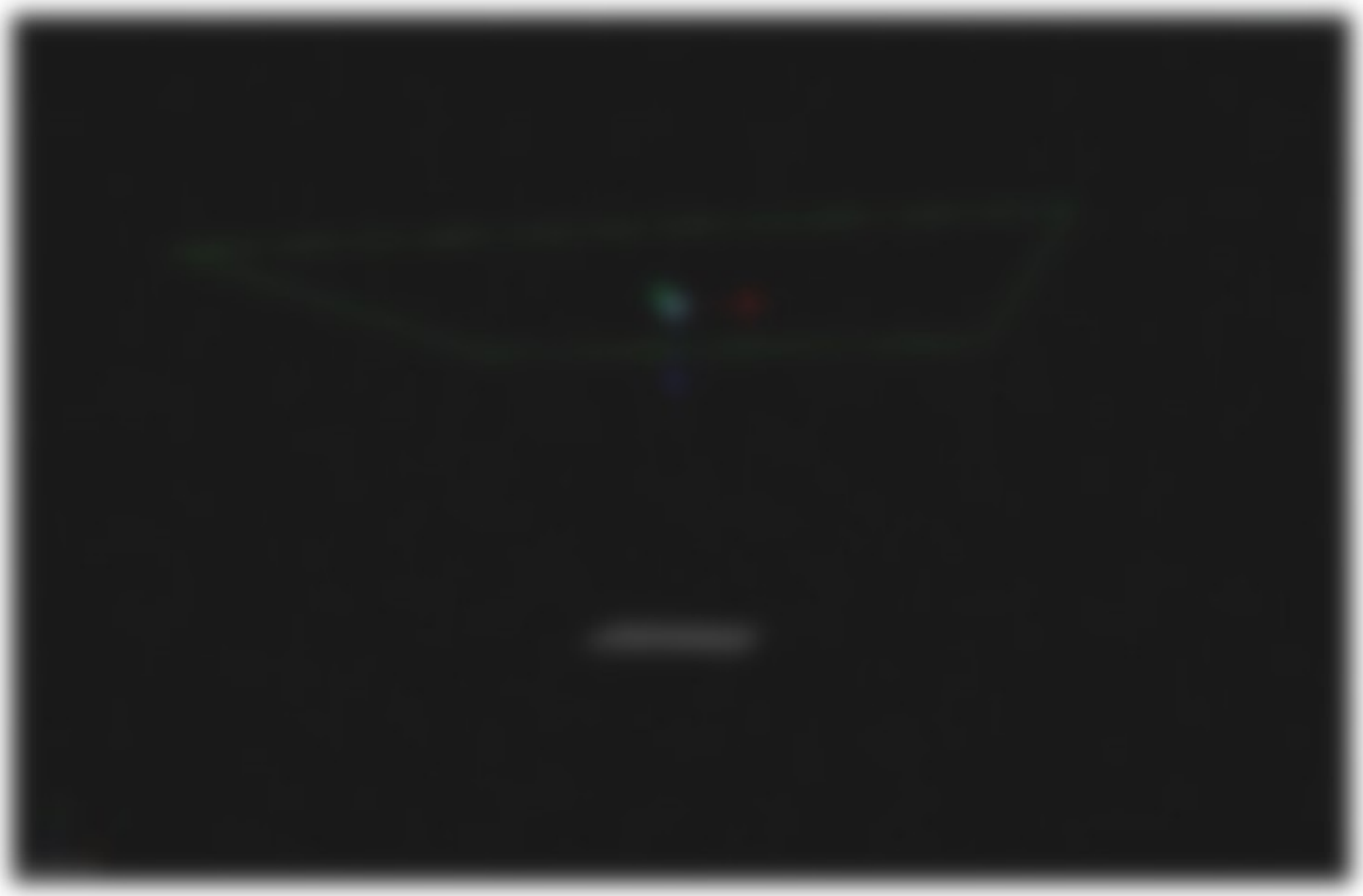
1. If necessary, click the Play button to begin playing the comp.
2. Click the Controls tab in the Inspector.

   Particle cells start with no motion. They require some force to make them move. So when you first click the Play button, the particle cells appear to fill up the rectangle emitter shape, but they don't go anywhere.
3. In the Velocity section of the Inspector, set the Velocity value to about 20.

   All the particle cells shoot to the right at a steady, constant rate. However, not all particles fall at the same rate—a result of gravity—so the particles don't appear more realistic.
4. Below the Velocity setting, add 0 in the Velocity Variance parameter.

   The value of 0 means some raindrops will have a variable velocity between 100 and 120.

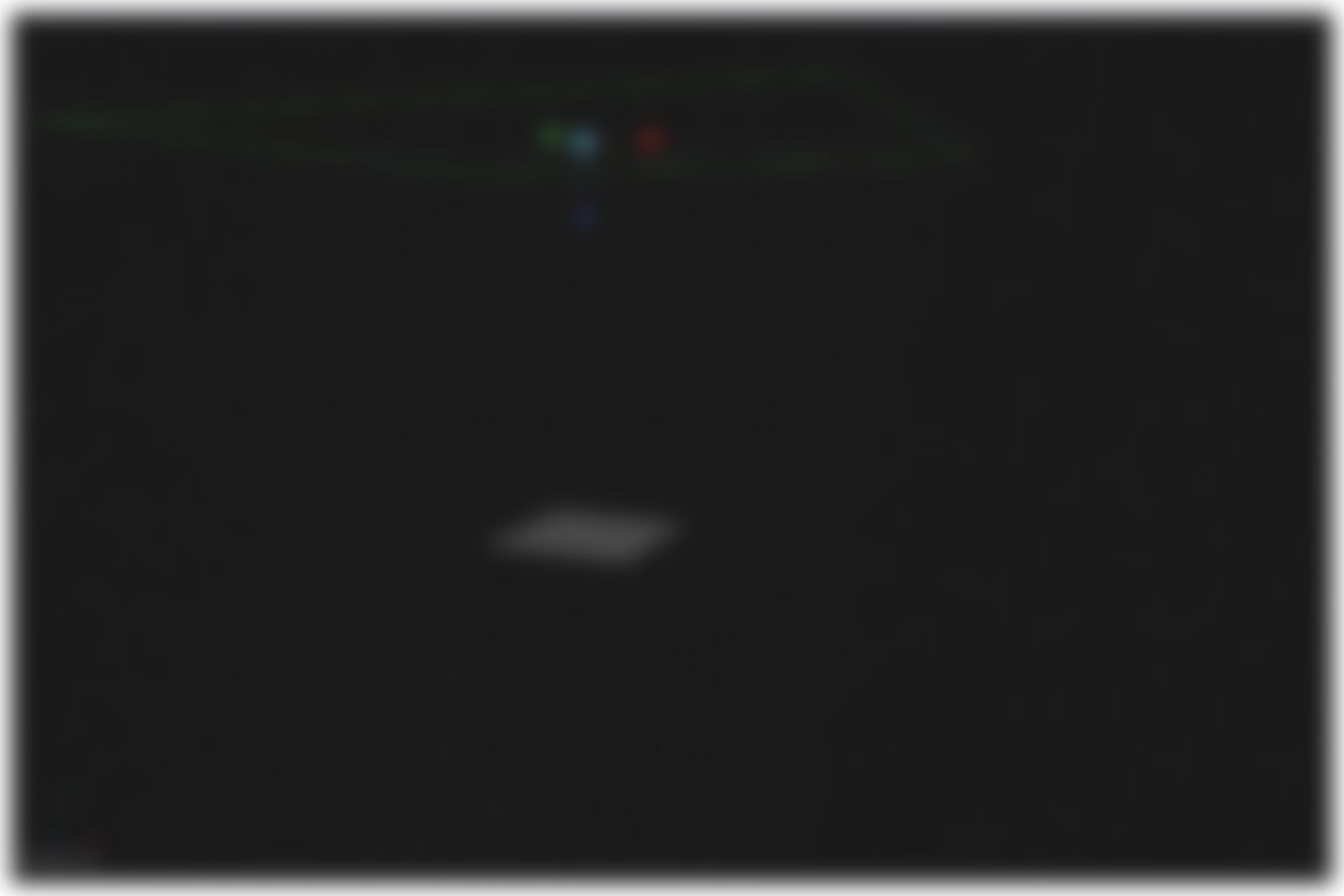
   To change the angle of direction so the rain falls down, use the Angle control.
5. Adjust the Angle to -90, causing the particles to move downward.



   Now the rain is falling, but moving left (generally because it has a default drift effect), let's adjust the angle so the rain falls in a more realistic direction.
6. Adjust the angle to -100.

   The Number setting determines the number of particles generated on each frame. The default Number setting of 10 generates 10 particle cells on every frame, which may be too few for rain.

- Set the Number to 100.



In a particle system, hundreds or even thousands of particles are generated simultaneously, which can be demanding on your computer. To optimize performance, it's important to avoid generating unnecessary particles — especially those that are offscreen. One way to do this is by adjusting the Lifespan parameter, which determines how long each particle remains active.

The duration of our composition is 10 frames long, as indicated by the Render Range End value near the time ruler. The time it takes for a raindrop to fall from the top to the bottom of the frame depends on its velocity. Once a raindrop leaves the visible frame, there's no reason to keep rendering it since it no longer contributes to the scene. By setting an appropriate Lifespan value, you can ensure that particles disappear when they're no longer needed, reducing computational load. In this case, estimating a 2-second lifespan should be more than enough for a raindrop before it exits the frame.

- Set the Lifespan parameter to 48 so the particles only last 2 seconds.

These settings are the essential parameters for the initial setup of any particle system. You set the number of particles, the general speed, the direction, and the lifespan, and then you inevitably iterate a few times over the values when they are all composited.

Now it is time to create the actual look of the rain. The other essential set of controls determines the size, position, and shape of the particle cells. You've been using the emitter's default point cells, but it's now time to explore other options.

Using an Image for Particle Cells

It's unusual to stay with the small white points for your particle cells. In fact, the cells can be almost any object you choose. Often, you'll use one of the built-in shapes to get started and later switch to an image or small movie as you'll do when you have completely configured the cells' motion. You set the cells' appearance in the Style tab.

1. In the Inspector, click the Style tab and choose Image from the Style menu.

   The Style tab's Style menu includes a list of the objects that can be used for the particle cells. The Material options allow you to use the Standard material or any image or video.

2. Open the Media pool, and from the Action (Fx) Media bin, drag Rain Drop.png to the Node Editor near the pCloth1 node.

3. Select the Media01 node and press 7 to see it in the viewer.

The file is a small 200 x 200 pixel PNG that resembles a water droplet. When using an image or movie for particles, try to keep them very small. Small textures reduce the overall bandwidth demand, enabling the GPU to handle a large number of particles efficiently.

3. Connect the new Medium to the yellow Bitmap input of the pBirthVel.

   We'll need to connect our camera to the particles so the randMgpu node's the camera movement.

4. Drag an output from the CameraSOP to the green camera input on the pBirthVel node.

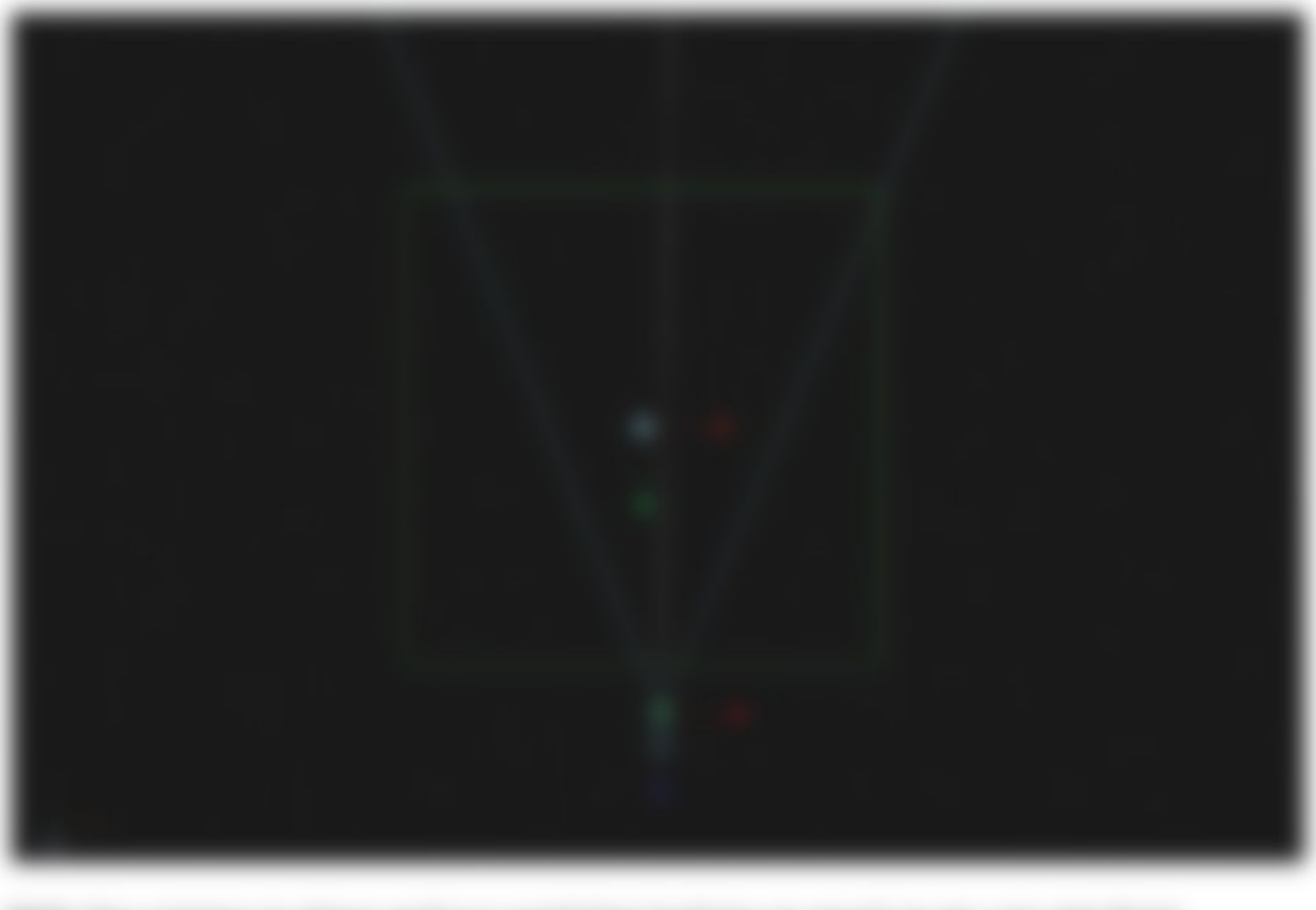
   The viewer shows the camera in our particle setup. You can see the two together a bit closer by switching to a top view.

