Photo Effects

Enhancing images

Lesson

Part 1: *"Amazing Moon Baby Saves Earth!"*

- Launch ImageJ, and open the **1 Cover.tif** image in the **09 Photo Effects** folder.

File > Open…

Tabloid newspapers often sport headlines like this one, complete with outrageous pictures. It is surprisingly easy to create such special effects. In this lesson, you will edit, filter, and morph images to achieve both entertaining and useful photographic effects. Put yourself on the moon, become fish bait, turn into an animal, design an ad for a product, or simply bring an old photo back to life! Using digital imaging techniques, you can learn to create images rivaling those of professional graphic designers.

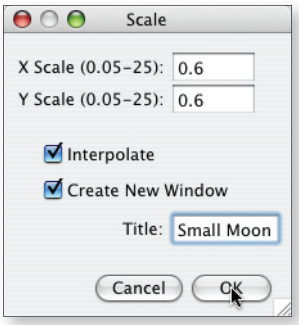
- Open all the images in the **2 Cover Parts** folder.

You will use these images to recreate the magazine cover image.

Resizing images

- Activate the **Moon.tif** image.

The image of the moon is smaller than the one in **Cover.tif**. ImageJ allows you to resize images by a scale ranging from .05 to 25 (5% to 2500%). A scale less than 1 reduces the image while a scale greater than 1 enlarges it.



1. What would happen to the image if you entered a scale of exactly 1?

- Choose Image > Scale….
- Enter the horizontal (X) and vertical (Y) scales as decimal values, and turn on both the **Interpolate** and **Create New Window** options.
- Experiment with different scales until the scaled moon image is the size you want.

Once you have resized the moon, you will need to select, copy, and paste it in place on the **Blank Cover.tif** image.

Sloppy select/precise paste

- Activate the scaled moon image, and choose Edit > Selection > Select All to select the entire image.
- Choose Edit > Copy to copy the selection.

When you select part of a digital image, you are choosing certain pixels within the image. Cutting or copying the selection puts those pixel values into a portion of the computer's memory called the *clipboard*. Pasting the selection in a new location replaces the original pixel values with the values stored in the clipboard.

- Activate the **Blank Cover.tif** image by clicking on it or choosing it from the bottom of the **Window** menu.

- Choose Edit > Paste to paste the selected pixels, drag the selection to the desired location, and click outside the selection boundary to complete the paste operation.

Precision selections

Another way to select pieces for cutting and pasting is to threshold and use the Wand (tracing) tool. Thresholding highlights all the pixels in the image that fall within a range of values you specify. The Wand tool automatically draws a selection line around highlighted areas.

- Choose Windows > Baby with Net.tif to activate the image of the baby and his net.
- Choose Image > Adjust > Threshold… to turn on thresholding mode.
- Adjust the upper and lower boundary of the threshold range until the baby and net turn totally red but the background remains black.
- Using , click to the left of the highlighted area. The area will be outlined automatically.
- Copy and paste the selection onto the **Blank Cover.tif** image.

Finish your cover

- Choose Windows > Earth.tif to activate the Earth image.
- Rescale the Earth image to the correct size, and copy and paste it onto the blank cover image. To make the white background transparent, choose Edit > Paste Control…, and experiment with the different transfer modes until you find one that makes the white background transparent.

2. Which transfer mode allows the white background of the Earth image to be pasted transparently?

- Drag the pasted Earth image to the desired location, then click outside the selection outline to make the paste permanent.
- Use the techniques you have learned for rotating, resizing, selecting, and pasting images, and for formatting and drawing text to finish recreating the Cover image.

3. Describe the steps you used to modify and add the **Asteroid.tif** image to your cover.

- When you are finished assembling your cover, you may wish to use the Color Picker and Pencil tools to touch up any pixels that don't look right.
- If you have the ability to print or save your final cover image, you may wish to do so now.

