When scanned, an image has a set number of pixels per inch. In this example, the one-inch square "photo" has 64 pixels per inch. Half of the pixels are white, and half are black. If this photo is simply enlarged, all that the pagination software can do is enlarge the pixels making the photo look "pixelated." If the photo is made smaller, the pixels move closer together, and the output device throws this extra information away.
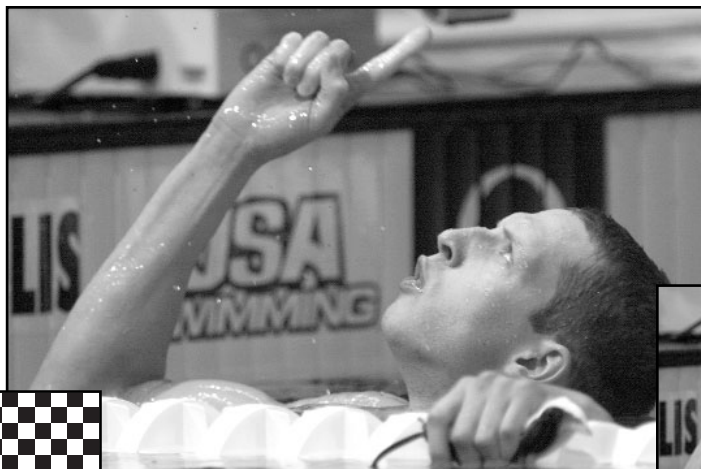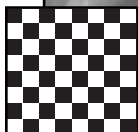
Photo caption
Tom Malchow, who owns numerous swimming records, looks up as he points to the sky, Aug. 12, following his first place finish in the men's 200m butterfly, at the Indiana University Natatorium. Malchow finished in 1:56.87, and was under world record pace at one point. *Indianapolis Star Photo by* **Rob Mattson**.

Why you can't just enlarge a digital photograph
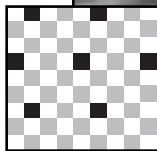
Story by **Bradley Wilson**

At the time a photograph is scanned (or otherwise digitized), the amount of digital information in that image is fixed, based on the settings at the time of the scan. It will never contain any more information than at the time of capture.

Still, time after time, page designers try to enlarge photos beyond the original size resulting in a loss of quality. When a photo is enlarged in a page layout program, the pixelation ("jaggies") becomes evident.

The best procedure to follow is the same one page designers followed in the "old days." Sketch out the page and decide the approximate size of the photograph and then digitize the image at that size with enough information to reproduce it clearly.

For example, if you know a photograph is going to be printed in a newspaper that uses a line screen of 85 lines per inch (information that you'll have to obtain from your printer) and you know it's going to be about 4 x 6 inches in size, you can scan it with that information in mind. Entering the appropriate size and resolution (85 * 2 = 170 PPI) into the scanner settings dialog box.
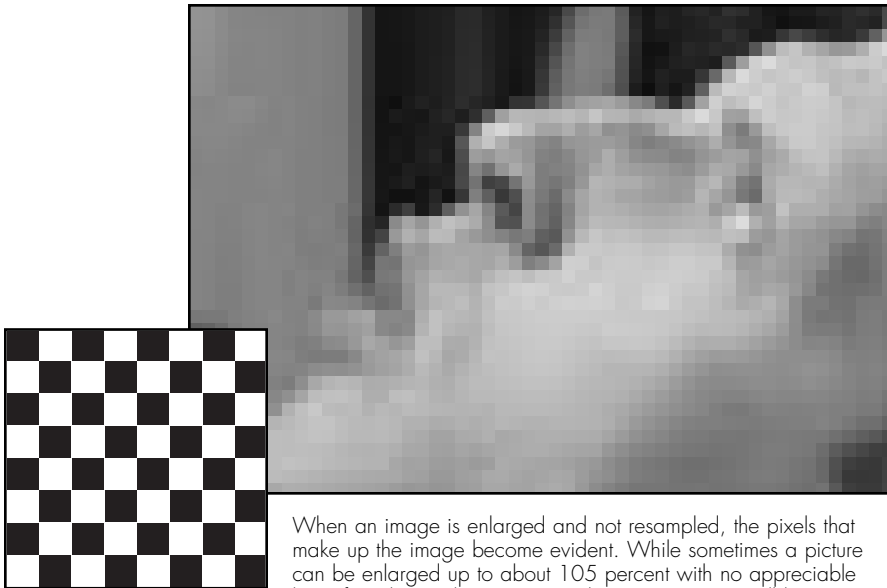
Of course, programs such as Photoshop will allow a user to resample an image – adding information where necessary to fill in the gaps. The software will take the information that is available and extrapolate the necessary data. However, this

If, in Photoshop, you turn ON resampling and force the software to extrapolate (make it up from what is known) the missing data, the photo will look blurry. In this example, the original photograph was reduced in size and then enlarged, allowing Photoshop to fill in the missing data.

data will only be a rough approximation of what was really there, and the photograph will look blurry at best.

