Choosing a Display

A brief talk by William Matheson

Three Common Technologies

CRT

LCD

Plasma

(click on images to visit sources)

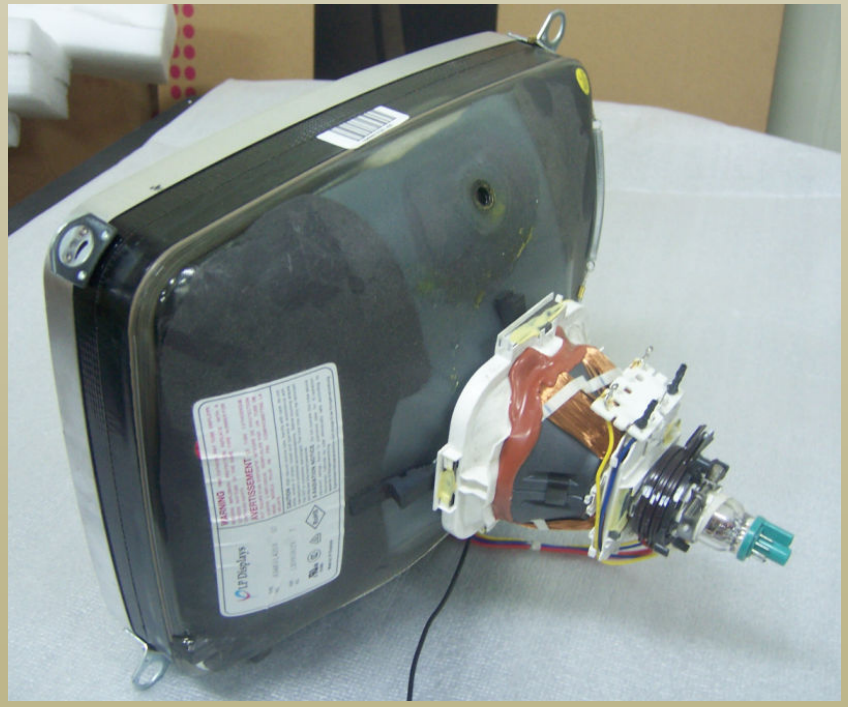
CRT: Cathode Ray Tube

- Cathode rays are streams of electrons observed in vacuum tubes:

Cathode rays casting a shadow on the wall of a Crookes tube

CRT: Cathode Ray Tube

- To make a display, we need an electron gun and an evacuated picture tube:



CRT: Cathode Ray Tube

- We need a strong material to hold a vacuum against our atmosphere!

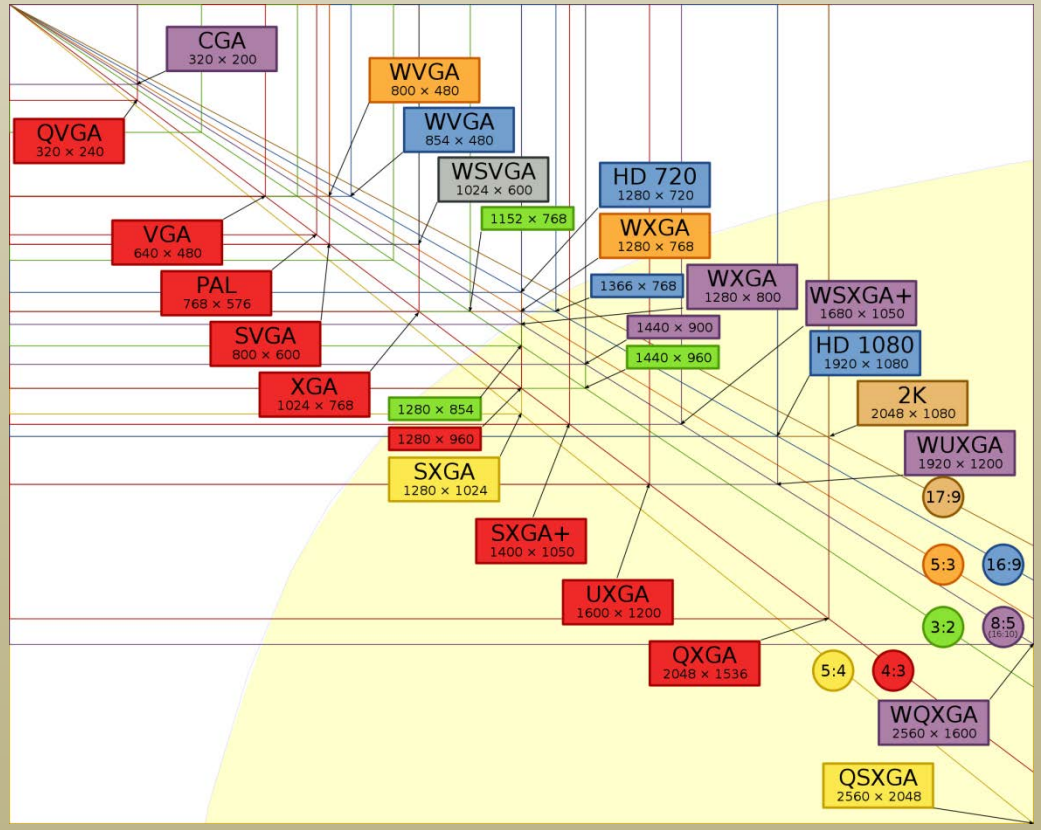
Mauna Kea, Hawaii: Plastic bottle sealed at 14,000 feet (left) taken down to 1,000 feet (right).

