

Choosing a Display

A brief talk by William Matheson

Three Common Technologies



CRT



LCD

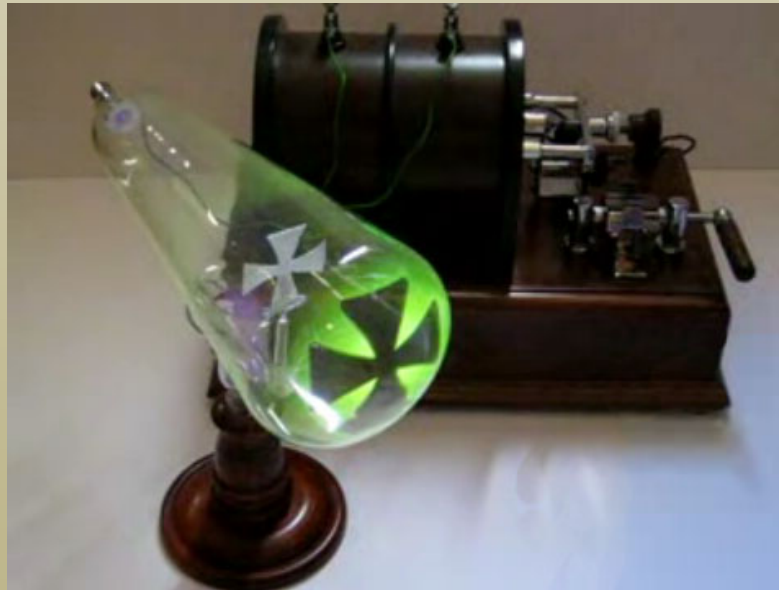


Plasma

(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).