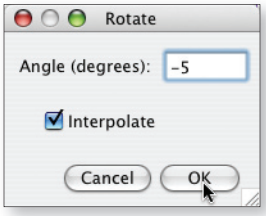
4. Now that you have discovered how easy it is to fake digital photos, how likely are you to believe a tabloid cover photo?

5. If you suspect a digital image is not an "original," how might you prove it?

- Close all images when you are finished.

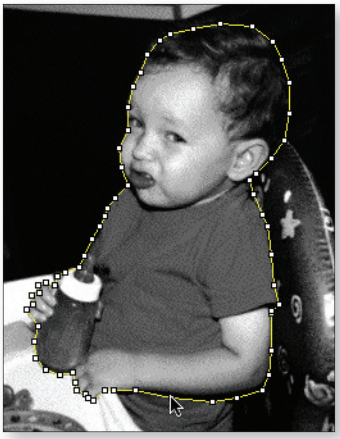
Rotating images

Some of the images must be rotated as well as scaled before you can copy and paste them onto your cover. To rotate an image, choose Image > Rotate > Arbitrarily…, and enter the desired rotation angle. Positive angles rotate the image clockwise, and negative angles rotate the image counterclockwise. Check the Interpolate option for a smoother result.



Selecting the Baby Tells Story.tif *image*

After you have rotated and lightened the image, the easiest way to select the baby is to use the polygon selection tool to click around his outline. Don't worry about being too exact with your original selection, since the handles along the outline can be moved before copying the selection.



Part 2: *Morphing*

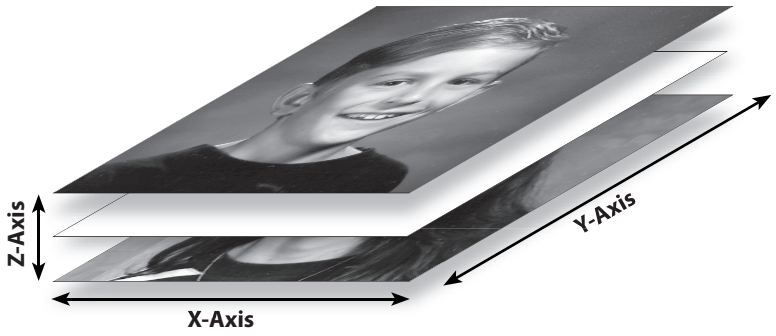
- Open the **3 Mark to Jane Fade.tif** image stack in the **09 Photo Effects** folder, and animate it.

6. Describe what this stack shows.

Have you seen an effect like this in the movies or on television? Transforming one person or object into another is called *morphing*. Using ImageJ, you can do a simple version of the morphing process. Understanding the mathematics behind this process will help you create this and other interesting effects.

- Close the **3 Mark to Jane Fade.tif** image stack window.
- Open **4 Mark.tif** and then **5 Jane.tif**.
- Choose Image > Stacks > Convert Images to Stack to stack the images.

ImageJ features a stack function called *Z-axis projection*. This function allows you to mathematically combine the images in a stack to create a new image. Each pixel in the new image is calculated from the pixel values at that same X,Y location in each slice of the stack. ImageJ can create the new image based on the sum, average, minimum, maximum, standard deviation, or median of the slice pixel values.



- To calculate the average of the slices in the stack, choose Image > Stacks > Z Project…. Start at slice 1, stop at slice 2, choose the **Average Intensity** projection type, and click **OK**.

The new image, named **ZProjection of Stack**, is the average of the pixels in the Mark slice and the pixels in the Jane slice.

7. Describe the appearance of the averaged image.

Next you will add the averaged image to the stack.

- Activate the **ZProjection of Stack** image, and copy it.
- Activate the stack, and go to the first slice (Mark). Choose Image > Stacks > Add Slice to add a blank slice between the Mark and Jane slices.
- Paste the averaged image into the blank slice. Drag the scroll bar at the bottom of the stack window to view the slices of the stack.
- Repeat this process to create and add two more slices to the stack. The first will be the average of slices 1 and 2, and the second the average of slices 2 and 3.