CRTs: Advantages

- Very wide viewing angle (close to 180°):

CRTs: Advantages

- Every resolution is optimally displayed.



CRTs: Advantages

- Ideal for displaying low-resolution content.
- Lowest-possible input lag, fast response time.

CRTs: Disadvantages

- Heavy

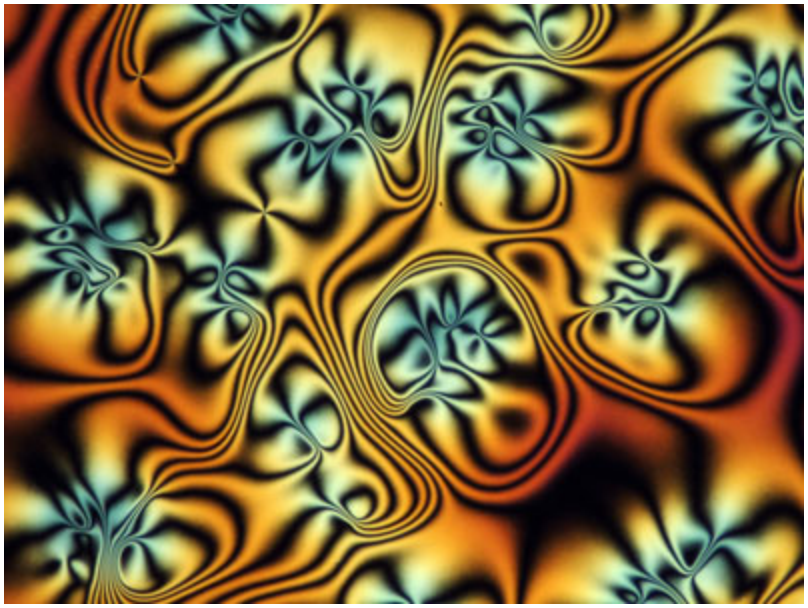
CRTs: Disadvantages

- Expensive

Sony KV-40XBR800:
40 inches, 304 pounds, 2,999 dollars

LCD: Liquid Crystal Display

- Use light modulating properties of **liquid crystals** *(being of a state of matter between conventional liquid and solid crystal)*