5. Right-click over the axis controls in viewer 2 and choose Top, and then click in the viewer and press F.

- Select the **Emitter** node.

  This view clearly shows the region rectangle far from our camera, so the rain will be falling far away. We want it falling directly over our actor, so let's correct the region now.

- Select the **Region** tab in the Inspector and adjust the Width and Height to **2.0**.



With the camera in place and our particles looking as good as we can get them without the background in place, it's time to composite the rain into our scene.

Rendering and Compositing Particles

As we did earlier in this lesson, when we have a 3D scene and want to composite it into a 2D scene, we must add a RenderedIO node, which we can connect to a 2D Merge node to composite the particles over the background.

1. Select the pMerge1 node and click the RenderedIO node in the toolbar.

2. Select the RenderedIO node and press `1` to see it in viewer 1.
3. In the Inspector, set the Camera to Camera3D1 and the Render Type to Hardware for better performance.

   To composite the set, we need to add another Merge node after all our color corrections.
4. Select the ColorCorrector2 and click the Merge tool in the toolbar.
5. Drag the output of the RenderedIO into the green foreground input of the Merge4 node.

1. Select the Merged node, press 2 to see it in viewer 2, and then play the comp.

   Again, these particles are very small, which is good for performance, but sometimes you'll need to increase their size, which can be done in the Duplicate.

2. Select the pSmasher node, and in the Style tab, increase the Size to 1.5.

   Since the raindrops should reflect the light of the sky, they should have a bit more glow. We can achieve this with an Ageing node.

3. In the Duplicate, set the Ageing node to Screen.

   Finally, we need to apply motion blur to make the raindrops more realistic. The RenderMan RS allows us to render additional channels beyond RGBA. We can also render motion vectors. Motion vectors represent the direction and speed of movement for each pixel in a rendered frame. We'll use that data to blur those our 3D particles motion, allowing us to add motion blur as a post-processing effect.

- Select the Renderer/3D mode and, in the Output Channels section, enable Normal

> The motion blur for our last simulation is based on the forward motion of the cartridge relative to the camera, so there is no need to generate back vectors.

- Press Shift-Spacebar, type **exr**, and add Vector Motion Blur to the Node Editor

- In the Inspector, lower the Vector Motion Blur's Scale to 0.5 to lower the amount of blur.

  The Vector Motion Blur generates motion blur using the vectors we output from the Renderer3D.

- Play the composite to see the results.

  You'll probably notice that the rain starts to fall at the beginning of the shot, but we really want it to be already falling when the shot begins.

- Select the pRender node, and in the Inspector, set the Generate Frames to 48.

  Now the rain will appear as if it had been falling for 24 frames before the

You have completed this shot for wet look with a Magic Mask, 3D camera tracking, and 3D particles. You could take this shot further by adjusting the rain, applying color corrections, or going into the color page and grading the clip with a darker and cooler look.

Completed node tree for Lesson 21

Lesson Review

1. True or false? The Magic Mask tool in DaVinci Resolve 20 Studio uses AI to create motion-tracked masks, eliminating the need for manual rotoscoping.
2. True or false? The rendering tool in Fusion affects the final composition by modifying the visual elements within the node graph.
3. True or false? The glitchistor node in Fusion must always use the default sphere shape for emitting particles.
4. What is the main advantage of using the Darken Apply Mode for sky replacement?
   a) It protects darker pixels, blending the new sky without affecting brighter foreground elements.
   b) It brightens the entire scene to match the sky.
   c) It only applies changes to selected layers.
   d) It automatically adjusts color grading based on the new sky.
5. Why should particle lifespans be adjusted in Fusion's particle system? (Choose two)
   a) To ensure the particles remain visible throughout the entire scene
   b) To improve performance by eliminating unnecessary particles once they leave the frame
   c) To make the particles move in a random pattern
   d) To increase the brightness of the particles

Answers

1. True. The Magic Mask tool in Optimo Resolve 20 Studio uses AI to create motion-tracked masks, eliminating the need for manual rotoscoping.
2. False. The Undo/Redo tool in Fusion does not affect the final composition.
3. False. The Primitive node in Fusion has multiple shape options for animating particles.
4. a) It prioritizes darker pixels, blending the new sky without affecting brighter foreground elements.
5. a) To ensure the particles remain visible throughout the entire scene, and b) To improve performance by eliminating unnecessary particles once they leave the frame.

Lesson 4

3D Camera Tracking

One of the most difficult tasks in budget filmmaking is set design. Without a lot of money - and a small army of carpenters - it's a challenge to make your set look like ancient Rome, the command bridge of a high-tech starship, or an alien planet with three moons. Typically, efforts to turn your cousin's basement into a secret government research lab will end up looking like your cousin's basement.

Fusion changes all that. Using its powerful 3D Camera Tracker node, you can create enhanced set designs with surprisingly little effort.

Time

The lesson takes approximately 1 hour and 10 minutes to complete.

Goals

Modifying the 3D Tracking ...
Preparing the Camera Tracker ...
Solving for the Camera ...
Refining the Solve ...
Exporting the Scene ...
Positioning Objects in a 3D Set ...
Blending Color and Light ...
Lesson Review ...

During this lesson, you'll learn how to set up, perform, and refine a 3D track to realistically add a pirate ship off the coastline of a single beach shot.

NOTE: This lesson requires the Camera Tracker node and Magic Mask node, which are available only in DaVinci Resolve 20 Studio.

Completed composite for Lesson 20

Masking for 3D Tracking

As you experienced briefly in the previous lessons, Camera tracking is used to re-create a virtual 3D scene corresponding to the physical set of your live action scene.

While the intricacies of photogrammetry used by camera tracking are far beyond the scope of this book, here's a simplified explanation of the process. The Camera Tracker uses the relative speeds and movement directions of items in your scene to determine which items are in motion. When you tell it to use an object, it creates a mask to find and track more quickly their edges in the far distance. The Camera Tracker can use this motion parallax to calculate the position of each element in the physical scene and calculate where a virtual camera should be to replicate the same parallax within the computer.

This calculated parallax works convincingly as long as everything in your shot is "rubber down." Objects within the shot that exhibit independent motion – such as those pesky actors who always seem to find their way into visual effects shots – can confuse the calculations and produce poor results because their speed is not dependent solely on their distance from the camera. Therefore, before performing a 3D camera track, you must use masks to identify which objects you want to track and which you want to ignore.

1. Open Sabine Resolve 01 Studio, right-click in the Project Manager, and choose Restore Project Archive.
2. Navigate to the DRUID Studio Fusion 3D Training Media folder, locate the Sabine3D camera tracking.dra Daltrix Resolve Archive file, and open the Camera Tracking project.
3. From the Media bin, load the Camera START timeline and play the clip in the timeline, which shows the beach.

Camera Tracking 101

As it plays, try to identify objects in the clip that will require garbage matting—that is, locate the objects in the shot that exhibit independent motion and/or respect to the shot (things that aren't "nailed to the set").

In this shot, the actors and the ocean have independent motion. The rock outcrop and the beach move only because the camera moves. You'll matte these elements separately.

> **Tip** Sometimes (and this is one of those times), it's easier to first create mattes of the objects you're trying to mask and then subtract the objects you're trying to avoid masking. Fusion's masking tools make these subtractions easy, as you'll see shortly.

1. With your mouse pointer still over the beach clip, switch to the Fusion page and move the playhead to the start of the clip.
2. Click in the gray space of the Node Editor to deselect any selected nodes.
3. Press Shift-Spacebar to open the Select Tool dialog, type Ma, and add a MultiMerge node.
4. Create a rough outline around the rock outcropping (including the path it takes at the start of the render range. You might want to pan the viewer to allow you to draw the shape beyond the left edge of the frame.

> **TIP** Emphasize speed over accuracy. As long as you keep the subtle moving within your garbage matte, the Camera Tracker algorithm can ignore stray pixels on either side of the matte edge. Your garbage matte shape should require no more than a dozen control points.

- Move to roughly the middle of the clip, around frame 80, and reshape the polygon to fit the subtle.

  Unless you need to move individual points, it's easier to keyframe the polygon using a Shape Box.

- Click the Select All Points button again, and then press Shift-B to enable the shape box around the entire polygon. Drag the control handles on the shape box to stretch and resize the polygon shape to encompass the rock.

- Press Shift-B again to dismiss the Shape Box.

  Scrub through the clip to make sure the shape consistently fits the subtle. Chances are you will need to add one or two more keyframes to ensure the shape fits well.

- Reshape the polygon using the Shape Box or individual control points in areas needing refinement.

> **TIP** Pressing the Option-Left or Right Arrow key (Alt-Left or Right Arrow key on Windows) will move the playhead to the previous and following keyframes, respectively.

- When you're done keyframing the shape, in the Inspector, double-click the Polygon1 shape in the Polygon list and rename it **RockMotShape**.

- Click the Polygon button under the list to add a new shape to the Polygon List.
- Rename the Polygon1 **BeachSubRegion**.
- Move the playhead to the start of the render range.
- Create a rought outline around the sandy beach. Avoid including areas where the water overlaps the shore.

- In the Inspector, enable the Shape animation and deactivate by clicking the diamond icon.
- Advance the playhead to the last frame of the render range, frame 120, and reshape the polygon to fit the beach.
- Move to roughly the middle of the clip, around frame 60, and reshape the polygon to fit the beach.
- Scrub through the clip and adjust the polygon shape to roughly follow the beach.
- In the Node Editor, select the BeachPoly node, press F2, and rename the node **SceneryBGMask**.

  This works for the beach and rocks because they don't require too many keyframes. However, that isn't always the case, and sometimes you'll need to add more keyframes or use other methods.

Creating Mattes with Magic Mask

> **NOTE** The Magic Mask requires DaVinci Resolve 17 Studio.

The next few items that need to be masked are the three actors since they are also not locked to the set. They run up the beach, and their movement must be excluded from the camera tracker. You could use the RotoPaint tool again to manually trace the actors, but as you learned in the previous lesson, a quicker way is to use DaVinci Resolve's AI-based Magic Mask tool. These masks can be less accurate than the results you needed for the previous lesson, so the Magic Mask can easily do the job.

1. Click in the gray space of the Node Editor to deselect all nodes. Press Shift-Spacebar, type **Magic**, and then press Enter or Return to add the Magic Mask node.
2. Drag a second output of the MediaIn node to the yellow input on the Magic Mask node.

3. With the Magic Mask node selected, press T to see it in viewer 1.
4. Go to frame 82, which is the last frame in which we see all three actors simultaneously and is when they are at their largest point within the frame.

1. For all three actors, draw a line for the head and spine, a line for each arm, and a line for each leg.

2. In the Inspector, click the Train Forward button.
3. When that's just completes, click the Reference Frame button in the Go To Frame area of the Inspector and then Train backward.

The results won't be perfect, but they should be good enough for our 3D tracking.

Currently, the Magic Mask and the Scene3DImage mask are uncombinable. Since the Camera Tracker has only one mask input, you need to combine them.

Combining Mattes

To create a single mask for your camera tracks, you must connect all the mattes and combine them so that the actors are subtracted from the beach and rocks mask.

1. With the Magic Mask still viewable in viewer 1, select the Scene3DImage node and press 2 to see it in viewer 2.

3. Connect the output of `CameraExchange` into the blue `Mask` input of `MergeMask`.

The result is viewer 1 is the combined matte, which we will now connect to the Camera Tracker.

Preparing the Camera Tracker

With all the manual labor out of the way, it's time to set up the tracker and let it do all the hard number crunching.

1. Click in an empty place in the Node Editor, under the `MedMatt` node.
2. Press Shift-Spacebar, type **cam**, and select the Camera Tracker from the list of tools. Click OK to add the tool to the Node Editor.

> **NOTE** The Camera Tracker requires DaVinci Resolve Studio.

3. Drag a third output of the `MedMatt` node to the yellow input on the Camera Tracker node.

The Camera Tracker is added to the Node Editor, and the `MedMatt` node connected to its input. To use the matches you created, you must connect the `MergeMask` to the track mask input of the Camera Tracker.

The problem is that the `MergeMask` outputs the wrong data type for the Camera Tracker. `MergeMask` is just one of those operations that must account for. To make it

work for the Camera Tracker, we need to use a Bitmap node to convert the output of the Magic Mask. The Bitmap node converts an image into a black and white binary. The values are set to 0 (black) or 1 (white), depending on the threshold you set.

4. Click in an empty area of the Node Editor near the Magic Mask.
5. Press Shift-Spacebar, type **Bit**, select the Bitmap tool from the list of tools, and click OK to add it to the Node Editor.
6. Drag the output of the Magic Mask to the input of the Bitmap tool and press `1` to view the Bitmap tool in viewer 1.

   You should now see that the data has changed to be a binary, black and white matte.
7. Connect the output of the Bitmap to the track mask input of the Camera Tracker node.

   The connection uses the matte to eliminate the sky and actors from your cloud of tracking points.
8. Select the Camera Tracker node, and in the Inspector, enable Preview Automatic Locations.

9. Press `1` to see the Camera Tracker in viewer 1.

The Camera Tracker starts by generating a cloud of trackers uniformed by areas of contrast in the image. The first job is to tune the settings for this particular shot to get a good set of tracks.

Although you may not see many right now, the small green dots in the viewer indicate features that would be tracked if you were to begin tracking now, but you want to track a bit more features to improve the tracking data. You can always delete tracking points later if they are inaccurately tracked.

- In the Inspector, reduce the Detection Threshold to around 0.3 and the Minimum Feature Separation to around 0.015

The Detection Threshold determines how much contrast an image feature must display to be considered trackable. Minimum Feature Separation determines how close tracking features can be to be considered unique. By lowering these two sliders, you should see many trackable features displayed in the viewer. However, we don't want that the green trackers are over the water and over our actors. This means our mask is important, and we need to invert it to get the trackers on the beach and rocks.

- Select the Bitmap node and click the Invert checkbox in the Inspector

- Select the Camera Tracker node to see the tracking points in the viewer.