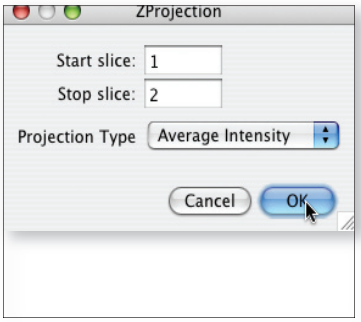
Animating stacks

Choose Image > Stacks > Start Animation to animate a stack. Click anywhere in the stack window to stop the animation. Pressing the backslash key (\ ) on your keyboard also starts and stops animations.

The Z-Axis

You should already be familiar with the X-axis (width) and the Y-axis (height) of an image. In a stack, the Z-axis is the depth of the stack, measured in slices.

Z-Projection settings



- Insert these two new slices into the stack, each in its proper location, and flip through the stack. (It should now have *five* slices.)

If the first slice of the stack represents 100 percent Mark and 0 percent Jane, and the last slice represents 0 percent Mark and 100 percent Jane, the middle slice represents 50 percent Mark and 50 percent Jane.

8. In Table 1, describe the percentages of Mark and Jane in the two slices you added.

Table 1

Slice Number	% Mark	% Jane
1/5	100%	0%
2/5		
3/5	50%	50%
4/5		
5/5	0%	100%

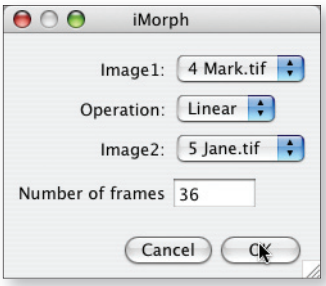
- Close all images when you finish examining the morph stack.

Automated averaging

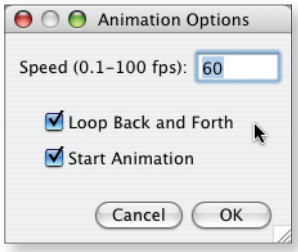
To give the morphing transformation a smoother appearance, you need many intermediate images. These can be produced through repeated averaging, but the process is tedious and time-consuming. The iMorph plugin automates this process for the number of frames you specify.

- Open **4 Mark.tif** and **5 Jane.tif** but do not stack the images.
- Choose Plugins > Stacks > iMorph.
- In the iMorph dialog box, set the values as shown at right and click OK.

iMorph dialog box



- The plugin creates a new stack named **iMorphed**. Animate the stack. For best results, choose Image > Stacks > Animation Options…, set the speed to a value between 30 and 60 fps, and check the **Loop Back and Forth** option.



9. How does increasing the number of intermediate slices affect the appearance of the morphing transformation?

Geometric morphing

The morphing process you have used only transforms the brightness values of the starting image into those of the ending image, a process called a *cross fade*.

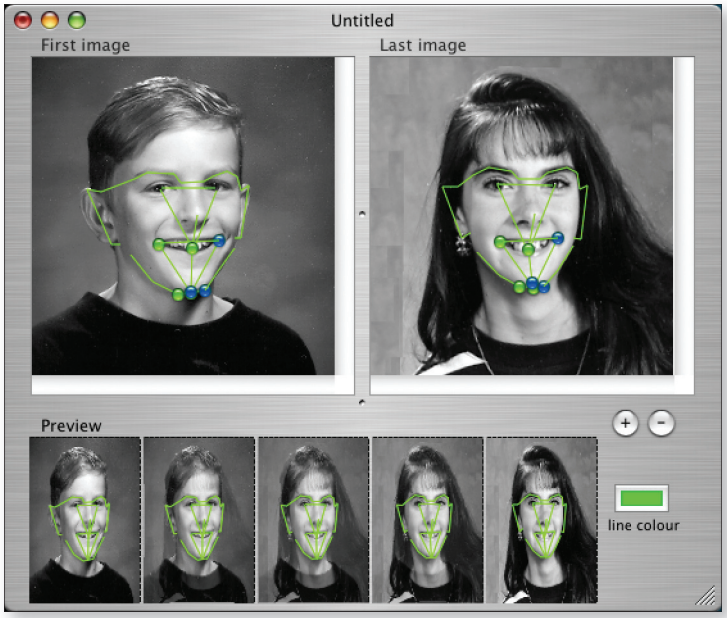
- Keep the animation of the iMorphed stack running, open the **6 Mark to Jane Warp.tif** stack, and animate it.