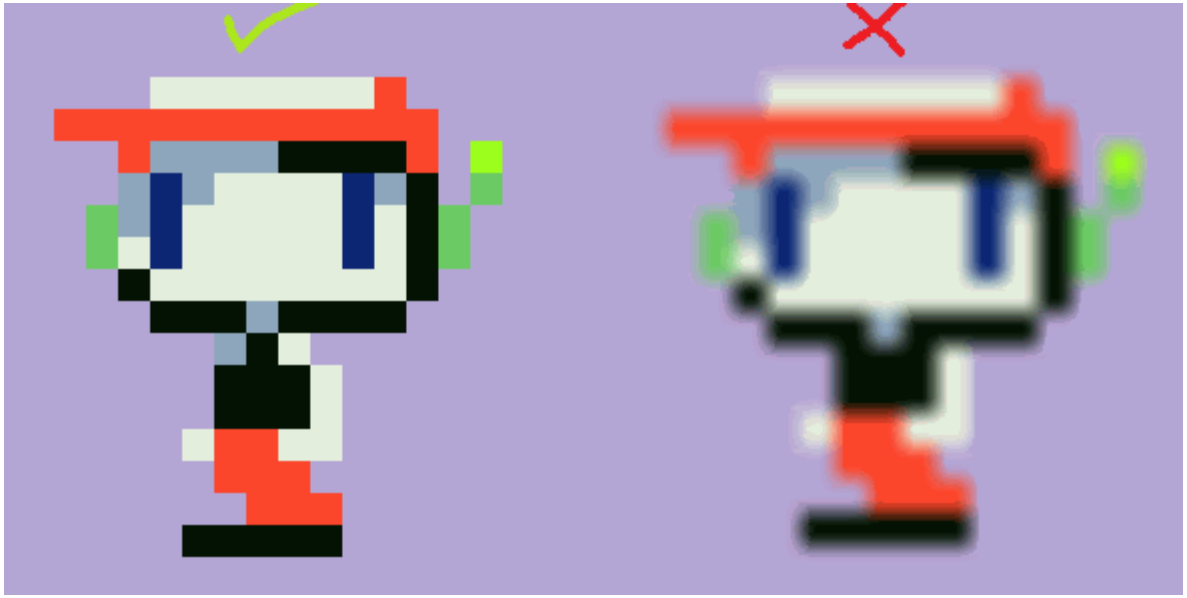


LCDs: Advantages

- Compact
- Light
- Cheap

LCDs: Disadvantages

- Only operate well at one (native) resolution

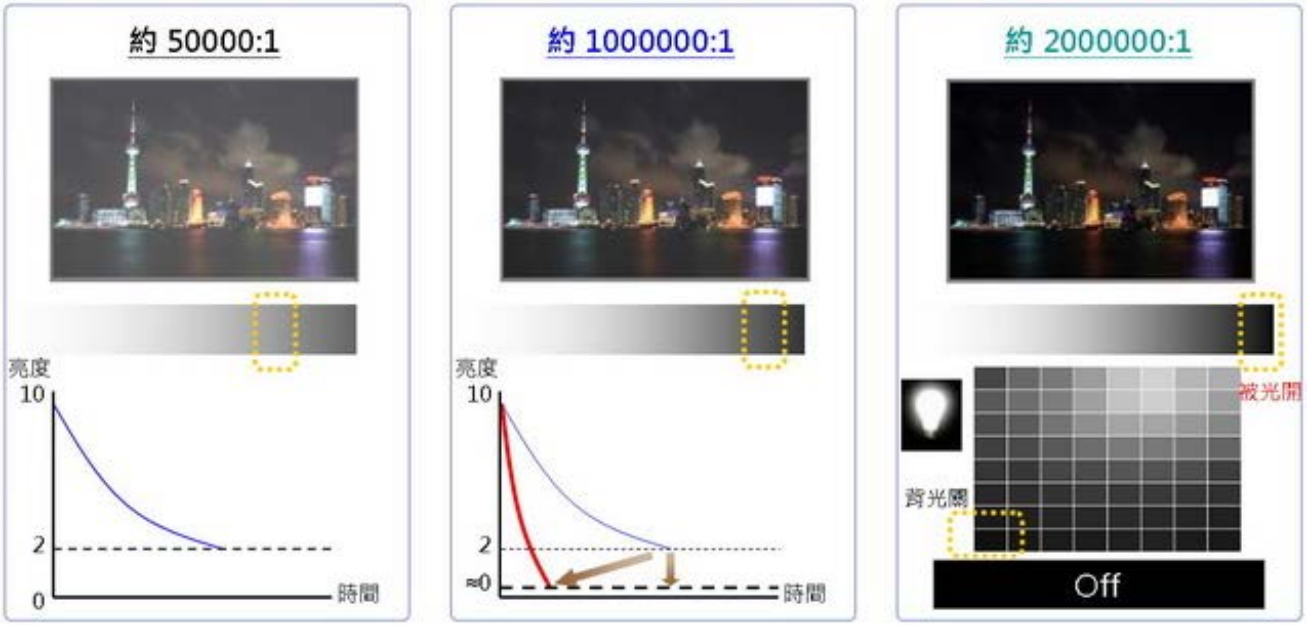


LCDs: Disadvantages

- Require backlighting

LED-*backlit* LCDs

- New LCDs are often backlit by LEDs*, allowing for finer control of backlighting:



Single rear backlight | Edge-positioned backlights | Array of LED backlights

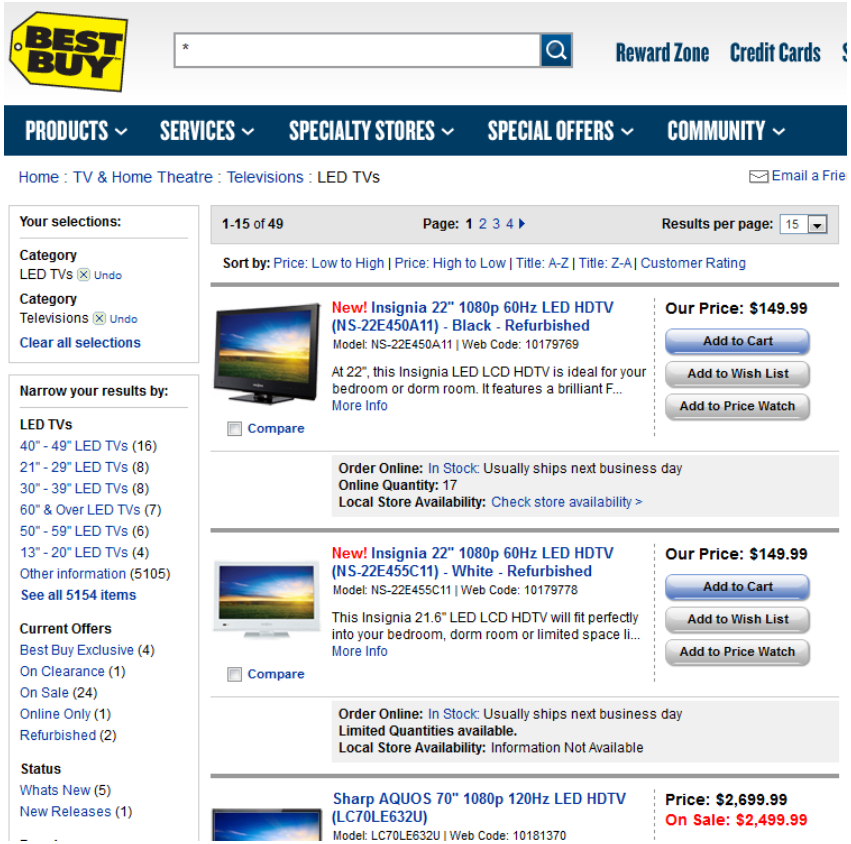
* - **L**ight **E**mitting **D**iode. Seen increasingly in things like bus destination signs (the individual LEDs make up a dot matrix) and automotive headlamps (the LEDs replace conventional light bulbs).