Now, we are ready to track the camera movement. The Camera Tracker uses an optical flow based algorithm to follow points from frame to frame. You can further refine the tracking using a pattern recognition based method similar to the normal Tracker in Fusion: a planar tracker algorithm that works well when you have large areas of planar transformations in a shot. Or you can combine using optical flow, which works well for a short like this with very few occlusions or motion blur.

- To potentially create better tracking results at the expense of some additional time, click Bidirectional Tracking.
- To initiate the tracking, click the Auto Track button.

The Camera Tracker usage frame by frame, calculating the positions for all the tracking points. Obviously, the more tracking points you create, the longer the process takes. When it reaches the end of the render range, the Tracker moves backward frame by frame to refine the existing points.

Solving for the Camera

Once auto tracking is completed, you can enter Inspect Camera and some parameters to calculate the 3D representation of your live action set. While Fusion can estimate much of the camera information, the more information you provide about the physical camera that captured the scene, the better the results will be. Often, this information is logged on set, but you can also examine a clip's metadata in Resolve's Metadata Inspector to see if useful information is saved there.

This footage was shot with a Blackmagic Ursa 4K using a focal length of 120 mm. At a minimum, you should enter the focal length to solve the camera track.

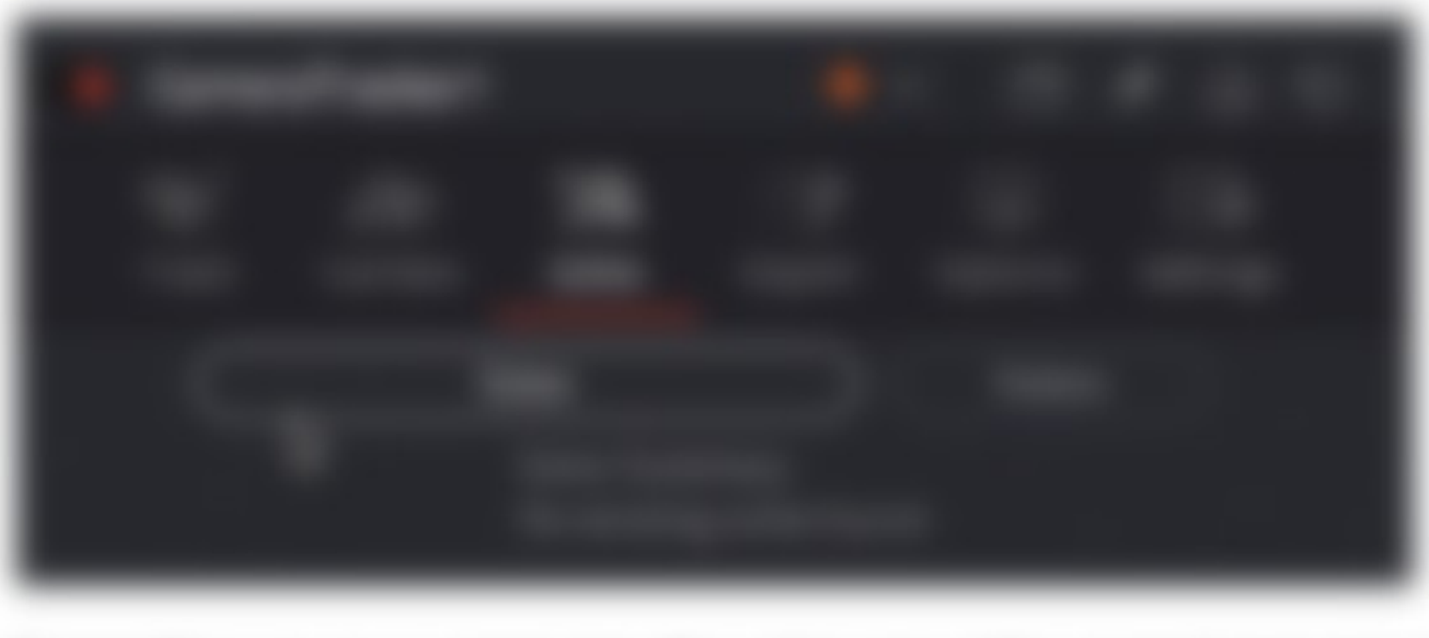
> **TIP** If you don't know the focal length, you can use trial and error, entering your best guess for the focal length until you get a satisfactory result. Fusion will attempt to refine the focal length from your initial guess, but you must be in the ballpark with your initial guess to succeed.

1. At the top of the Inspector, click the Camera button to switch to the Camera tab.
2. Enter a focal length of **52.85** and set the film gate to Blackmagic URSA Production 4K 3:2. Resolve automatically enters the correct aperture settings for that camera's gate.

> **TIP** You can often ignore mild lens distortion up in this shot, but when working with lenses with more distortion, you should select the Refine Lens Parameters checkbox in the Solve tab to correct the distortion automatically.

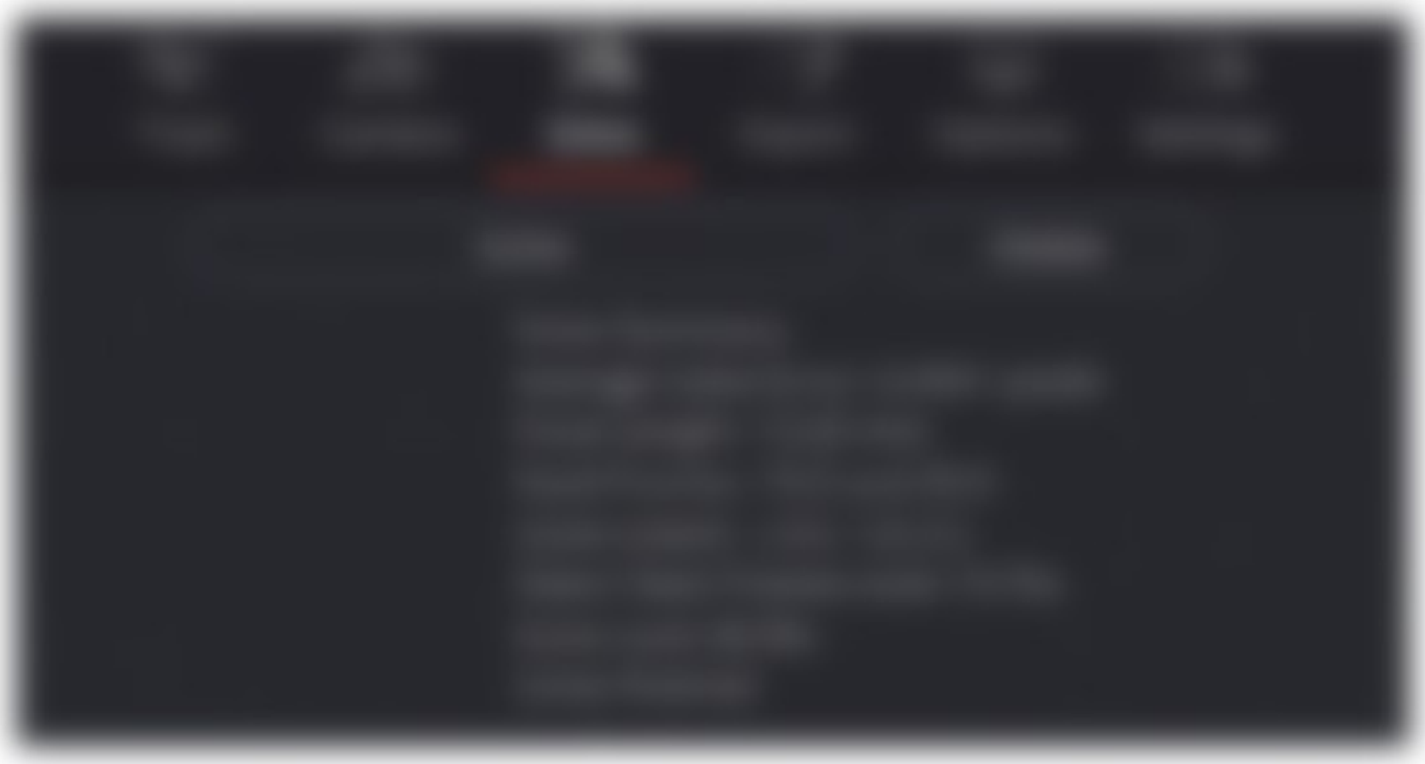
Time to solve the camera track!

4. Click the Solve button to switch to the Solve tab, and click Solve.



Depending on your computer, the solve may take several minutes to calculate.

When the solve is completed, the reward for your effort is well be a list of information. But the first one is the key: the Average Solve Error.



An average solve error of around 0.5 means that, on average, any digital environment we're should be just over a half a pixel off, at most. Typically, you want this error value below 1 at a minimum and ideally below 0.5. No matter where your average solve error ended up, let's refine the solve to see whether you can get this error below 0.5.

> NOTE Depending on whether you're using the saved Nanocage Dune composition or the composition with your animated garbage matte, your average solve error will be different from the value in the preceding figure.

Refining the Solve

The average solve error is sometimes called the reprojection error because it measures how closely the computer model of your live action set can predict and re-create 3D locations in the physical set.

Imagine replacing your live action camera with a digital projector placed at exactly the same location as the camera, pointing in the same direction, and using the same lens. If your virtual set is perfectly reprojected back onto the scene using the virtual camera image, every projected pixel should line up perfectly with the object in the physical scene. If the reprojected pixels miss their marks, that's a reprojection error.

The solve error is measured in pixels and refers to, on average, how far pixels are misaligned from the original scene.

Looking at the screen, most tracked features appear green to indicate a reprojection fit. You'll also see a few of the tracked features colored red to indicate that they have an unacceptable reprojection error. To improve the overall solve quality, you can delete the features with high errors.

Solving is computationally demanding and RAM intensive, but it is also iterative as you refine the calculation. Switching too many masking markers and re-solving can cause problems affect your compositing power to not go to it. If you plan on doing multiple iterations, you should make a copy of the original Camera Tracker node after each solve.

1. Select the Camera Tracker node.
2. In the viewer, drag a selection over a group of tracked features.

The trackers will highlight yellow to indicate that they are selected.

3. In the Inspector, click Delete to remove the high error tracked features.

This shot doesn't have many redundant, compact together. Making it very difficult to select more than a handful at once. The Inspector provides an easier way to select trackers when manual selection is difficult.

The Maximum Track Error determines how poorly a feature was tracked during the solving phase. The Maximum Solve Error determines how poorly a feature reprojects

- In the Solve tab, set the Maximum Trial Error to 0.2 and the Maximum Solve Error to 0.5.

  If you push these values too far, you might actually find the reprojection error worsening. By starting with a value of 0.2, you avoid deleting too many points at once.

- Click Apply Trust Selection (Warp.ai uses) for deletion all the tracks with errors exactly that the ones you just set.
- Click Delete to remove the high error marked features.
- Click Solve again to re-solve the scene with a leaner, more accurate sample of features.

At this point, you've likely achieved the goal of reducing the solve error to a little lower than your initial results. It's probably not worth the effort to reduce the error further.

> **NOTE** Your solve errors will almost certainly be different from those shown here. For example, slight differences in the positions of your garbage matte shapes will change the accuracy of your solve. These differences are negligible, though, and you'll almost certainly achieve similar or better results by following the steps described here.

On tougher shots, you'll often repeat the refining and error reduction process several times, lowering the error rate a little more each time until your solve falls and you must return to the solve values that you previously saved as a backup or you achieve your desired average solve error goal of less than 0.5.

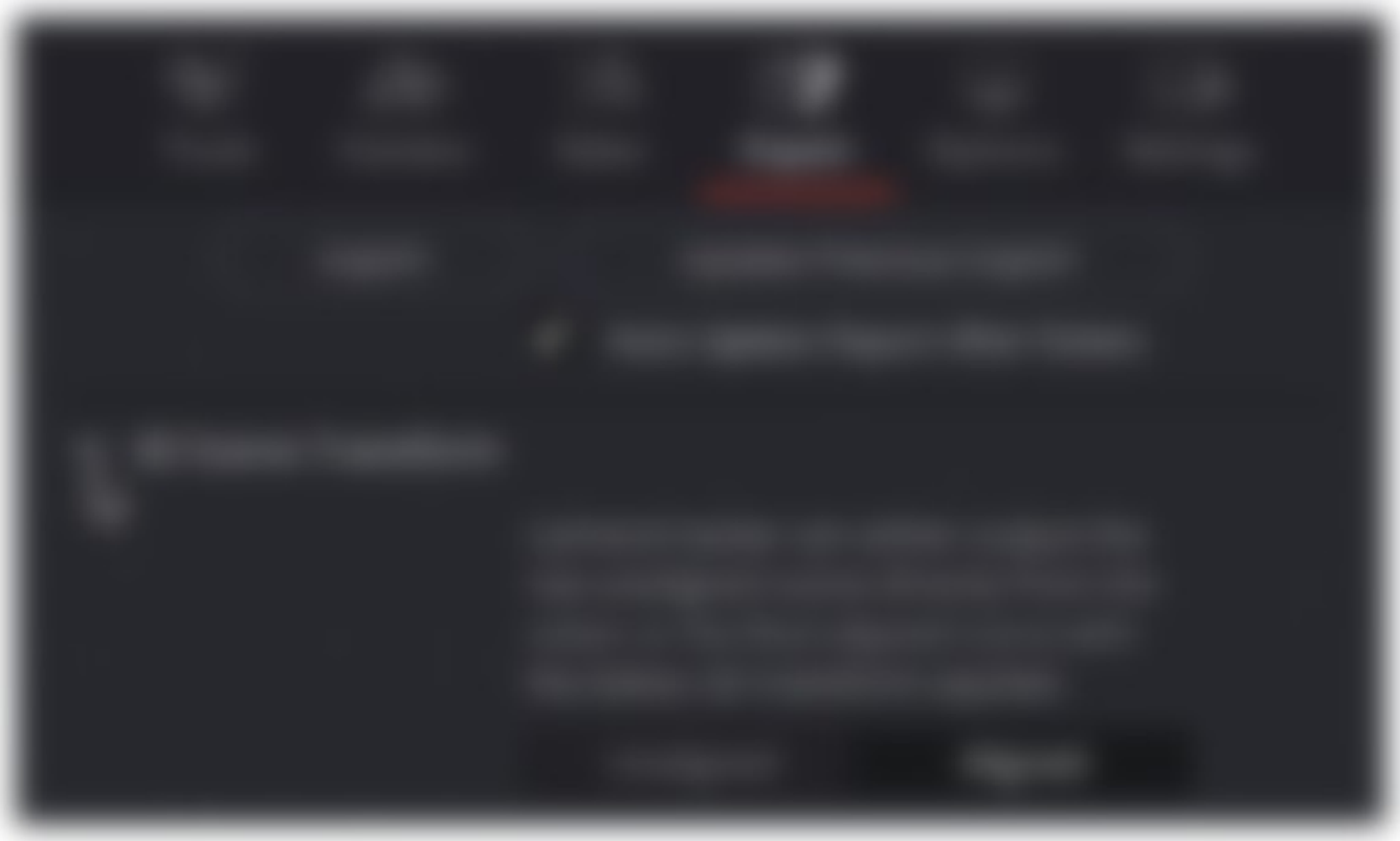
Exporting the Scene

At this point, the Camera Tracker node has computed a virtual 3D scene that matches the original live-action scene to within slightly less than half a pixel. But before you can play with this new scene, you need to establish some ground rules. In fact, you need to establish a ground.