10. Describe the differences between the two morphing stacks.

True morphing involves transforming not only the brightness (or color) of one object to another but also includes transforming the *shape* of one object to the shape of another. This is called *geometric warping* and is a very complex mathematical process.

Unfortunately, ImageJ does not have the ability to do geometric warping. Other software was used to create the full morphing effect you see here, including both the cross fade and geometric warping. In image warping, you usually define points or shapes on one image and select the corresponding points or shapes on the other image.

(Note: This capability and the screen shot below are NOT part of ImageJ.)



Close all images and stacks when you are finished viewing them.

Part 3: *Photo restoration*

In the **8 Old Photos** folder open **Faded Uncle Frank.tif**.

You probably noticed that this image looks pretty bad. If this were a recent photograph, you might think that the exposure was way off. However, because this photo is very old, the image has probably faded with time. Examining the numbers behind the image will help you understand why this photo looks as it does. With help from mathematics and image processing techniques, you can restore this faded old photo to something closer to its original appearance.

As you look at the photograph, your eyes see many shades of gray. Your eyes are sensitive to a range of brightness from pure black to pure white. In this grayscale image, pixel values can range from 0 to 255, with white pixels having a value of 255, black pixels having a value of 0, and gray pixels having values from 1 to 254.

Let's examine the range of pixel values in this image. Making a histogram is the easiest way to see the distribution of these values.

Choose Analyze > Histogram to make a histogram of the image.

This histogram shows the total number of pixels with each "brightness" value in the image, from 0 (black) to 255 (white).

Move your cursor from left to right in the histogram window, and read the **Level:** (pixel value) and **Count:** (number of pixels) at the bottom of the window.

What software is it?

The geometric morphing software used here is a freeware application called MorphX (Macintosh OS X only)

You try it!

Become your friend. or turn into a bird! Use the iMorph plugin to create your own image morphs. Check out the images in the **7 Special Effects** folder, or scan your own.

You may need to resize, rotate, and register your images first. To resize images for registration, measure a distance on both images, such as the spacing between the eyes, and use the ratio between these two measurements to find the scaling factor. For example:

Image 1 = 156 px

Image 2 = 187 px

Ratio = 156 px/187 px = 0.834

Activate Image 2, choose Image > Scale, and enter 0.834 for the X-and Y-Scale values.

Registering images involves aligning matching points in the scaled images so they are in approximately the same location in each image. To create a smooth morph from the images of two people, make sure that key features such as eyes, mouths, and noses, are scaled and registered as closely as possible.

To align one slice with another:

- Choose the slice you want to use as the reference image.
- Find the coordinates of a point in the reference image that you want to align the other slices to.
- Select the slice you want to shift, cut it, and paste it back into its own window.
- Drag the pasted selection, or nudge it with the arrow keys to move the point to the same location as in the other slice.
- Flip between the slices to check the alignment, and re-align again if necessary.

11. According to the histogram, what is the minimum pixel value (**Level**) in the image? (What is the lowest **Level** with a **Count** of at least 1?)
12. According to the histogram, what is the maximum pixel value (**Level**) in the image? (What is the highest **Level** with a **Count** of at least 1?)
13. Sketch the histogram, or print it out, and paste it onto the Data Sheet. Put a descriptive label on each axis and a title above the graph.
14. How does the shape of the histogram relate to the shades you see in the image?
15. What is the range (maximum-minimum) of pixel values in the image?