Contrast Ratio

- Difference between brightest and darkest light level the display can show at once (*static*) or ever (*dynamic*)
- The bigger the better
- Static is harder to achieve than dynamic
- Measurement differs among manufacturers, so only use it to compare among a single model line

LED-*backlit* LCDs

- Beware: LED-backlit LCDs are often marketed as “LED TVs”:

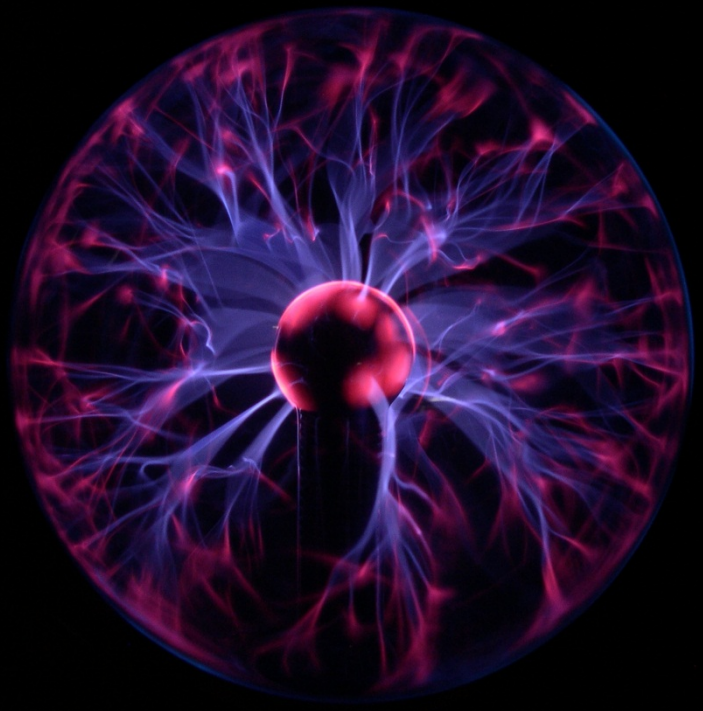


An *actual* LED TV

Sony XEL-1: 11 inch diagonal, 3 millimeter thickness, 2,499 dollar expense

Plasma

- Uses cells containing electrically charged ionized gases



Plasma: Advantages

- Obviates backlighting

This industrious user is working around a broken LCD backlight by mounting the liquid crystal panel onto the case of a disused CRT monitor and installing a fluorescent lightbulb.

Plasma: Advantages

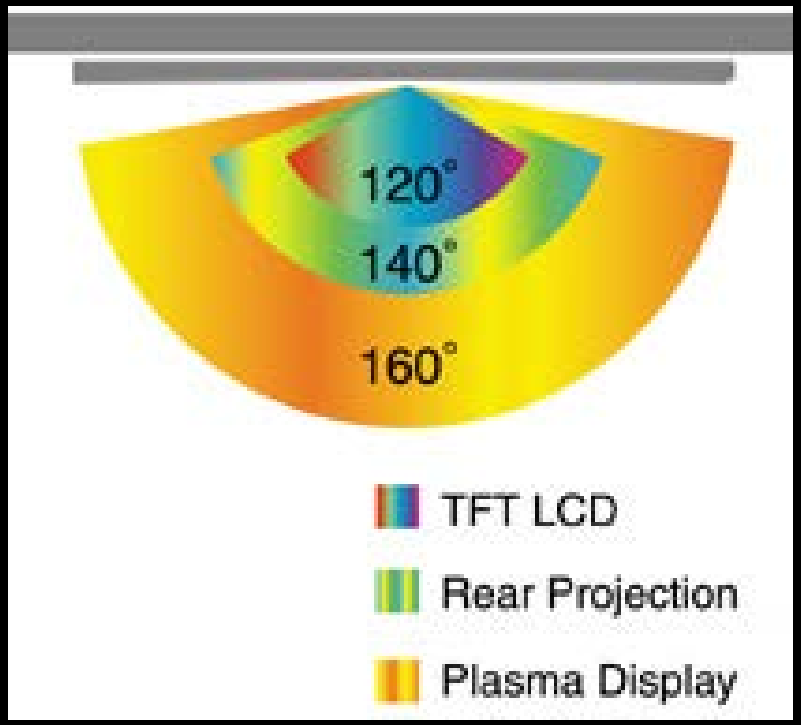
- Fast response time, less motion blur

Sharper

Blurrier-er

Plasma: Advantages

- Wide viewing angle:



Plasma: Disadvantages

- Expensive; seldom offered in sizes smaller than 37 inches

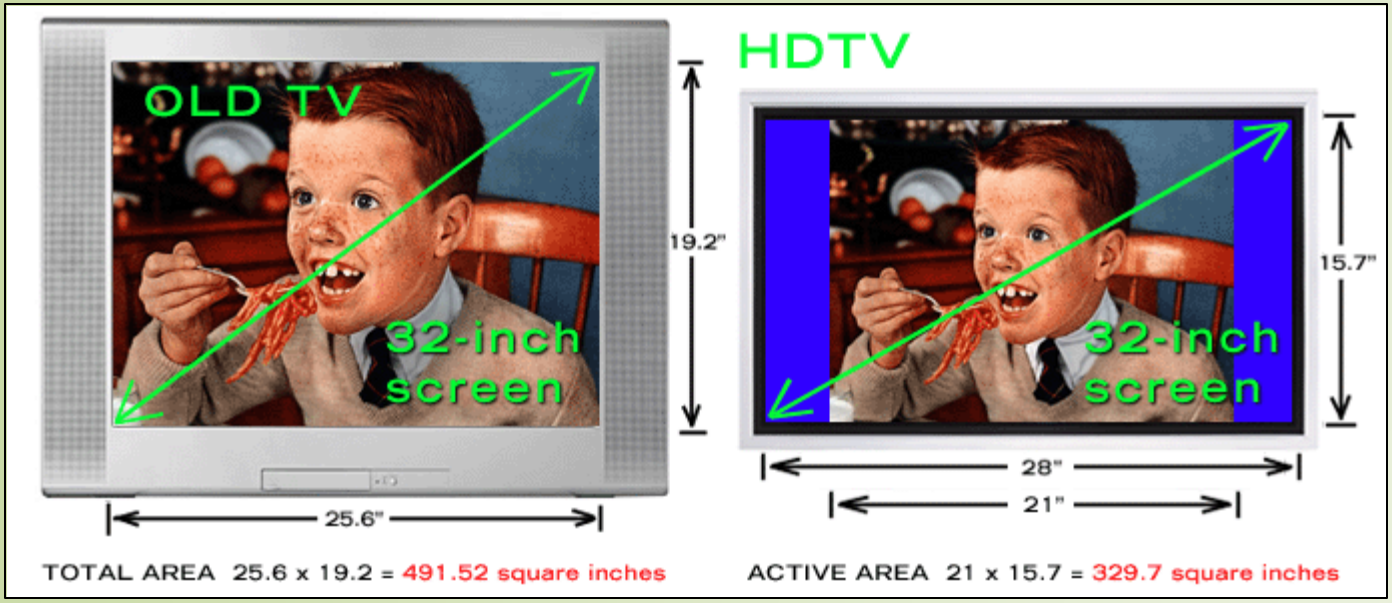
- … but the initial outlay for the technology scales well: At very large sizes, plasmas are cheaper than comparatively sized LED-backlit LCDs (but still more expensive than conventional LCDs).

Plasma: Disadvantages

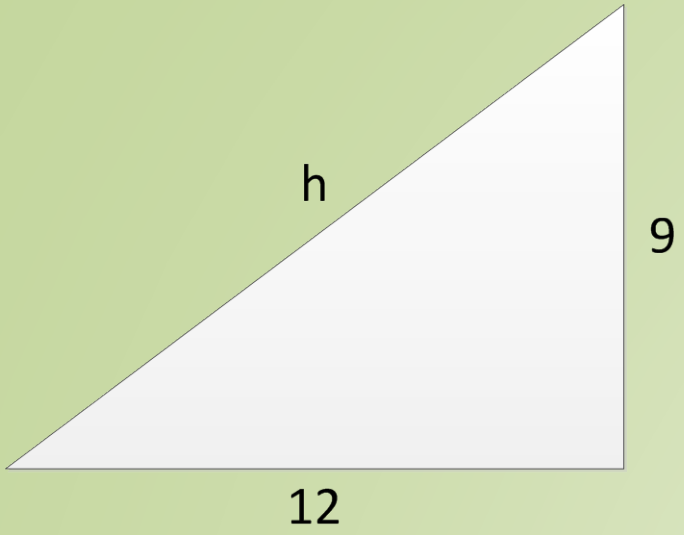
- Doesn’t work well at high altitudes because of the pressure differential