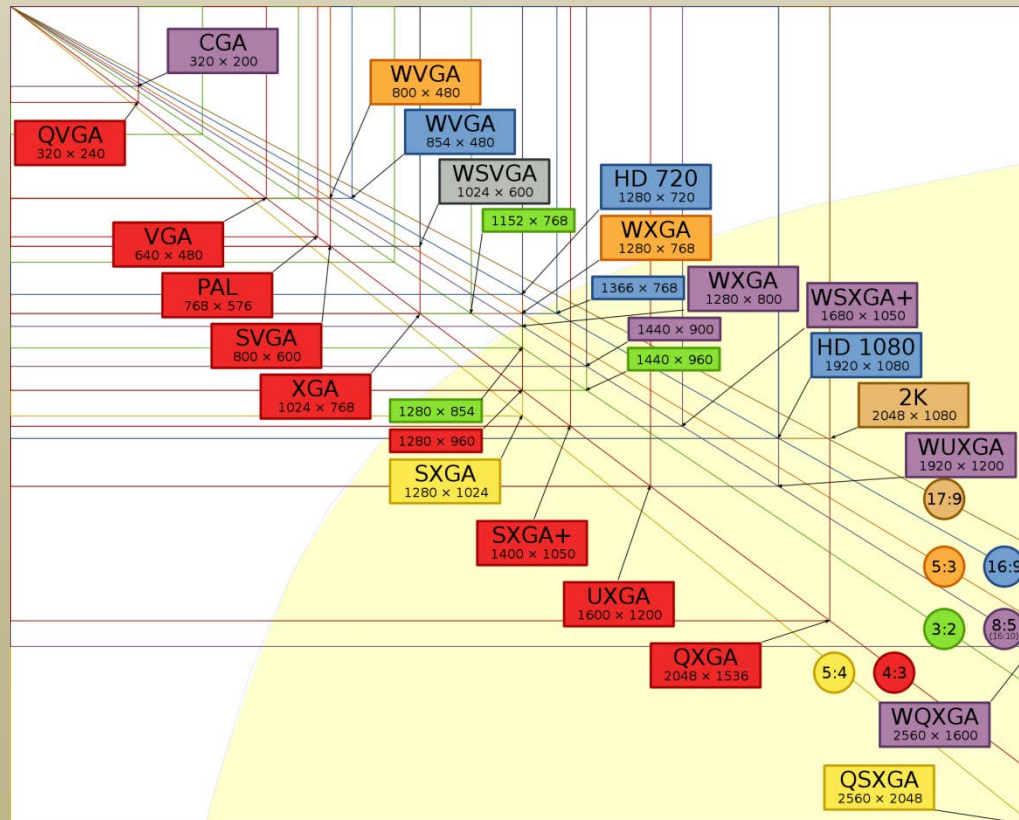
CRTs: Advantages

- 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

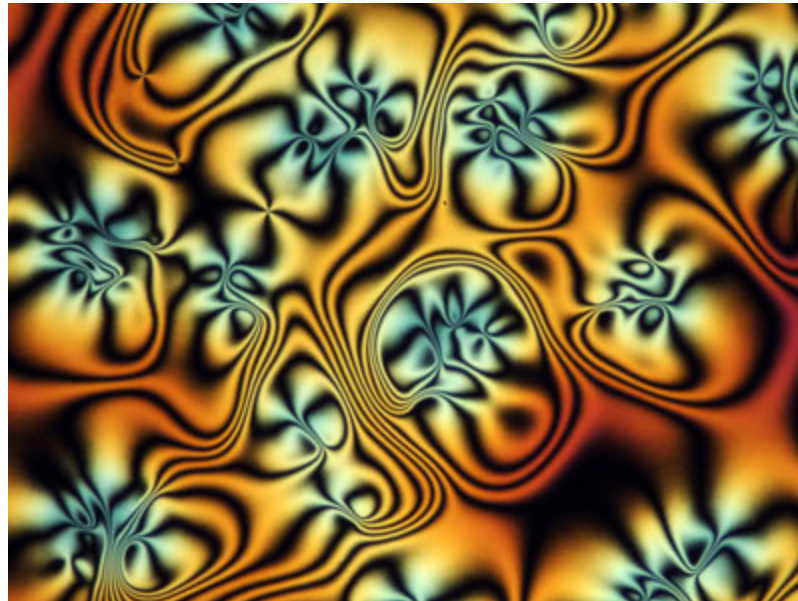
- Expensive



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)*



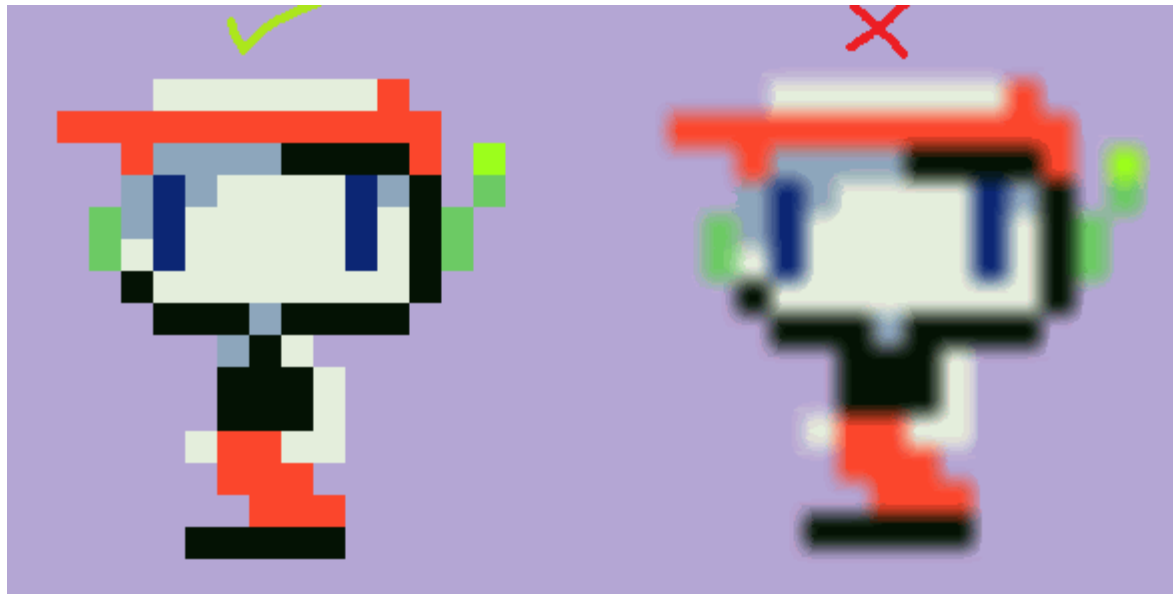
LCDs: Advantages

- Compact
- Light
- Cheap



LCDs: Disadvantages

- Only operate well at one (native) resolution



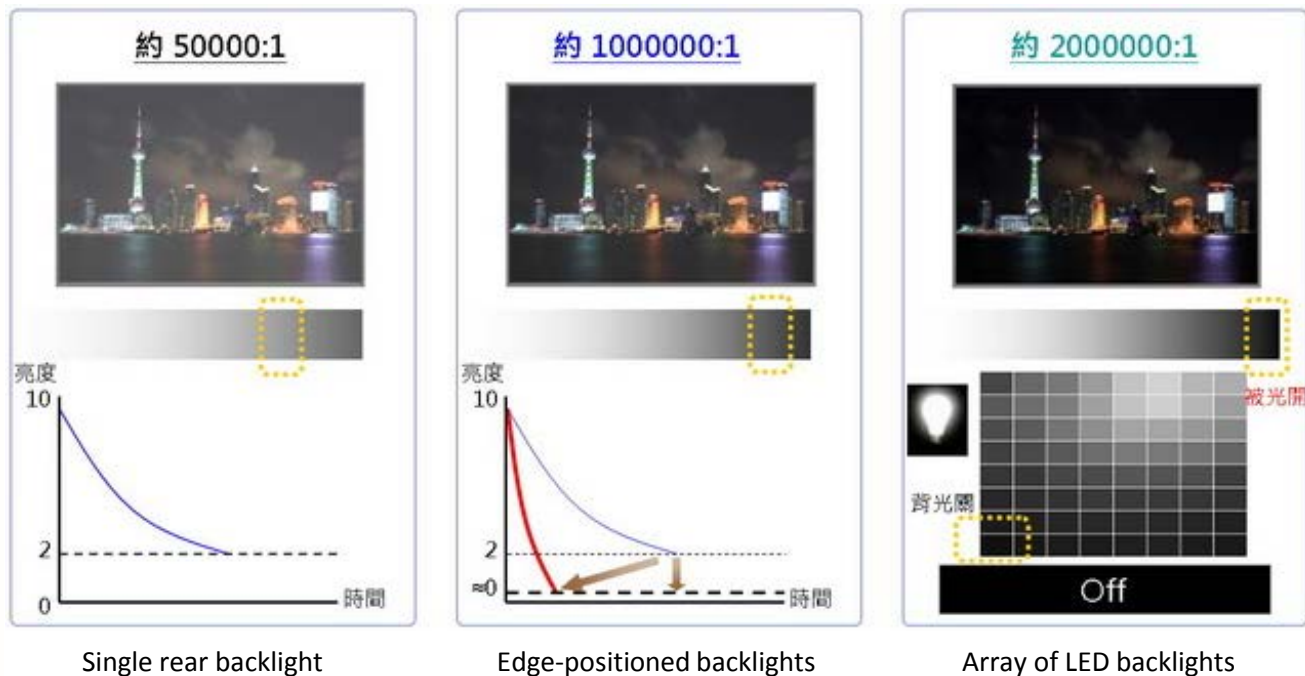
LCDs: Disadvantages

- Require backlighting



LED-backlit LCDs

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



* - **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”:

The screenshot shows the Best Buy website interface. At the top is the Best Buy logo and a search bar. Below the logo is a navigation bar with links for PRODUCTS, SERVICES, SPECIALTY STORES, SPECIAL OFFERS, and COMMUNITY. The main content area displays a list of LED-backlit LCDs under the category 'LED TVs'. The first two items are Insignia 22" 1080p 60Hz LED HDTVs, one in black and one in white, both refurbished. The third item is a Sharp AQUOS 70" 1080p 120Hz LED HDTV. The interface includes filters on the left for category, narrow results, current offers, and status. The right side shows product details, price, and ordering options.

BEST BUY

Home : TV & Home Theatre : Televisions : LED TVs

1-15 of 49 Page: 1 2 3 4 ▶ Results per page: 15 ▼

Sort by: Price: Low to High | Price: High to Low | Title: A-Z | Title: Z-A | Customer Rating

Your selections:

Category
LED TVs [Undo](#)

Category
Televisions [Undo](#)