The range of pixel values in this image is very narrow. A narrow range of values corresponds to a narrow range of colors, so that the picture looks gray and washed out. It would be nice to expand the range of brightness in the image to cover the full range your eyes can detect. This is similar to adjusting the contrast on a television or computer monitor. In ImageJ, you can use math to adjust the contrast very precisely.

Image arithmetic

To use the full range of values from 0 to 255, the minimum value needs to be shifted down to 0. Subtracting the current minimum pixel value from every pixel in the image will make the new minimum equal to 0. All other pixel values will be lowered by the same amount.

16. Predict what will happen to the image and its histogram when you subtract the minimum value from every pixel.

    Choose Process > Math... > Subtract and enter the minimum value you found in question 11 to subtract this value from each pixel in the image.

17. How did the appearance of the image change after the subtraction? Did you predict correctly?
18. Create a new histogram, and sketch it. (Be sure to label the axes and title the graph). How well did you predict its appearance?
19. The minimum value is now 0. To stretch the pixel values from 0 to 255, the maximum value needs to be 255. What is the maximum pixel value on the image now? (Look for the highest **Level** with a **Count** of at least 1 on the most recent histogram.)
20. What math operation would stretch the maximum value to 255 without changing pixels that have a value of 0?
21. What factor would you multiply the maximum value in the image by to get 255? (Hint: maximum × ? = 255)

    Choose Process > Math… > Multiply…, and multiply the pixel values in the image by the factor you calculated.

22. Describe how the image changed after the multiplication.
23. Create and sketch the new histogram.
24. Why are there gaps in the new histogram?
25. If you multiplied a pixel with a value of 92 by 4, its new value would be 368. This is beyond ImageJ's range of 0 to 255. What do you think happens to this pixel? (Try it to find out).

- Close **Faded Uncle Frank.tif** and the **Histogram** window.
- Open another image in the **Old Photos** folder, and "restore" it using the techniques you have just learned.

Part 4: *Images and the law*

The degree to which retouched and altered images can be made to look "flawless" creates controversy. Not only is it possible to put people in photos of places where they have not been, but it is possible to make it seem as if the altered photo is an original. What are the ethical implications of using altered images, particularly when the images are intended for use as evidence in court?

Read the article, "*Making the Camera Lie, Digitally and Often*" on the next page. As you read, think about what rights, if any, an individual should have over the use of his or her image.

26. Write a position statement addressing the above issues and outlining what you feel to be the guidelines for appropriate use of digitally enhanced and altered images.

On your own

- Try out any of the photo effects you learned in this lesson on images that you scan or create.
- Share your position statement through class discussion or debate.

More articles on ethics and digital images

When your eyes tell you lies

http://www.insightmag.com/news/2000/10/16/Nation/Media.When.Your.Eyes.Tell.You.Lies-213320.shtml

A brief history of media fakery and its ethical implications.

Digital photography: A question of ethics

http://www.fno.org/may97/digital.html

A teacher's perspective on digital manipulation and ethics.

What's real, what's phony?

http://www.dartmouth.edu/~vox/0405/0726/photos.html

The development of a mathematical way to tell if a digital image has been faked.

Journalism faces a serious technological threat

http://www.lib.utah.edu/epubs/undergrad/vol7/tilman.html

Discussion of digital technology as a possible threat to journalistic credibility.

Making the Camera Lie, Digitally and Often

By AMY M. SPINDLER (NYT)

Published: June 17, 1997

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Among photographers, it's called digital dieting: the digital enhancement used on celebrity and model photographs today, making the subjects look freakishly flawless.