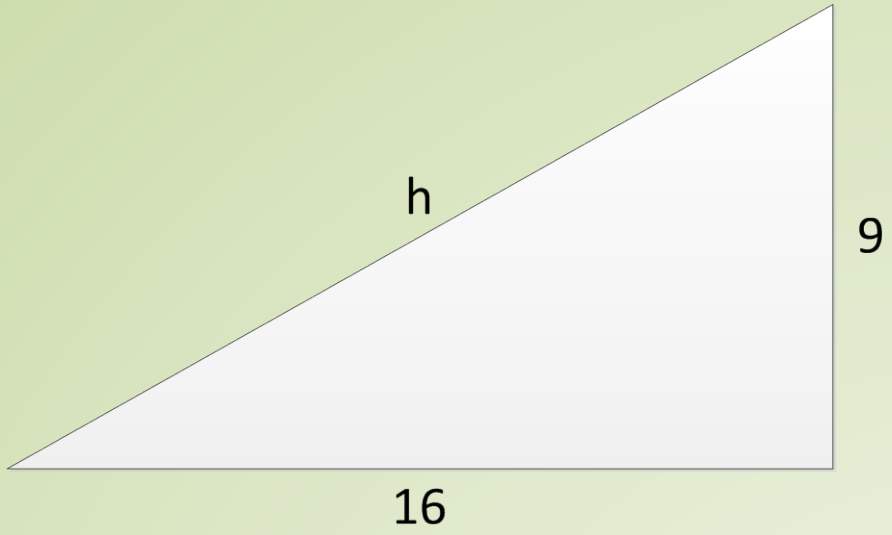
Screen Size

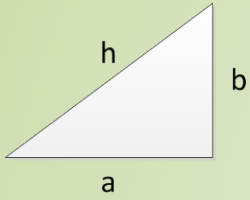
- Displays are typically sold by their diagonal
- When changing the ratio of the display, the relative length of the diagonal also changes:



Screen Size







$$a^2 + b^2 = h^2$$

Screen Size

$9^2 + 12^2 = h_{12:9}^2 = 225$

$h_{12:9} = \sqrt{225} = 15$

$9^2 + 16^2 = h_{16:9}^2 = 337$

$h_{16:9} = \sqrt{337}$

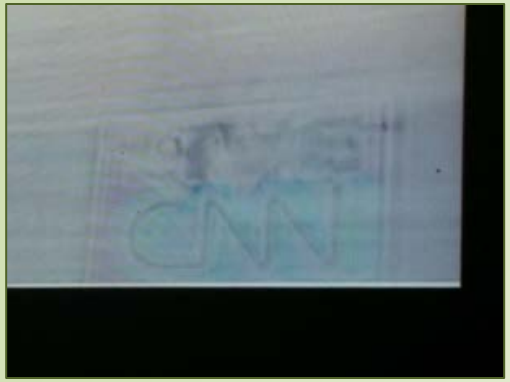
$\frac{h_{16:9}}{h_{12:9}} = \frac{\sqrt{337}}{15} \approx 1.2238\ldots$

- To find the diagonal of the appropriate 16:9 replacement for a 4:3 display, multiply the diagonal of the 4:3 display by **1.22**.

Screen Burn-in

- Though the mechanics differ among them, this anomaly affects all display types:

CRT



LCD

Plasma

Screen Burn-in

- To avoid burn-in, avoid long-persisting pixels (prompts, sign-in screens, watermarks, channel indicators, etc..)

At Saint Mary's in the middle of the last decade, this login screen was persistent enough that it burned itself into many of the workstation LCDs.

Thank You