The Camera Tracker has no access to camera-acclimatization data, so it doesn't know if the camera was level, tilted, upside down, or on its side. Before you begin working with the 3D scene, you must tell the Camera Tracker where the ground is located.

> **NOTE** If you were unable to get a satisfactory track, there is a good version of the composition with the camera track completed. Open the Timelines > Backups bin and use 03 Backup to continue from this point.

1. Click the Export tab at the top of the Inspector.
2. Click the disclosure arrow next to 3D Scene Transform.



The options for setting the ground plane aren't made visible until you switch to Unaligned.

4. Click the **Unaligned** button. The option to set the ground plane becomes visible in the Orientation section.

In Fusion's 3D coordinate system, X is the horizontal axis, Y is the vertical axis, and Z is the depth axis. So the default XZ plane is the typical ground plane as defined by the horizontal (X) and depth (Z) directions.

> **TIP** In some shots, the ground may never be visible. In such a case, it might make more sense to use another plane to identify the ground. For example, if a green screen wall has clear tracking features, selecting the XY plane would allow you to lock the camera direction to the green screen wall, even when the floor isn't visible in the shot or doesn't track well.

5. Move to the start of the render range.

   Here you have a clear view of the "ground" of the beach. To set the ground plane, you first select all the tracking points that track features located on the beach.

6. In the viewer, drag through the trackers on the beach to select them.

- Shift-click any beach track points you may have missed with your selection.
- In the orientation section, click Set from Selection. The Camera Tracker adjusts the scene rotation to align with the selected feature tracks.

  You also need to tell the Camera Tracker where the origin point - the center of your 3D universe - should be. It can be anywhere that's convenient. We'll select a feature track point from the center of the beach and set it as the origin point.
- Hover your mouse pointer over the viewer and notice how it soon offers a readout of the color error for the specific point beneath the pointer.

- Click a point with a reasonably low color error on the beach in front of the pirates.
- In the Origin section, click Set from Selection.

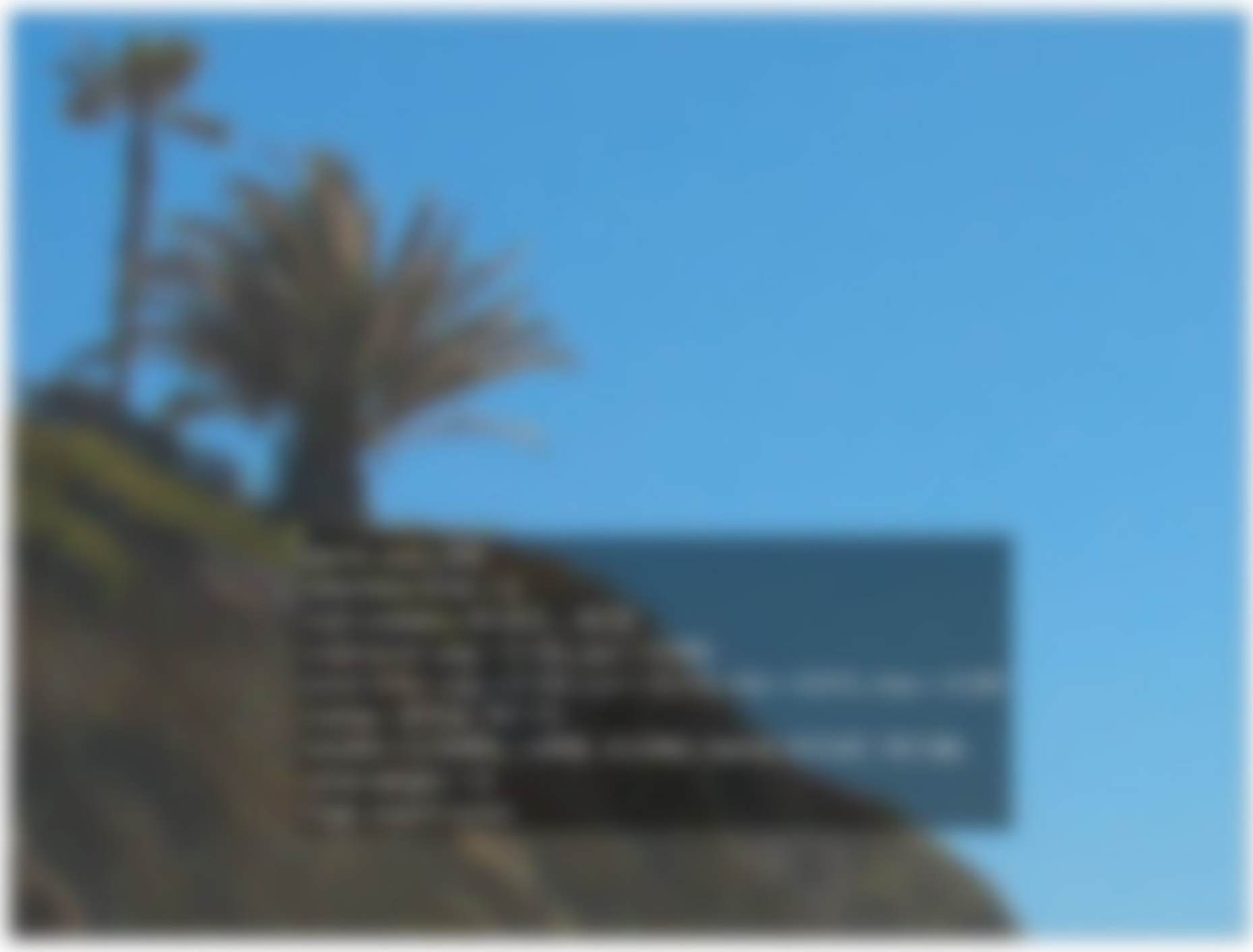
The Camera Tracker sets the center of the internal 3D scene to the selected feature.

The last detail you should define is the scale of the scene.

Defining Scale

Setting a scale when performing 3D camera tracking defines the real-world size of the 3D space relative to the tracked footage. This step ensures that objects, movements, and distances within the 3D scene correspond accurately to the physical dimensions of the original filmed environment. 3D objects or 2D elements composited into the footage must match the physical scale of the scene to appear realistic. For instance, a ship in our scene must be proportionate to the rocks and the people. The scale ensures that camera movements behave naturally, maintaining accurate depth and parallax between objects in the scene.

- In viewer 1, Ctrl+ click a green tracking point at the base of the short Canary Island date palm tree.



3. Hold the Command key (macOS) or the Ctrl key (Windows) and select a green tracking point at the top of the same data path line.

The use of this tool is, like masks, it's helpful to get rid of information from someone on set. In our case, we know Lonely Island data path's gone to between 10 and 20 meters, and we are willing to put this on the longer side. After the two points are selected, you can define the scale.

4. In the Inspector, click the Set From Selection button, and in the dialogue, enter 10

> **Tip** Conventional wisdom is to use the metric system for measurements. This will help if you eventually need to add simulations from 3D applications such as Houdini or Maya. Whatever measurement you choose, you must remain consistent throughout the project.

Fusion uses a normalized coordinate system, meaning the value "1.0" can represent any unit of measurement - feet, meters, or another unit - as long as you remain consistent when importing object data. In this case, we'll assume that "1" represents 1 meter in Fusion. Therefore, a value of "8" corresponds to 8 meters, which is the height of our Canary Island data path tree.

You now have a ground plane, origin, and scale defined. It's time to export the scene.

1. Click the Aligned button in the Inspector to lock in the adjustments.
2. At the top of the Inspector, click the Export button.

The Node Editor automatically creates a group of Tool nodes representing the created 3D scene.

3. Drag to reposition the new nodes as desired.

Congratulations! You've performed your first 3D mask.

The new nodes create a 3D scene with a Merge 3D, Camera 3D, Ground Plane, Point Cloud 3D, and a Camera Tracker renderer.

With the 3D camera mask performed, it's time to turn all that quality data into movie magic. This will be a straightforward composite of adding a pirate ship out on the horizon.

Positioning Objects in a 3D Set

To add a ship to the horizon, most of the heavy lifting is already done, and we can achieve the result with just six more nodes.

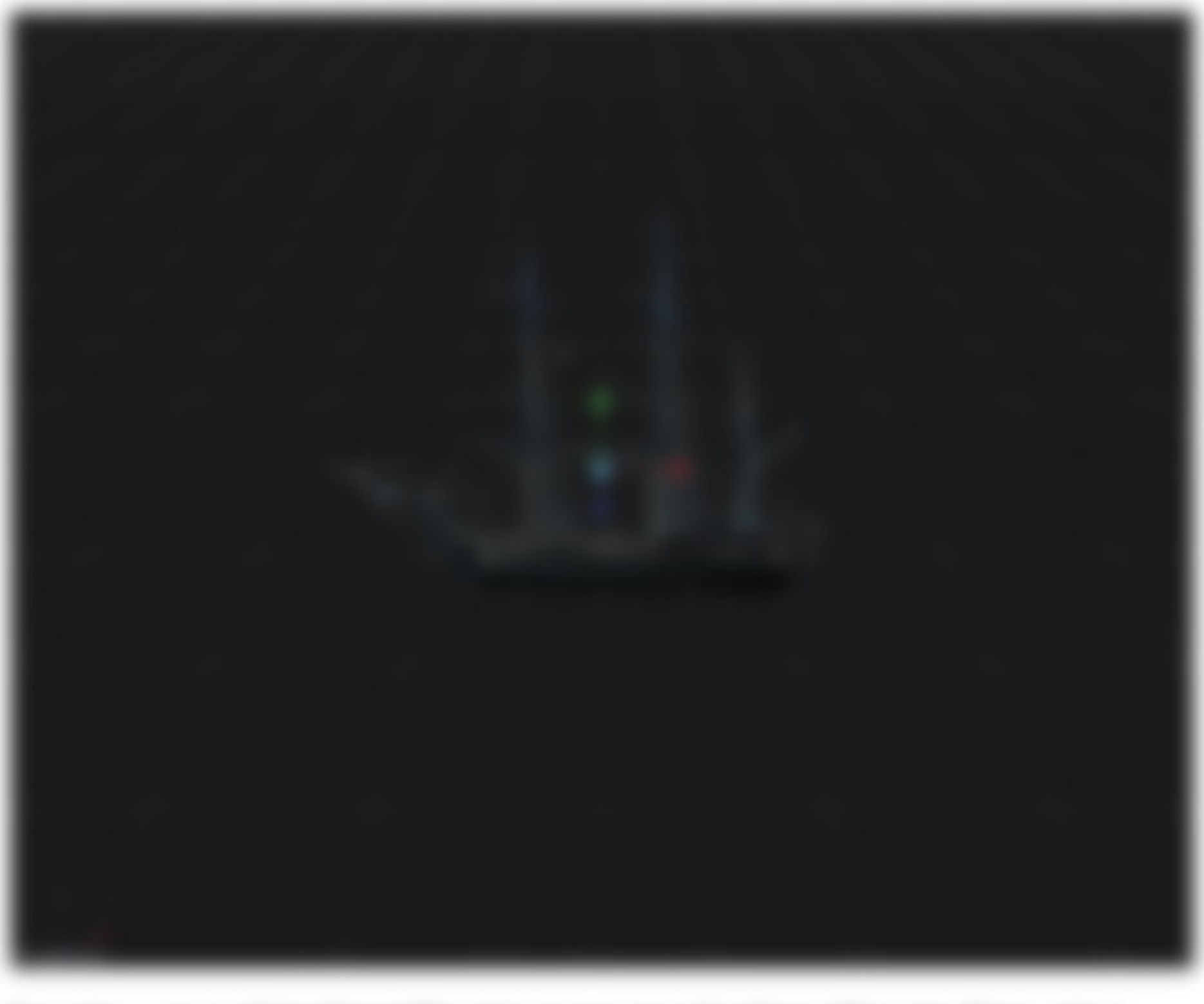
1. From the Clips bin in the media pool, drag *ProceedShip.png* into the Node Editor.

2. Press `1` to see the *ProceedShip.png* in viewer 1.

   To composite the ship into our 3D scene, the MediaIn1 node must be placed on a 3D shape.

3. With the MediaIn1 selected, use the Select Tool dialog to add a Shape3D node.

4. Press `Ctrl` to select the `DragonBI` and `MongoDB` nodes.



5. Drag the output of the `DragonBI` and connect it to the `MongoDB` node. Then select `MongoDB` and press `F` to see it in viewer (1).

6. Select `DragonBI` node in viewer(1), and press `F` to frame it.

TIP You might need to use the modifier keys plus middle mouse button combinations that you learned in previous lessons to get the same framing shown in our frame.

The ship is composited into the 3D scene at the origin you defined, but the graphic of a galleon ship is not scaled correctly for our scene, as we need to scale it. Remember, we are using the metric system, so in meters, a galleon is 50 meters long.

- In the Shape3D node, set the Size to 50 (meters).

  Now, we need to position it offshore by about 175 meters. It is easiest to do this while viewing the output of the CameraFinder1_Renderer node.

- In the Node Editor, select the CameraFinder1_Renderer node and press 1 to view the output in viewer 1.

- Select the Shape3D node, and in the Inspector's Transform tab, use the 2 Translation slider to push the ship out in Z until it's somewhere between 150 and 200 meters. You'll know the right distance when the movement of the ship looks realistic.

NOTE Depending on your choice of ground plane and origin, your ship won't perfectly match the one pictured here. You might need to adjust the Translation 2 value to get a closer match.

Depending on the ground plane you selected, the scope of the beach may not be as flat as the ocean, so you may need to correct this (I recalibrated your orbit

Play the composition to see how the ship matches the camera move.