But the same technology that has long been the subject's friend has grown to encompass an entirely new art form that some people now see as the enemy. Photography with digital doctoring is so far from the conventional journalistic art where seeing is believing that Richard Avedon suggests giving it a new name.

''There is no such thing as photographic reality,'' Mr. Avedon said. ''You cannot believe a photograph.''

Mr. Avedon has been manipulating his images, not on a computer but by hand, since about 1953, when Marella Agnelli's swanlike neck was elongated even further for effect.

''I feel I have the right to interpret my subject as an artist,'' he said. ''And photography is an art.''

That right is being questioned now by Mira Sorvino, who took issue with photos by David LaChapelle that were digitally altered to portray her as Joan Crawford in the May issue of Allure. Mr. LaChapelle is certain to influence the work of a new generation of photographers in the same way that Mr. Avedon pioneered so much of what is familiar today.

But Mr. LaChapelle is just one of a growing band for whom the photo is only the beginning. Under their influence, the idea of the sanctity of the negative is on its way to becoming the most important issue in modern photography. The fact that photography is being redefined as illustrative invention is jarring to those who think of photos as truth.

''That's an interesting concept: where to find reality,'' said Mr. LaChapelle, who is in Los Angeles this week shooting the cover for the Fleetwood Mac reunion album. ''It used to be you turned to photos for that. People say photos don't lie. Mine do. I make mine lie.''

Mr. Avedon said that of all the photographers inventing surreal images, it was Mr. LaChapelle who has the potential to be the genre's Magritte. Magritte didn't need complicity with a subject. And in many ways, the new generation of photographers doesn't either. The independence of photographers like Mr. LaChapelle was made glaringly clear in the controversy fanned by Ms. Sorvino.

No one seems to know exactly why Ms. Sorvino was unhappy at being portrayed as Joan Crawford. ''Her reasoning behind not wanting to do a certain image doesn't matter,'' said Mara Buxbaum, her agent at PMK Public Relations. When she posed for Allure's ''Hollywood Babylon'' shoot, she was fine recreating other creepy settings like the lobotomized Frances Farmer with her brain in a jar. And she has also not complained about digital retouching on the same photo that perfected her skin, lengthened her legs, and thinned her waist.

But while Ms. Sorvino thought she was posing as Marlene Dietrich, she was later digitally given big eyebrows and cruel lips, with a model playing Christina Crawford superimposed beside her, like ''Mommie Dearest.''

The issue has become one of artists' rights: Ms. Sorvino's to appear as she'd like, and Mr. LaChapelle's to create the image he'd like.

''Editorial is a laboratory,'' Mr. LaChapelle said. ''There's a place where I do execute other people's ideas. It's called advertising. I'm not there to do what the publicists want.''

It isn't only the seamlessness of the computer work that has caused anxiety. It is the pervasiveness of it and its limitless potential. On the computer, any photo of Ms. Sorvino that exists could be made to look like Joan Crawford. Or Fatty Arbuckle, for that matter. For artists like Mr. LaChapelle, Nick Knight, Inez van Lamsweerde, Jean-Baptiste Mondino, Raymond Meier and Jean-Paul Goude, making the photography unbelievable, more astonishing than life, is the goal.

''It is the single most important step in photography since its invention,'' Mr. Knight said, referring to digital technology. He has just shot the latest Christian Dior campaign, and he works regularly with Alexander McQueen, most recently on Bjork's new album art. ''It's going to completely alter how we approach photography in the future,'' he said. ''Photography has been burdened with the responsibility of showing reality since its invention. It isn't a good medium to do that.''

Photographers like Mr. Knight and Mr. LaChapelle construct a photograph from its inception with an eye to what will be done digitally to it later. The work on such photos is considered so important today that it isn't unusual for the image-manipulation artist to be given a separate credit in magazines. Stephen Gan, who works with many of the photographers in Visionaire magazine, said for artists like Mr. Goude, the credit often reads ''image making.''

''These photographers have become storytellers, almost illustrators,'' he said.