Given that enlarging a photograph past 100 percent results in a loss of quality, some users prefer to scan images at a

When an image is enlarged and not resampled, the pixels that make up the image become evident. While sometimes a picture can be enlarged up to about 105 percent with no appreciable loss of quality, it's better not to enlarge an image at all but to scan it with enough information.

resolution and size higher than they could possibly use. For example, a newspaper photographer may scan a photograph at 300 PPI even when they know they'll be using it at 170 PPI. Because the photograph contains much more information than necessary (300 pixels per inch instead of the required 170 PPI), the output device will ignore the extra information.

Some people are taught to scan everything at 300 PPI regardless of the output resolution or file size.
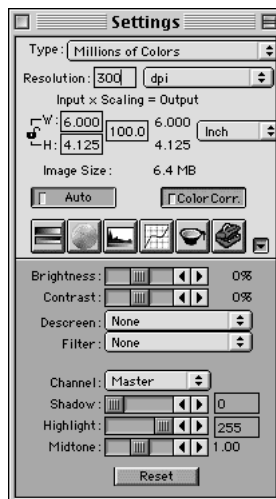
This uniform approach presents its own set of problems, not the least of which are slower operating speed and an increased chance for disk errors because the file size will be much larger than necessary. Larger files are slower and prone to error.

For example, a 3 x 5 inch photograph at 300PPI will occupy 1.29MB at 300 PPI but only 424KB at 170 PPI (about one-third of the disk space). The smaller file size results in faster operations and less chance for disk errors.

To expedite production when the final size is not known, it is always better to have more information than not enough. For example, if you know that a photo is going to be used on the news page but do not know the exact size, it is better to scan it a little larger than necesssary perhaps even at a higher resolution than necessary. Then, when the final size is determined, resample the image (down) in Photoshop.

For example, scan a 4 x 6 inch photograph at actual size (100%) for output at 133 LPI and it will occupy 1.63 MB. If you later decide that this same photo is going to be reproduced at 2 x 3 inches, go into Photoshop and, under Image/Image Size, make sure Constrain Proportions and Resample are turned on. This will keep the dimensions of the photo in proportion. The photo won't look stretched. It will also force Photoshop to discard the unneeded data. Then type 2 inches in for width, and you will notice that the height changes proportionally. And the final size (at the top) changes from 1.63MB to 415KB, substantially smaller

This scanner is set to scan a 4.125"x6" photograph at actual size (100%) for reproduction at 150 LPI (300 PPI). Notice that this software replaces "PPI" with "DPI."

Definitions

LPI Lines per inch; reserved for the number of lines in a screen of a printed image; determined by the maximum resolution of the press on which the page is being printed;
photocopy............65 LPI
newspaper ....85 LPI
yearbook ....133 LPI

DPI Dots per inch; reserved for the number of dots available in output of a laser printer or other output device
laser printer ......600 DPI
imagesetter......2400 DPI

PPI Pixels per inch; the number of "picture elements" in an image as it appears on the screen
Web page...........72 PPI
photocopy ....130 PPI
newspaper.........170 PPI
yearbook...........266 PPI

Formulas

The MAXIMUM RESOLUTION of a printer

10% * DPI = LPI

Example: A 600 DPI printer can output a maximum of 60 LPI (600 * 10%) and still retain all 256 levels of gray