That's all it really takes to add the ship and have it match the camera move from the 3D track. Now comes the compositing part, where you must make it appear as if the ship fits naturally in the beach setting. That will require some lighting and color correction.

Matching Color and Light

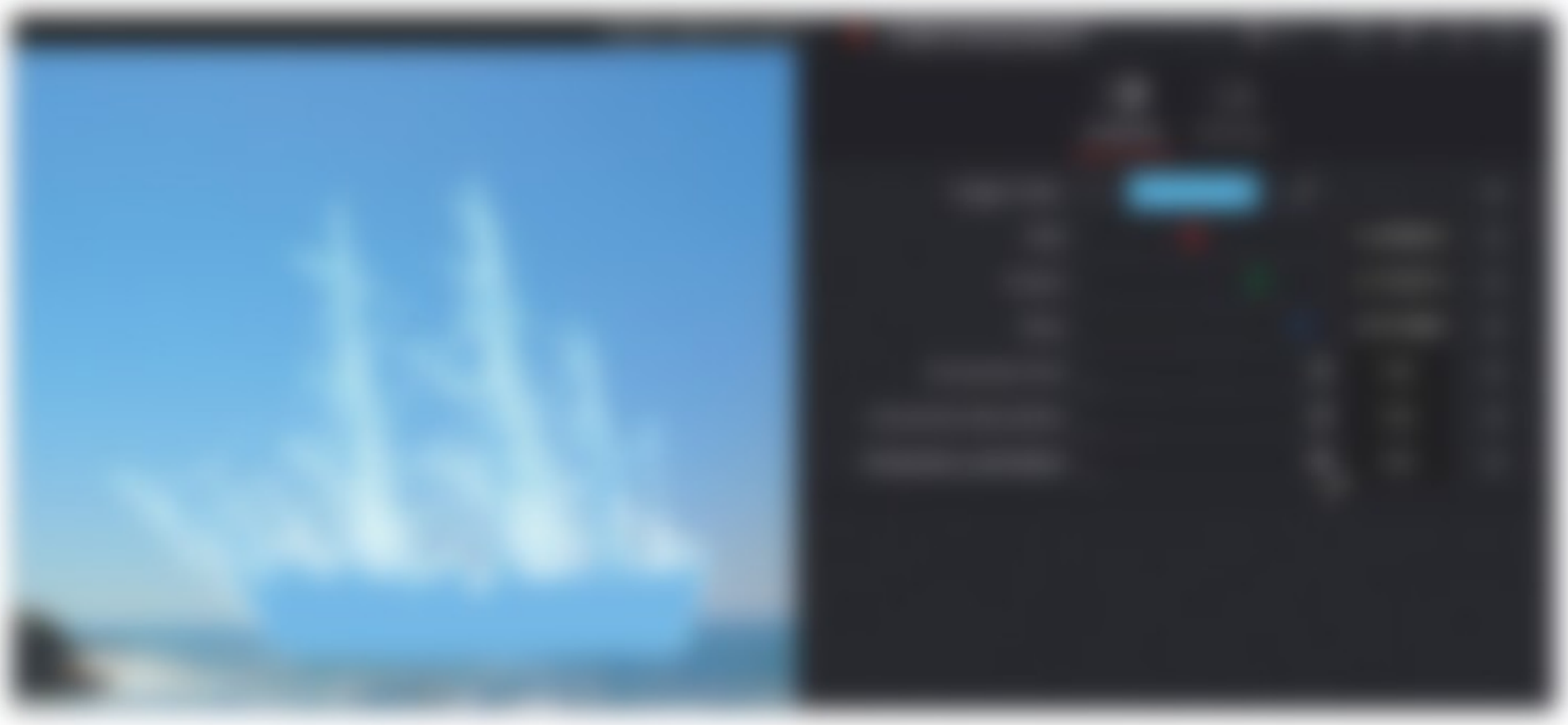
Compositing isn't just about placing one object on top of another. At this point, you probably know that. Although the ship follows the camera motion perfectly, it still needs work to look realistic. One of the nice things about Fusion's 3D space is that when there are no 3D lights in a scene, it simply passes pixels data through. This means we can add a single color correction to the ship graphic in MediaOut to create the illusion of matching atmospherics over the ship.

1. Select MediaOut1, press Shift-Space to open the Node Selection tool, and choose a Color Corrector node.

To create a realistic blue hues, we need to sample the blue as a "sun light" reference. To do that, we need to load the image into a viewer.

- Select `MedianIT` and press `1` to load it into viewer `1` (viewer `1` should still have the `CameraOfTucker1_Rendered` node loaded).
- Select `ColorCompressor1` and drag its EyeDropper tool to sample the sky where the green chip will be.

- Drag the Compress Hue, Compress Saturation, and Compress Luminance sliders all the way to 1.0.



The result... is not pretty. First, the edges of the image are overshooting black. We can use a little trick to fix that.

- Drag from the output of MediaIn1 to ColorCompressor1's Mask input.

This way, uses the ship's own alpha channel as a mask for the color correction, preventing it from affecting the edges.

The second issue is that our initial values wash out the ship almost completely. Let's correct that.

- Lower the Compress Hue, Compress Saturation, and Compress Luminance sliders until you have created a slight "sea haze" effect.

You can use the Blend slider in the Color Compressor's settings tab to blend more or less of the original image with the effect.

You now have a pirate ship sitting commodingly in the water off the headland.

The last step is to ensure the camera tracker renderer is connected to WebsiteTool so that you can see the results in the GIS page timeline.

3. Drag the CameraTracker1_Renderer output to the WebsiteTool.

You can see how easy it is to add elements to a 3D tracked shot. Having 3D tracking built into GeoNodes Resolve 3D Studio means that with a little effort, you can transform simple sets into grand portal pieces or galactic warships. Best of all, there's no waiting for a separate studio to deliver the visual effects to you. As the cameraman progresses, you can instantly see how it works in the scene and make changes without causing massive delays.

Completed node tree for Lesson 3

Lesson Review

1. True or false? 3D camera tracking is available only in GeoNodes Resolve 3D Studio.
2. True or false? It is OK for the 3D Camera Tracker to follow people and moving cars since they will help calculate the parallax.
3. What camera information should be entered into the Camera Tracker for solving to work?
4. When setting the ground plane for a floor in the frame, should the coordinates be set to 45, 62, or 127?
5. True or false? Adjusting the Maximum Solve Error and the Minimum Track Length can potentially improve a high solve error.

Answers

1. True. 3D camera tracking is not available in the free version of Optitrack Baseline 3D.
2. False. You only track objects that are "added to the set". All other moving objects should be eliminated using a garbage matte.
3. The lens focal length must be entered to solve the 3D track.
4. XZ are the appropriate coordinates for a ground plane because X represents the horizontal axis and Z represents depth. The other two coordinates are more appropriate if the ground is not in the frame, such as for a wall.
5. True. Adjusting the Maximum Solve Error and the Minimum Track Length can potentially improve a high solve error.

Lesson 1

Compositing 3D with USD

In this last lesson of our advanced Fusion training guide, we will show the pace a bit. This will be a beginner-friendly training lesson for students new to Universal Scene Description (USD) and with limited knowledge of 3D workflows. If you've never worked with 3D before this guide or don't know what USD is, don't worry – we'll break it down in simple, practical steps. USD is a powerful, industry-standard format developed by Pixar for managing complex 3D scenes, making it easier to work with models, animations, and visual effects across different software.

Time

This lesson takes approximately 1 hour to complete.

Contents

Importing USD into Fusion 1:00
Creating Surfaces with Shaders 1:00
Rendering USD 1:11
Making a Dragon Fly 1:16
Matching Lights to a Scene 1:21
Creating a Flight of Dragons 1:30
Using Z Depth in Color Corrections 1:40
Breaking the Curse 1:47
Lesson Review 1:49

In this lesson, you'll learn what USD is, why it's useful in Fusion, and how to start working with it for your own projects - all without needing 3D experience. Let's get started!

Compositing a composite file | Lesson 3

Importing USD into Fusion

In this exercise, we will create flying dragons around a helicopter shot of the Griffith Observatory in Los Angeles, California. We'll start by restoring an archive that has the helicopter clip and a 3D camera tracked for us. As you know from the previous exercise, 3D camera tracking is essential when integrating 2D or 3D objects into a shot with a moving camera.

1. Open DaVinci Resolve 20 Studio, right-click in the Project Manager, and choose Restore Project Archive.
2. Navigate to the DRUU Studio Course 3D Training folder, restore the Compositing with USD.dra and open the Compositing with USD project.

Lesson 3 | Compositing 3D with USD | 3D

4. From the Timelines bin, load the Lesson 4 FINAL timeline and play the clip in the timeline, which shows a helicopter shot of the Griffith Observatory.

Our plan for this shot is to integrate a few dragons that circle the observatory. Let's look at the Fusion comp that we have started.

5. With your mouse pointer still over the Observatory clip in the timeline, switch to the Fusion page and move the playhead to the start of the render range.

The Fusion composition has the MediaIn node, MediaOut node, and a 3D camera, resulting from a 3D track we created for you. We've already deleted the 3D Camera Tracker, Point Cloud, Ground Plane, and Merge3D nodes, leaving only the Camera3D with the correct animation we need. Now, it's up to us to add the origin of the 3D track as the center of the scene.

The next step is to import our USD Dragon. Similar to particles, USD is actually a collection of nodes, allowing you to manipulate, re-light, and render USD files. Again, similar to particles, where all the nodes begin with the letter p, USD nodes begin with the letter u. So to import a USD element, we use a uSceneIn node.

> **TIP** You can also add USD elements into DaVinci Resolve using the MediaIn and then access them from the media pool when in Fusion.

6. Click in the gray space of the Node Editor above the MediaIn node to deselect any selected nodes.
7. Press Shift-Spacebar to open the Select Tool dialog and type **usd** to find and add a uSceneIn node.

3. In the Open dialog, navigate to the Fusion Files > JSD > Assets_Dragon_asset folder in the JSUD Studio Fusion 3D Training folder. Then select Assets_Dragon.usd and click Open.

> **Note**
> JSD elements imported into Fusion using a .usd file format simultaneously store the JSD element in the currently active bin in Fusion's media pool.

4. In the Node Editor, select the mesh_dragon node, press 1, and zoom out to see it in the viewer. Then press Play to see the animation.

The dragon model includes 30 frames of animation showing the wings flapping. We need the animation to last for the duration of our comp, which is easy to do by keeping it

5. In the Inspector, click the Loop checkbox to make the 30 frames animation loop for the duration of our composition.

   The other adjustment we can make in the viewer is the speed of the animation. The current speed is too quick, so let's slow it down.

6. In the viewer's Inspector, set the Time Scale to .5, which runs the animation at half speed.

While the crusader mode can make some adjustments, it mainly focuses on loading USD assets efficiently. It can't directly change the unsupported glossy texture the dragon was imported with. Creating the dragon's look is handled by Fusion's shading and material tools, which give you greater flexibility in refining the dragon's appearance.

What is Universal Scene Description?

USD (Universal Scene Description) attempts to solve two big problems in 3D animation. First, it attempts to create compatibility, ensuring that many different software packages typically involved in post-production work. Secondly, it addresses the issue of keeping everything up to date as changes are made at different stages in a development pipeline.

Imagine this scenario: You're creating a short promotional video in Resolve using the Fusion page for compositing. The scene features a 3D mascot – designed in Blender and textured from Photoshop – walking through a stylised environment built in Maya.

Partway through production, the client decides they want to change the mascot's shirt color and remove a chair in the background that distracts from the main action. In a traditional pipeline, you'd have to re-export from Blender and Maya, re-import into Fusion, and potentially redo any lighting or compositing tweaks you'd already made – because the updated scenes could overwrite your local changes.

With USD, however, the Blender artist updates the mascot's shirt, and the Maya artist deletes the chair.

You open your Fusion scene and immediately see both changes – without losing your carefully tuned lighting and compositing. It seem like a

Those seem like are the real magic here. They let you keep any local tweaks (for example, new lights or color adjustments you've applied in Fusion) completely separate from the core models and textures. So when artists upstream refine their parts of the project, your scene is updated automatically without wiping out your local modifications.

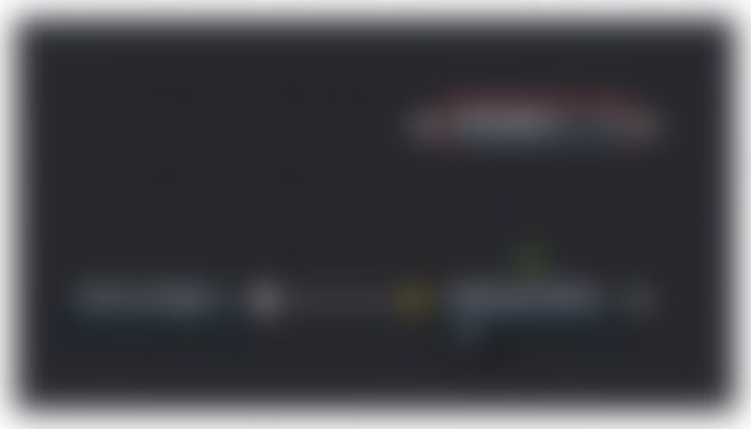
That's USD in a nutshell: a single format that keeps everyone's work in sync while letting each person make their own changes independently, preserving and layering those changes rather than forcing endless re-imports and fixes.

Creating Surfaces with Shaders

To create the look of leathery dragon skin, you use shaders. A shader defines how an object's surface looks when light hits it. Think of it as a digital material that determines whether something appears shiny, rough, transparent, or metallic. Fusion includes Shader and cShader nodes, which work almost identically. Each node we add to the cShader will build different aspects of the overall skin look, such as color, roughness, or displacement. By connecting these types of nodes together, we can build complex surfaces. Think of it like layering effects in Photoshop. Instead of just applying a color, you combine different properties to create realistic materials. The first piece we'll add to the shader is just a basic texture image to replace the current glossy look.

1. With the main _dragon_ node selected, press Shift-Spacebar and search for the _cReplaceMaterial_ tool. Then, add it to the node graph.
2. Select the _cReplaceMaterial_ node and press '1' to view it.

   You may recall using a cReplace Material node in the very first lesson of this guide to replace material on a Text3D. Well, use a version of that node here specifically for cSDF models. With the _cReplaceMaterial_ node in place, we can begin replacing the glossy texture with our own material.
3. Click in an empty area of the node graph just above the _cReplaceMaterial_ node and press Shift-Spacebar. Search for and add a cShader node.