The resulting image truly has never been seen before, because, of course, it never existed.

''I'm taking photos for a generation that grew up in a time of provocative images,'' Mr. LaChapelle said. ''I'm part of what I consider the entertainment industry. For my photos to be entertaining, they have to be provocative and new.''

Mr. LaChapelle's Crawford photo has created a brouhaha among those who control celebrity images, as if such art-department tricks were

something new.

''Fashion magazines and other magazines have improved or thought they improved pictures forever,'' said Patrick McCarthy, the chairman and editorial director of Fairchild Publications, which owns Los Angeles Magazine, in addition to Women's Wear Daily and W. ''You get into issues of how far do you go. If the dress didn't look good in blue, do you do it in red? Maybe you shouldn't. But you can't assume a fashion photo is a U.P.I. picture of a war zone.''

Dustin Hoffman is suing Los Angeles Magazine for dressing his image from ''Tootsie,'' on the computer, in Richard Tyler.

''They made him an involuntary model, and he's suing on that ground and other grounds,'' said Bert Fields, Mr. Hoffman's lawyer. He said of digital imaging: ''It's fascinating because there is no area of the law. There are going to be cases all over the place dealing with what happens when you put a computer to work.''

The official Allure stance, from its editor in chief, Linda Wells, is that the issue is between Ms. Sorvino and Mr. LaChapelle. Which is odd, considering that the magazine regularly doctors celebrity photos, giving them double chins (Ms. Sorvino got one in June 1996) or new noses.

Even photography presumed to be true isn't always. For years, Mr. Avedon has switched heads with bodies he liked better. In the new Givenchy advertising he shot with Mr. McQueen last week, he switched one model's head in a photo with her body in another.

And in a feat that has become legendary in the industry, Nucleus Imaging, a leading digital retouching company in New York, took Karl Lagerfeld's photos of Princess Caroline of Monaco and made a cover for Harper's Bazaar by grafting skin from one frame, hair from another, the face from yet another, and the body from another. It was done with a Macintosh and a Silicon Graphics computer, which has been used for special effects in films for years.

''Ultimately, digital imaging is another gadget in the photographer's camera bag,'' said Jon Rosen, the owner of Nucleus Imaging. ''Photography was always filled with illusions. Where do you draw the line? Half these people talking about ethics had wedding pictures done with soft focus on them. There is no genuine question of ethics.''

Mr. LaChapelle stresses that photography will never be completely supplanted. ''The computer is the slave to the photograph,'' he said. ''You have to start with an interesting image.''

Which means there is a downside to efficient manipulation. Just as there is no way of knowing what photos are real, there is no way of knowing when conventional photography has produced an amazing image. For instance, Mr. LaChapelle's current Detour cover of Uma Thurman is otherworldly but was not digitally enhanced, he said. And Mr. Avedon's photo of a giant chair with models hanging from it, to advertise Versace, was indeed a giant chair with models hanging from it.

Name(s) _____ Class _____ Date _____

Data Sheet

Photo Effects

1. What would happen to the image if you entered a scale of exactly 1?

2. Which transfer mode allows the white background of the Earth image to be pasted transparently?

3. Describe the steps you used to modify and add the **Asteroid.tif** image to your cover.

4. Now that you have discovered how easy it is to fake digital photos, how likely are you to believe a tabloid cover photo?

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6. Describe what this stack shows.

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16. Predict what will happen to the image and its histogram when you subtract the minimum value from every pixel.

17. How did the appearance of the image change after the subtraction? Did you predict correctly?

18. Create a new Histogram, and sketch it. (Be sure to label the axes and title the graph). How well did you predict its appearance?

19. The minimum value is now 0. To stretch the pixel values from 0 to 255, the maximum value needs to be 255. What is the maximum pixel value on the image now? (Look for the highest **Level** with a **Count** of at least 1 on the most recent histogram.)

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22. Describe how the image changed after the multiplication.

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