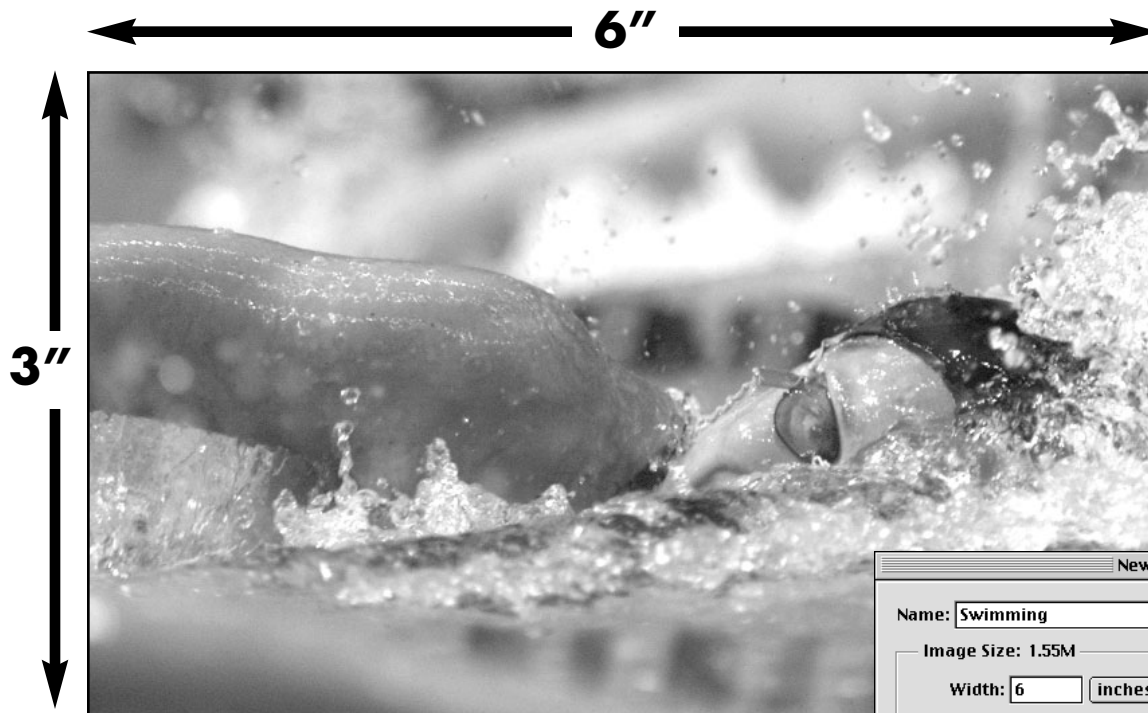### Number of PIXELS NEEDED in an image at actual size

LPI * 2 = PPI

Example : A photograph to be reproduced at 85 LPI must be scanned at 170 PPI (85 * 2) to avoid pixelation.

ENLARGEMENT/REDUCTION

LPI * % enlargement/reduction * 2 = PPI

Example : A photograph to be reproduced at 85 LPI and enlarged 150% must be scanned at 255 PPI (85 * 150% * 2) to avoid pixelation

Exercise

← **6"** →
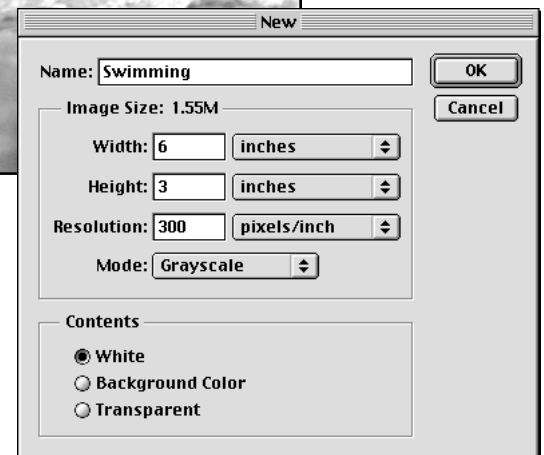

3"

ORIGINAL PHOTO

DIRECTIONS FOR PART 1: FUNDAMENTALS

On a separate piece of paper, answer the following questions. Show all calculations.

1. This original photo was 6 x 3 inches and was scanned at 300 pixels per inch (PPI) — resulting in a 1.55 MB file. However, in the yearbook, it's only going to be 4 inches wide. How tall will it be?

2. Because it will be reproduced in a yearbook using a 133 lines per inch (LPI) screen, how many pixels per inch does this image need at actual size?

3. With the actual values of size and resolution, what is the file size of this image in KB?

4. If you need to use this image at 4 x 3 inches, what would you have to do to avoid stretching the photograph?

5. What would you have to do to reproduce this photograph on the Web at 72 PPI?

6. If you want to use this photograph as a dominant photograph on a yearbook spread at 9 x 4.5 inches, describe the process necessary to prepare this photo for reproduction.

Lindsay Benko competes in the women's 200m freestyle semifinals, Aug. 11, 2000, at the IUPUI Natatorium. Benko finished second, in lane 4, with a time of 2:00.76.

Indianapolis Star Photo by **Rob Mattson**.

New

Name: Swimming

Image Size: 1.55M

Width: 6   inches

Height: 3   inches

Resolution: 300   pixels/inch

Mode: Grayscale

OK

Cancel

Contents
- ● White
- ○ Background Color
- ○ Transparent

1 To keep the photograph in proportion, the photo that was originally 6 x 3 inches will be 4 x 2 inches. To prove this, remember basic algebra.

$$\frac{6}{3} = \frac{4}{x}$$

2 Since the number of pixels per inch is twice the line screen, this photo needs 266 PPI (133*2).

3 The file size of this 4 x 2 inches grayscale photos at 266 PPI, as indicated in Photoshop's Image Size dialog box is 553K.