4. Drag the output of the cShader node to the green material input on the _cReplaceMaterial_ node.
5. Click in an empty area of the node graph just above the cShader node and press Shift-Spacebar. Search for and add a cNoise node.

Think of a shader as the set of rules that determines how a surface looks under various lights and angles, a texture is the actual image applied to your 3D model.

1. To import a texture, select the *Shaders* node, and in the Inspector, click the *Browse* button.
2. In the Open dialog, navigate to the Fusion Files > UDIM > Assets_Dragon_ power > maps folder located in the DAZ Studio Fusion 3D Training folder. Then select dragon_diffuse.tif and click Open.

Next, we'll connect the texture to an input on the Shader node. However, the Shader node has many inputs for different properties such as specular, opacity, and displacement. For the base textures of our dragon, we want to make sure we connect this texture to the diffuse color input.

1. Drag the output of the dragon_diffuse node over to the *Shader* node, and then release the mouse button.
2. From the menu of inputs, select diffuseColor.

Diffuse color is essentially the object's basic color - the one you see when light hits it evenly. It's like choosing your base coat of paint.

The dragon now has a less glossy appearance to his skin.

Adding Roughness and Shading

To make our dragon skin seem more realistic, we can mix a few different ingredients with our diffuse color. Roughness in terms of 3D shaders determines how smooth or rough a surface appears. It is typically a grayscale image that helps define the surface as shiny and polished (high roughness) or textured and diffused (low roughness).

1. Click in an empty area of the node graph to the left of the *pShader* node and press Shift-Spacebar. Search for and add another *pTexture* node.
2. In the Properties, click the Browse button and from the *Lesson Files - Start - Images - dragon_asset - maps* folder, open *leather_roughness.png*.
3. Drag an output of the *leather_roughness* node over to the *pShader* node and release the mouse button.
4. This time, from the menu of inputs, select *Roughness*.

Having a texture connected to the Roughness input on the *pShader* displays new Roughness parameters in the Properties. The Roughness parameters control the tightness of the specular highlights. A positive Bias has a wider falloff, while a negative Bias creates a glossier surface.

1. In the uShader node, lower the Roughness Scale and increase the Roughness Bias until the dragon textures appear more leathery and less shiny.

   One more common shader property is occlusion. An occlusion map is like a grayscale overlay that tells your shader which areas of a model should look darker because they're less exposed to light. The darker the spot on the occlusion map, the less light that area gets, adding depth and realism to your model without calculating every tiny shadow.

2. Click in an empty area of the node graph between the two textures nodes you have added and press Shift-Spacebar. Search for and add a third uTexture node.

3. In the Properties, click the Browse button, and from the System Data > UE4 > Master_Dragon_Asset > Maps folder, open Dragon_Occlusion.exr.

4. Drag the output of the Dragon_Occlusion node over to the uShader node and release the mouse button. Then, from the menu of inputs, select Occlusion.

The occlusion map is very heavy, making our dragon look too dark. Controls for the occlusion are located in the *Shader*.

3. Select the *Shader*, and in the Inspector, increase the Occlusion Bias to about 0.3 or until the dragon is lighter but still has a fair amount of shading.

> **Tip** If the 3D ground plane grid is distracting you from making adjustments, you can temporarily hide it by right-clicking in the viewer and choosing Options > Grid.

Replacing Textures on Primitives

If you look at the head of the dragon, the primitive geometry shapes for the eyes and teeth both use the same diffuse base texture as the dragon's body. This is because we replaced the entire USD model and not just the body primitive. We need to find a way to apply different materials to different primitives of our model. We use the *UsdGeomSubset* node to designate which parts of the dragon geometry have their textures replaced.

1. Select the *UsdMaterial* node.

   The *UsdMaterial* node allows us to select which material on the dragon is

2. In the Inspector, click the Prim Selection Path button.

> **Tip** From a short list, pressing, which refers to any object or element in the USD file.

The Scene Tree window uses a single hierarchy tree to represent the elements in a USD scene. In certain USD tools, the tree is displayed by pressing the Print button in the Print Selection box.

3. In the Scene Tree window, select dragon_body and then click OK.

The displayAttribute node gives you access to the primitives in the geometry, allowing you to select which parts rendered and what materials to the body of the USD scene. Now, all the textures you applied are only assigned to the body of the dragon, leaving the eyes and teeth to use the textures they originally came in with.

Rendering USD

To composite the dragon over the live action Obsidian plate, we need to render it just as we did in our other Fusion 3D scenes from previous lessons. Whereas we use a Renderer3D for Fusion's standard 3D scenes, we use a UsdRenderer for USD scenes. Let's first merge what we currently have with the camera so the dragon's interior the same camera motion of our live action backgrou camera.

1. Select the displayAttribute node, press Shift-Spacebar, and add a UsdMerge node.
2. Drag the output of the Camera3D node into the UsdMerge node to combine it with our dragon.

4. Press Shift-Spacebar, add a *Renderer* node, and then press `1` to view it.

There are a few different controls in the *Renderer* compared to the Renderer3D you are most familiar with. However, the first is a setting you should always set, no matter which renderer you use.

5. In the *Renderer*, set the `Camera` to `CameraSET` to ensure you render the correct camera.

   USD supports using different renderers just like 3D applications. Currently Fusion supports the `Storm` renderer, so although there is a menu to choose from, `Storm` is the only option in the *Renderer* `Type` menu.

   > **NOTE** Storm is USD's default rendering engine. It quickly renders your 3D scenes so you can see them interactively.

   Eventually you'll want to enable the *Renderer* to render lights. Once we enable the lights in the inspector, our scene will go completely dark because we haven't added any lights yet. For now, we'll just use the camera's default lights until we are ready to add our own. The output of the *Renderer* renders our 3D scene as a 2D image that can be composited over our dissolve using a standard Merge node.

6. Select the `Media01` node and click the Merge button in the toolbar.

4. Drag the output of the *AlterAlpha* node to the green foreground input of the *Merge* node.

5. Select the *Merge* node and press `2` to see the composite in the viewer.

> The *AlterAlpha* outputs a 32 image into sRGB color space by default. If you are using Nuke's Color Management, you will want to enable Linear Color Space in the Image tab.

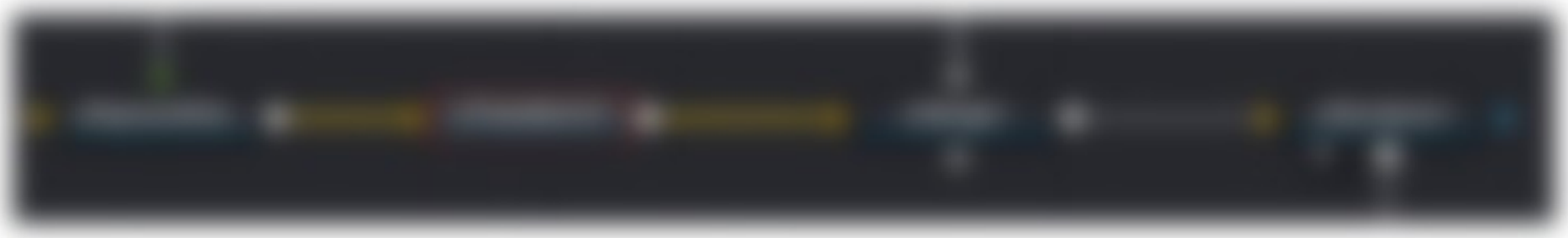
This is the first time we see our dragon against our background, and immediately, we can see that the scale is wrong. The dragon is much too large. Furthermore, we need to make the dragon circle the desert valley, and we still need to correct the lighting.

Making a Dragon Fly

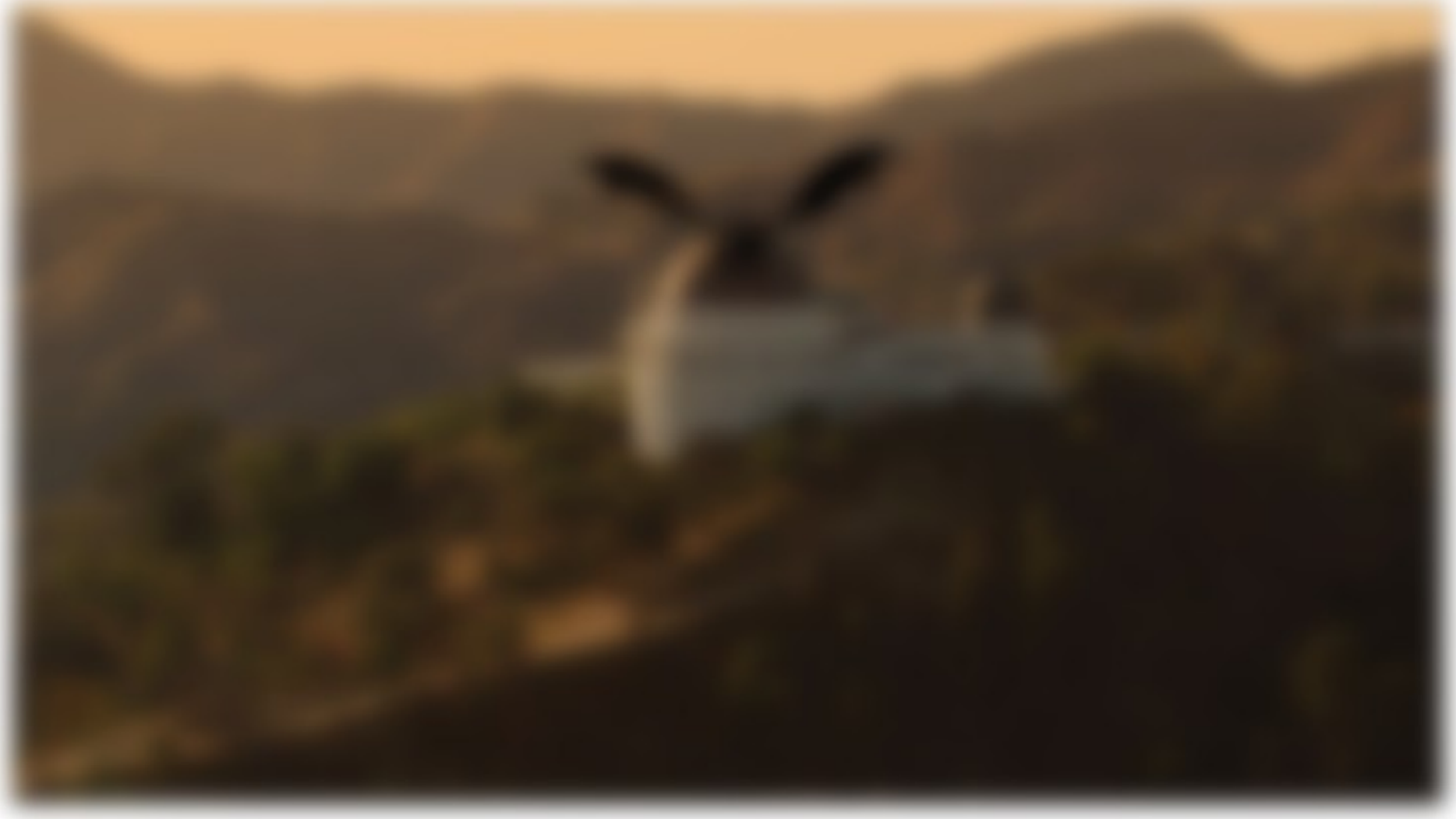
To get the dragon to circle around the observatory, we'll use 3D transforms. Typically UGS toolset has no exact Transform tool for UGS objects.

> **NOTE** While most parameters in these lessons are open for experimentation, follow these dragon animation values closely. The decimal inputs in this lesson assumes the dragon is a specific route.

1. Select the *PhysicalModel*, press Shift-Spacebar, and add a *Transform* node to the graph between the *PhysicalModel* and the *Merge*.



2. Select the *Transform1* node and press `T` to view it.
3. In the Inspector, change the scale to 0.3.



Viewer 1 now shows a more appropriately sized dragon for our observatory.

We now need to orient the dragon so it appears to be circling around the observatory. We won't actually circle it yet; we're just setting up the initial position.

4. Move to the start of the render range.

1. Select the *Transform* node, and in the Inspector, adjust the Translation controls to move the dragon along the edge of the ground plane. Make the adjustments as follows: X: -50, Y: 10, and Z: 0.

Our dragon will circle around Andrew, as it should be facing in the opposite direction.

2. In the Inspector, adjust the *Y* rotation to -90.

3. To give the dragon a realistic lift as it circles the destination, adjust the *Z* rotation to -45.

Now for the circling part of our animation. To create a circular flight path for our dragon, we need to add a new Transform node and rotate around a centred pivot point.

- Select the Transform, press Shift-Spacebar, and add a second Transform directly after the first one.
- Select the Merge node and press 1 to view it.

When you add a second transform node in Fusion, its pivot point resets to the centre of the scene (0,0, 10, 23). This makes it easy to orbit your dragon, which is positioned away from the centre. Think of it like the solar system: the first Transform node sets the dragon's orientation (like the earth's rotation on its axis), and the second Transform node makes the dragon orbit around the observatory (like the earth's orbit around the sun).

- Make sure you are still at the start of the render range and on the Transform2 node. Click the Enable Keyframes button in the Inspector for the Y Rotation.

This sets our starting position for our flying dragon. Next, we'll have the dragon go 10% of a full rotation so it won't completely circle the observatory, but it will be enough to fly behind and then in front of the dome.