4 If you needed to use the photo at 4 x 3 inches, you would have to crop the photograph, possibly as below.
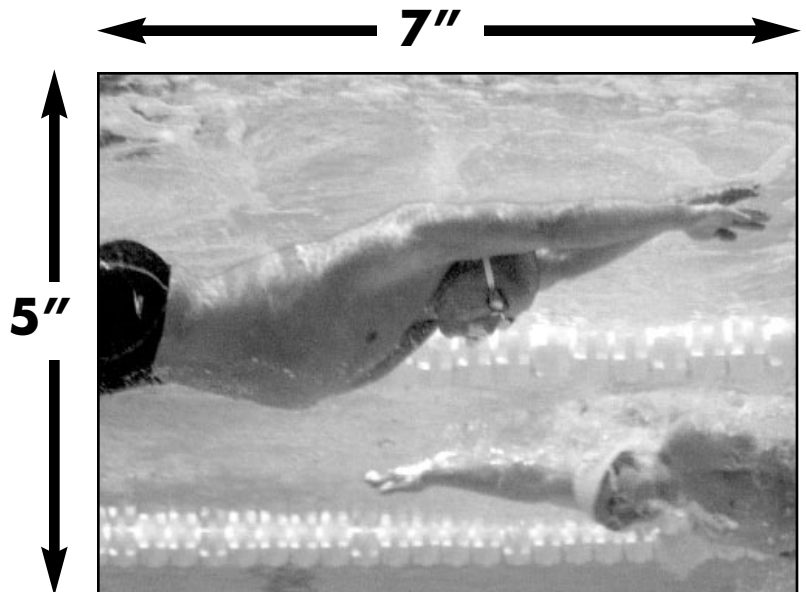

5 To reproduce this photograph on the Web, the output resolution would be 72 PPI, significantly less than the resolution at which the photograph scanned. Because Photoshop can easily discard information, it's simply a matter of resampling the photograph under the Image Size dialog box after determining the size at which the photo will appear on the Web to keep the file size small. For example, at 3 x 1.5 inches at 72 PPI, this file is only 23KB.

6 If you wanted to use this photo at a size larger than the size at which it was scanned, you would probably have to rescan the image. Because this photo was originally scanned at 300 PPI and you only need it at 266 PPI, you can use the photo at up to 6.767 x 3.383 inches in the yearbook with no loss of quality. In the newspaper, at only 170 PPI, the same scan could be used at 10.58 x 5.29 inches with no loss of quality. The pixels will not be spread out to a resolution lower than that required for quality newspaper reproduction.

7"

5"

ORIGINAL PHOTO

DIRECTIONS FOR PART 2: ADVANCED CONCEPTS

On a separate piece of paper, answer the following questions. Show all calculations.

1. This original photo was 5 x 7 inches and scanned at 170 PPI for reproduction in the newspaper at actual size. Later, however, the yearbook wants to use the same photograph. What is the largest size at which the yearbook can use it at 266 PPI?

Turn off resample image in Photoshop's Image Size dialog box, and type in the new resolution: 266 PPI. You will see that the new reproduction size is 4.474 x 3.195 inches. Notice that the file size stays the same (988 KB) because the image is simply being made smaller. Information is being neither added nor removed.

2. This original photo was 5 x 7 inches and scanned at 170 PPI for reproduction in the newspaper at actual size. Later, however, the Web folks wants to use the same photograph. What is the largest size at which the Web can use it at 72 PPI?

Turn off resample image in Photoshop's Image Size dialog box, and type in the new resolution: 72 PPI. You will see that the new reproduction size is 16.5 x 11.8 inches. Notice that the file size stays the same (988 KB). Practically, this is way too large for the Web so the designers will also want to decrease the dimensions of the photograph.

3. Off the Web, you copy a photo that is 3 x 4 inches. Assuming you receive permission, what is the largest size you can use it in the newspaper?

Because Web photos are at 72 PPI, this same photo at 170 PPI will be 1.694 x 1.271 inches. In the yearbook, at 266 PPI, this same photo would be 1.08 x 0.81 inches.

From an underwater view, Erik Vendt, 19, pushes off the wall, passing Chris Thompson, during the men's 1500m freestyle finals, where Vendt set new American and Olympic Trials records with a time of 14:59.11. He beat the first seed Chris Thompson, who finished with a time of 15:09.16.

Indianapolis Star Photo by **Rob Mattson**.