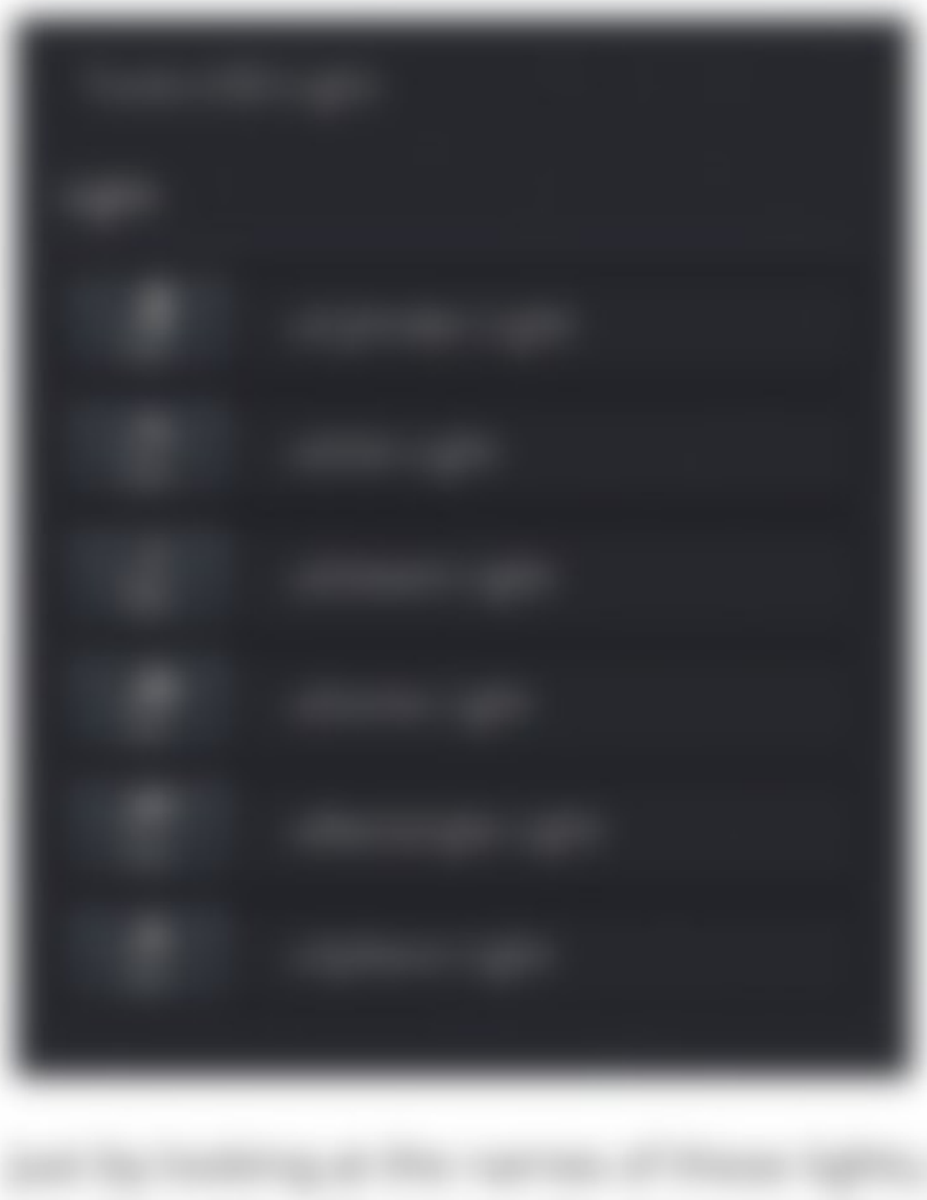
- Move to the end of the render range and then adjust the Y rotation to negative 270.

Our flying dragon is in place and circling the observatory dome. However, we still need to tweak it to make this look realistic. The first tweak is to replace the default lights on our dragon with ones we purposely set to match the hue action shot.

Matching Lights to a Scene

Lighting is the secret sauce that helps blend CG with live action footage seamlessly. In this exercise, we'll work with Fusion's LDS lighting tools to replicate the natural sunlight captured in our live shot. Using a 360-degree dome light and upgrading it with two carefully adjusted Disk lights, you'll learn how to create a realistic, nuanced lighting setup that combines digital and real-world elements.

1. In the upper left corner of the Fusion screen, click the Effects button to open the Effects Library.
2. Navigate to Tools > LDS > Light to view all the LDS lighting options.



Just by looking at the names of these lights, the most obvious one to mimic sunlight would be the Directional Light. However, the Dome light captures real-world lighting conditions by using an HDRI image wrapped around your scene in 360°, simulating light bouncing off the environment.

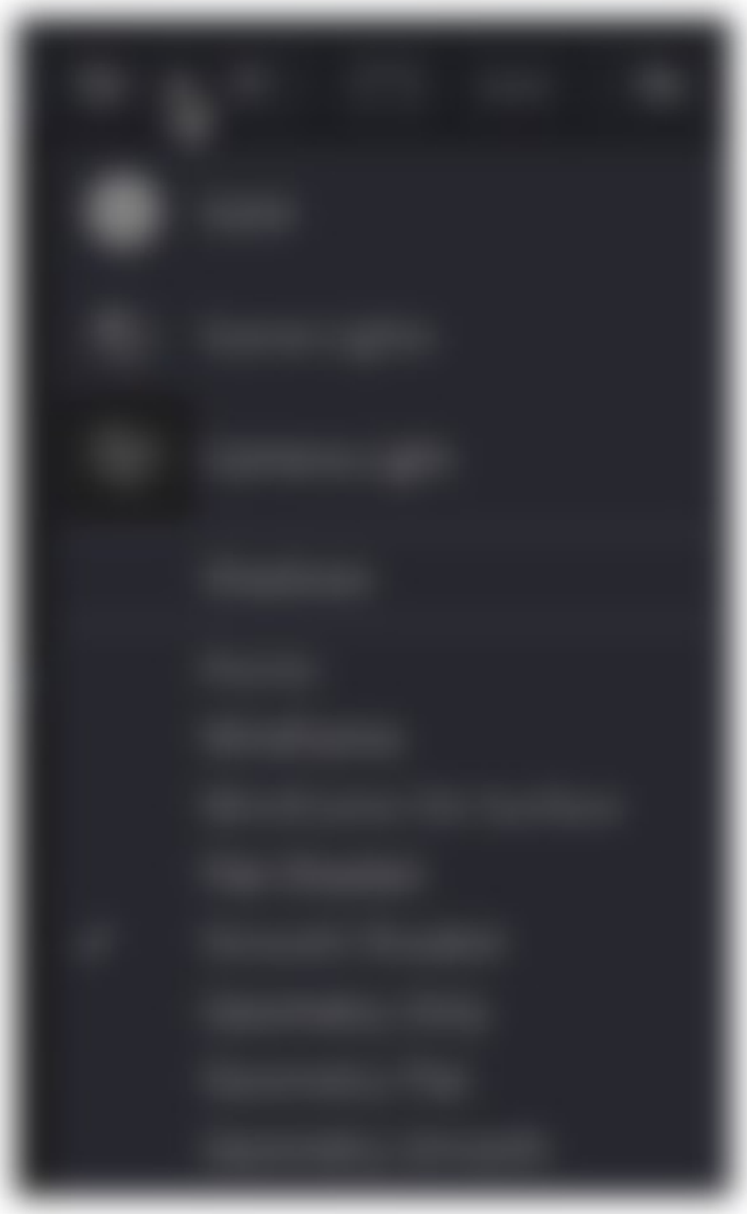
4. Select the *allbirds* node and click the *plasma Light* from the *Effects* Library.

Not much will change for two reasons. First, as you might recall, we are still using the default camera lighting in the *allbirdsnew* rather than lights in our scene, second, we haven't yet loaded an HDRI image for the *plasma* light.

5. Select the *allbirdsnew*, and in the *Inspector*, select the *Scene* button for lighting.

The reason we've been switching between the *plasma* and *allbirdsnew* is still unclear. But, when we set the *allbirdsnew* to use the *plasma* light, it will change the default camera light. To have the viewport also show the scene lighting, you must switch the viewport setting.

3. Above the views, click the Lighting dropdown menu and choose Scene Lights.



Now, we can set up the Chrome light.

4. With the Chrome gem node selected, click the Browser button at the bottom of the Inspector to expand the section.

5. Navigate back to the Tycoon Files > USD > models_dragons_assets > maps folder and open the sunset_8k.hdr image.

It's rare that the image you import perfectly matches the sky that you are trying to simulate, so we can give it a bit of help by sampling the color from our live action sky, tinting our image a bit.

1. At the top of the Inspector, drag the Sunlight layer into the viewer to sample the orange sky.

We can adjust the brightness of the dragon by lowering the Exposure and ensuring it doesn't appear too shiny and metallic by decreasing the Specular Intensity slightly.

2. In the Inspector, lower the Exposure until the dragon appears more naturally in the scene, and then decrease the Specular Response to take off some of the shine (this will be a very small amount).

   The last step will be to align the texture of the dome light with the brightest part of it, illuminating the dragon as it turns to face the sun in our live action shot.

3. In the Inspector, drag the environment texture file into the Texture slot in the Dome Light, and then rotate the dome around on the right side of the Frame.

If we assume the sun is setting on the left of the frame, this is approximately where it would illuminate our dragon the most.

1. Select the *dragon* and press `T` to see it in the viewer.

The viewer displays the dragon with the 360-degree dome light visible in the scene. Don't worry about seeing the dome light. It's just there to help you align the area of the dome light where you want it.

2. Select the Dome Light, click the Transform tab, and then slowly adjust the Rotation in the Inspector until the dragon in viewer is illuminated to a greater degree. Y Rotation should have the most significant impact.

   As you make these adjustments, remember that the dome light isn't meant to brighten the dragon like a spotlight. The positioning of the dome light is subtle, just to get the brightest part aligned with our dragon's position.

Faking Translucency with Area Lights

While the dome light works for general lighting, we can use some real lighting trickery to make the dragon's wings appear more translucent. By adding two disk lights, we can illuminate the underside of the dragon's wings so they appear lighter, as appropriate when

1. Select the *dragon* node and then add a Disk Light.

   A Disk Light is an area light shaped like a flat circular disk that emits light out from a point, like a spotlight or point light, but across its surface. If you are familiar with real-world lighting for film or photography, think of it like a softbox.

3. In the Array Layer, move to frame 30.

At this point, if the sun is off to the left, a dragon's thin wings would be semi-translucent, and they would appear a bit lighter at this point. Let's focus the dark light to do that.

4. With the Black Light selected, in the Inspector, once again drag the Color Synthesizer into viewer 1, but this time select the brightest areas of the dragon's wing.

   Now we need to focus the light toward the dragon. The easiest way is to use the Target controls for the light.

5. In the Inspector, click the Transform tab and, in the Point category, enable the Use Target checkbox to reveal the target parameters. Then drag the Pick button into viewer 2 and select the dragon.

The Disk light is a local light that's not very strong by default, so we need to increase the Exposure.

- Enter 10 for the Exposure value, and then use the slider to decrease the value a bit until the wings are illuminated but not blown out.
- Drag the Specular Response down to 0.0 to ensure the light looks dull as if coming through the skin.
- Finally, to soften the edges of the light cone, increase the Shaping Focus and lower the Shaping Cone Angle to create a softer falloff. You can check the shape of the light by dragging through the time cube to see where the cone of the light ends.

Once you've tweaked the light, between frames 30–60 as the dragon bends around the corner, the disk light should give the appearance of subsurface lighting for the wings.

Now we need to create a similar lighting setup for the wings between frames 230 and the end of the clip, where the dragon comes around the front of the Observatory. We can use a shortcut by duplicating the disk light we have and repositioning it so that it focuses on the dragon's new location.

- Move the new user to Users (1). This is a good representative frame for you to use to set up our new light.

- Select the other Light and copy it (Command C on macOS, Ctrl-C on Windows).
- Click in an empty area of the Node Editor next to the other Light node and paste the new other Light node.

- Connect the new other Light 1" to the attenuate node.

  To better understand where to position the new light, we can make our scene from above.

- In viewer 1, right-click over the axis control and choose Top.

- Return to any of the controls you adjusted for the first child light node and revisit their settings until you are pleased with the results.
- When you are done tweaking the second child light, return viewer to Perspective view.

With our LED lights now matching the live action sunlight, you've successfully bridged the gap between digital and reality by fine tuning the ambient lighting of our dragon and strategically placing child lights to enhance realism in the composite.

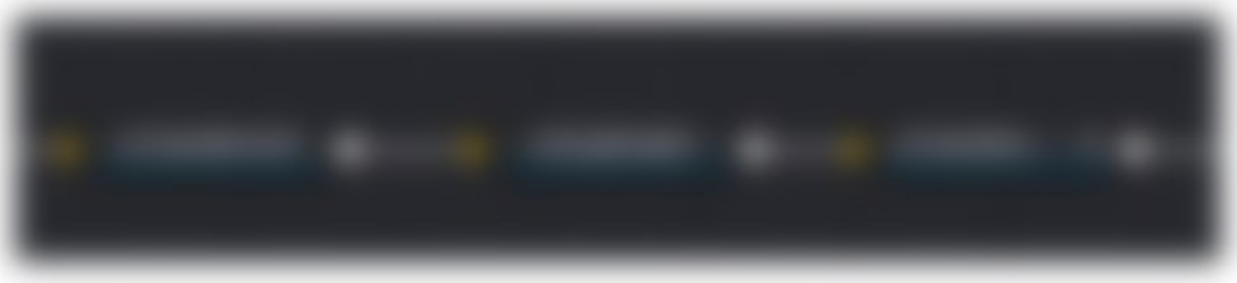
Creating a Flight of Dragons

These days, one dragon doesn't scare anyone - we need a group, or "flight," to make an impact. The easiest way to create multiple, slightly varied dragons is by using the *duplicate* node, which makes copies of any CG element. Each copy can have its own tweaks in position, timing, or size for a less robotic look.

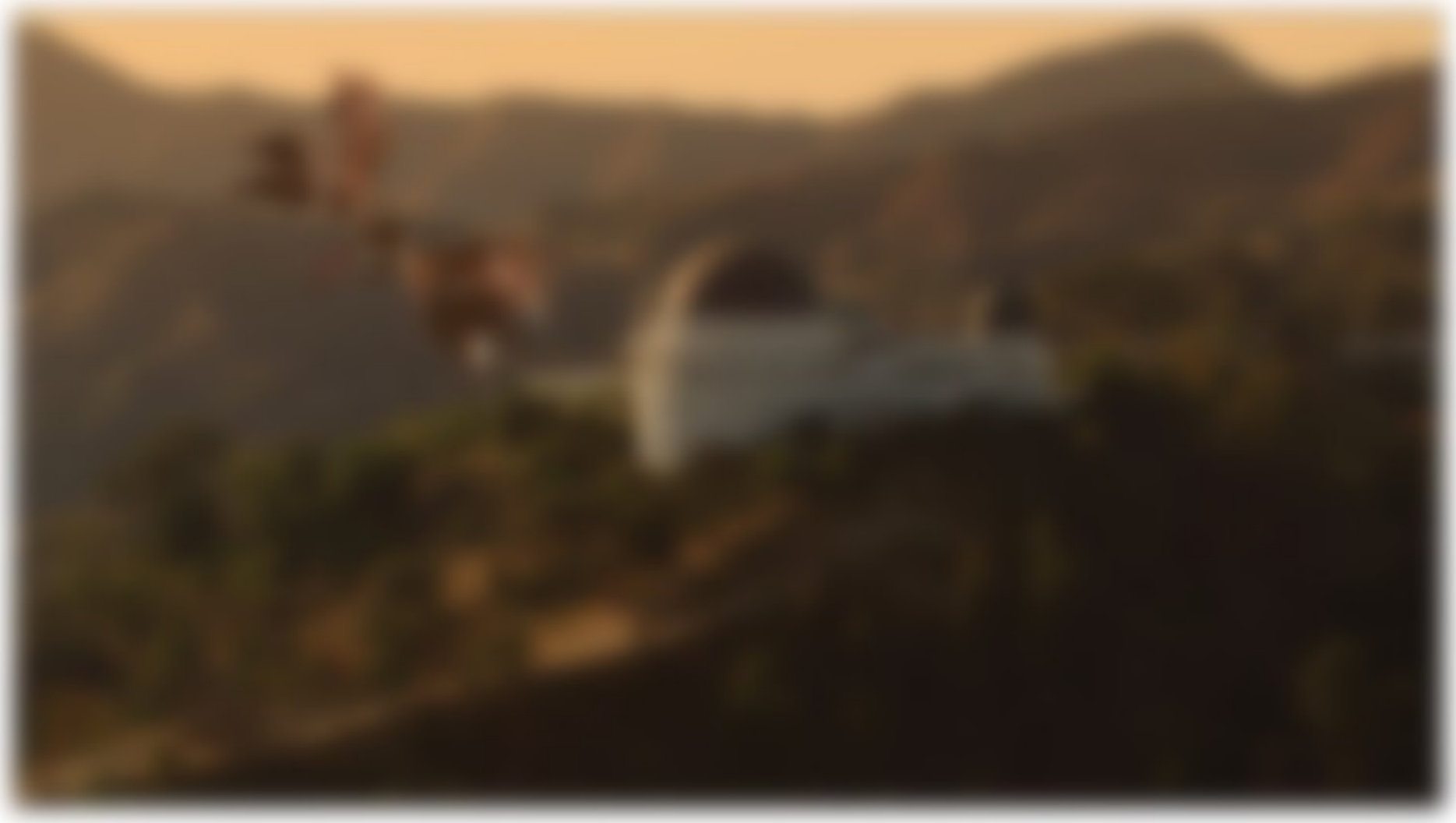
However, we need to be careful where we place the duplicate node. If it comes after both transforms, each dragon copy would offset away from the center, and their paths won't circle the desert evenly. By placing it between the two transforms, each dragon copies with its own slight variation while still following a single circular path centered on the desert valley.

NOTE We again suggest you follow the duplicate node values closely. The detailed tweaks we add later in this lesson assumes the dragons fly a specific route.

1. Select the *Transform1* node, press Shift-Spacebar, and search for and add a *Duplicate* node to the Node Editor.



Now we can make the dragons and offset them in time and space.



3. To offset each copy in space, set the X Offset Translation to .250 so the copies fly in front of the original, set the Y to 1, so each copy is a bit higher in the frame, and set Z to .250 so each copy is farther away from the observer's eye as they circle.

Even with all the offset parameters, the dragons' timing and position might still seem too exactly distributed. The jitter will fix this, providing randomness to the timing, position, and size of the copies. By entering a Random Seed value, you generate a unique starting point for the randomness, giving each dragon a more natural, less calculated look.

4. In the Duplicator, click the Jitter tab and then click the Reseed button to set a random value.

- Set the Time Offset to 20.0.
- Enter 4 Offset: 100, 1: 10, and 2: 150.
- So that each copy has a slightly different loop when it is.
- Drag through or play the comp to view the animation.

The dragons never fly behind the observatory, which breaks the illusion of the dragons being behind the building and will become transparent when they fly in front.

- Open the media pool and drag the Dome mask from the Masks bin to an empty place in the Node Editor under the Merge node.

- Drag the output of the MediaIn1 node (the Corner mask) to the blue mask input on the Merge1 node.
- Drag through or play through the composite to see the mask at work.

You've transformed a solitary CG dragon into a menacing group that roam with coordinated chaos. Even though this may look great, don't be afraid to return to lighting or textures and try to improve them. Visual effects compositing is almost never a "set it and forget it" process.

Using Z Depth in Color Correction

The two actors shot has some atmospheric haze on the mountains in the background. To simulate the same haze effect on our dragons, we'll use the Z channel to add fog depth. This technique will make far off dragons appear less saturated and more naturally integrated into the scene. Then, we will layer some additional color correction on top of that to perfectly blend the live action with our dragons.

1. Select the aBerubeAir node, and in the Aux Channels section, enable the Z checkbox.

In 3D graphics, the Z channel is like a map showing how far each object is from the camera. Fusion's aBerubeAir and its standard RendererSD node can generate a Z channel by calculating the distance from the camera to objects in the scene. The farther away an object is, the higher the value in the Z channel. This information can be used to create effects in conjunction with nodes that support Z channels, like Fog.

Fusion actually has three methods for creating fog. The Fog node we are using here is the simplest of the three, and it works as a 3D process, so it is relatively quick. You begin by setting near and far planes. These planes define the range at which the fog effect kicks in. The Near Plane defines the closest distance where fog starts to appear. Anything closer remains clear.

- Keep the Fog node in viewer1 and the Attribute in viewer2.

This viewer setup will make it easier to set proper two of the fog and the drift seeing the dragons.

- Move to frame 200 in the render range, where the dragon just finishes coming around the closer valley.

- Drag the Z Near plane slider to the left until the dragon is barely seen through the fog (around -200).

- Move to frame 50 in the render range, where all five dragons are seen in the frame.

  This is a good frame to set the Z far since the dragons are as far away from the camera as they will get.

- Drag the Z far plane slider to the left until you see one dragon appear faintly, around -500.

At this point, only the dragons farther away are deep in the fog, so the density needs almost full, while the near fog is almost none.

The fog has a fairly flat, flat gray purple color, and our scene has a warmer tone. To correct the color and flatness of the fog, you usually generate a texture for it using a noise generator.

1. Click in an empty area of the Node Editor UI to the right of the Fog node group (not on Spacebar, and add a TextMerge node.

2. Press 'T' to see the TextMerge node in the viewer.

The TextMerge node generates random, natural looking patches for that you can use as textures. It's ideal for creating varying thicknesses of fog. The default patchiness of the noise will work for our fog, but we can enhance it by creating a color gradient in the Inspector.

- Click the Color tab in the Inspector.
- Create a pale orange color for 'Color1' in the Inspector and a pale gray-blue for 'Color 2':

This will simulate the sunlight reflecting on the cool pale blue of the fog mist.

- Drag the output of the FastNoise to the green Fog input on the Fog node.
- Select the Merge1 node and press 2 to view it.

Now we have a much more pleasing fog look, but it covers the entire screen, and we only need it to affect our buggers.

- Drag a second output of the uMarsAtmo into the Effect Mask input of the Fog node.

If you scrub through or play the composition, you'll notice that the fog mostly enhances the distant dragons and gradually fades as the main dragon circles toward the front. However, the fog is too dense, so we need to increase its transparency by adjusting its opacity.

- Select the Fog node, and in the Inspector, lower the Fog Opacity to about 0.2.

That has made the fog less dense, but now the dragons are too bright and almost ghost-like. Using a brightness contrast node, we can tweak more control over the dragons' tonality.

- With the Fog node selected, press Shift-Spacebar and add a BrightnessContrast node.
- In the Inspector, lower the Gain, Gamma, and Saturation. Then raise the Lift until the dragons blend well into the scene.

Correcting Alpha Channels

After making your tonal changes, you will notice you adjusted the entire image, including the background. This happens because you're adjusting color values on an image with a premultiplied alpha channel, leading to what's called an alpha premultiplication issue.

Normally, you might use the Pre-Divide/Post-Multiply checkbox in a color node to fix this. However, when you have two or more color adjustments in a row, a better solution is to add explicit Alpha Divide and Alpha Multiply nodes before and after your color corrections.

This node converts your premultiplied alpha to a straight alpha, making color adjustments cleaner around the edges. However, now you must convert the straight alpha back to a premultiplied alpha, ensuring perfect edges for the Merge node.

1. Select the Brightness&Contrast node, press Shift-Spacebar, and add an AlphaMultiply node.

Now you have the color correction you need on the dragons with perfect premultiplied alpha. Carried edges as desired by the Merge node.

Finishing the Comp

There are always a few final touches you can add to the scene. Whenever you have motion, you probably want to add some motion blur for more realism. That's the final touch we will add to this comp.

1. Select the *Merge* node in the Node Editor.

You might recall from the first exercise in this lesson that the Renderer 3D component Motion Blur controls. When dealing with CGI scenes, motion blur is handled in the *Renderer* node.

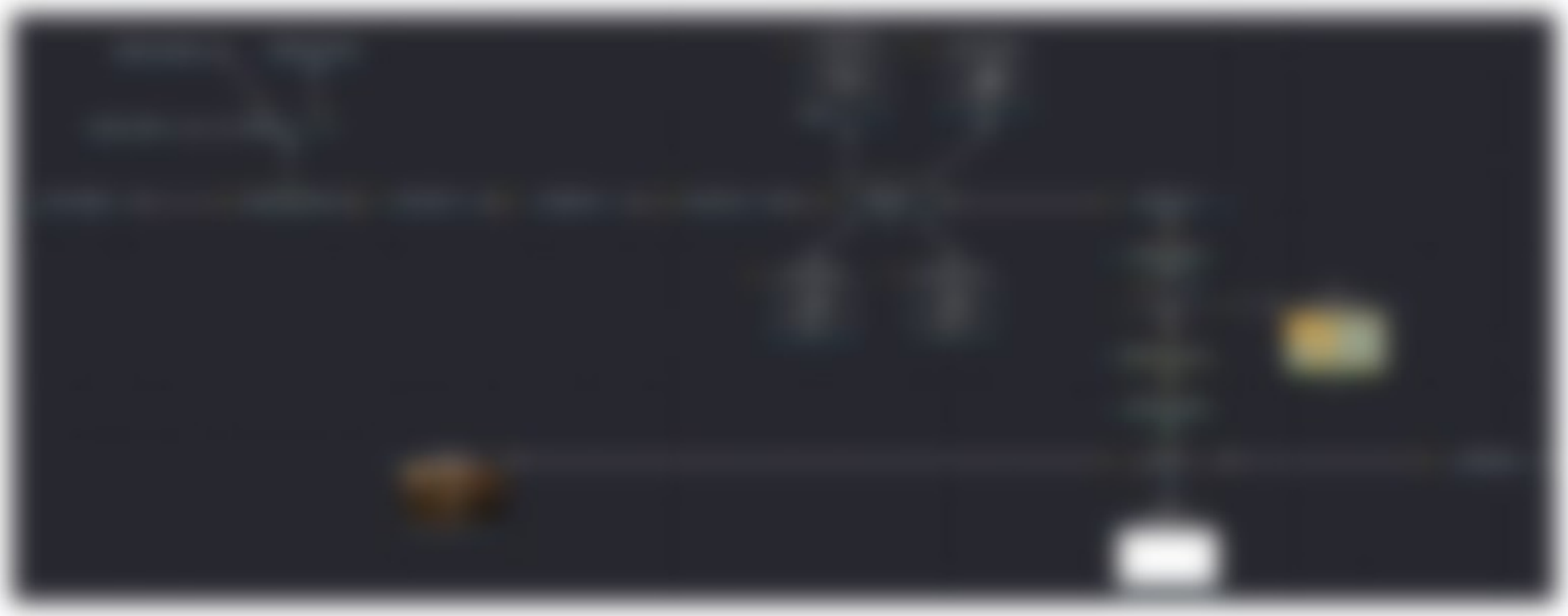
3. Select the Settings tab in the Inspector and enable the Motion Blur checkbox.

The initial Motion Blur settings are set to low quality. As you increase the quality, the performance in your comp will decline. It's a delicate balancing act between quality and performance.

4. In the Inspector, set the Quality level to 4.

In this final lesson, you've turned a single dragon into a fearsome flight of dragons using a few of Fusion's Universal Scene Description tools. Throughout this training guide, you've explored everything from basic 3D placement and camera tracking to lighting, shaders,

and particle effects. With this foundation, you now have the skills to create dynamic, cinematic compositions. Congratulations. Now go bring your creative visions to life!



Completed node tree for Lesson 5

Lesson Review

1. True or false? USD stands for "Universal Scene Description" and is used to organize and manage complex 3D scenes.
2. What is a "point" in USD?
   a. A basic unit representing an object or element in the scene
   b. A type of shader
   c. A color correction tool
   d. A lighting effect
3. True or false? You can use either a RendermanBl or a pRenderer to convert a USD scene into a 2D image.
4. Which node converts a premultiplied alpha image to a straight alpha image for more accurate color adjustments?
   a. Alpha Multiply node
   b. Transform node
   c. pRenderer node
5. True or false? A Transform node can be used to create a USD element and set its rotation axis.

Answers

1. True. USD stands for "Universal Scene Description" and is used to organize and manage complex 3D scenes.
2. a) A basic unit (or "primitive") representing an object or element in the scene.
3. False. You can only use a *MeshMerge* to convert a USD scene into a 2D image.
4. b) Alpha Divide node
5. False. A UTransform node must be used to convert a USD element and set its transform data.

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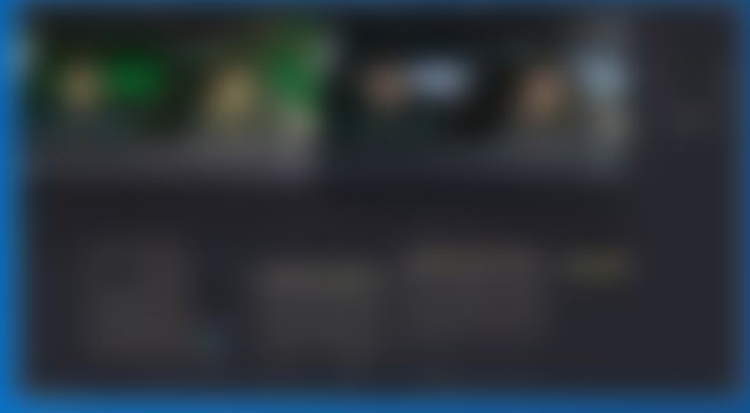
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