[Clear all selections](#)

Narrow your results by:

LED TVs

40" - 49" LED TVs (16)
21" - 29" LED TVs (8)
30" - 39" LED TVs (8)
60" & Over LED TVs (7)
50" - 59" LED TVs (6)
13" - 20" LED TVs (4)
[Other information \(5105\)](#)
[See all 5154 items](#)

Current Offers

[Best Buy Exclusive \(4\)](#)
[On Clearance \(1\)](#)
[On Sale \(24\)](#)
[Online Only \(1\)](#)
[Refurbished \(2\)](#)

Status

[Whats New \(5\)](#)
[New Releases \(1\)](#)

New! Insignia 22" 1080p 60Hz LED HDTV (NS-22E450A11) - Black - Refurbished
Model: NS-22E450A11 | Web Code: 10179769
Our Price: **\$149.99**
[Add to Cart](#)
[Add to Wish List](#)
[Add to Price Watch](#)

At 22", this Insignia LED LCD HDTV is ideal for your bedroom or dorm room. It features a brilliant F...
[More Info](#)

[Compare](#)

Order Online: [In Stock](#): Usually ships next business day
Online Quantity: 17
Local Store Availability: [Check store availability >](#)

New! Insignia 22" 1080p 60Hz LED HDTV (NS-22E455C11) - White - Refurbished
Model: NS-22E455C11 | Web Code: 10179778
Our Price: **\$149.99**
[Add to Cart](#)
[Add to Wish List](#)
[Add to Price Watch](#)

This Insignia 21.6" LED LCD HDTV will fit perfectly into your bedroom, dorm room or limited space li...
[More Info](#)

[Compare](#)

Order Online: [In Stock](#): Usually ships next business day
Limited Quantities available.
Local Store Availability: Information Not Available

Sharp AQUOS 70" 1080p 120Hz LED HDTV (LC70LE632U)
Model: LC70LE632U | Web Code: 10181370
Price: **\$2,699.99**
On Sale: \$2,499.99

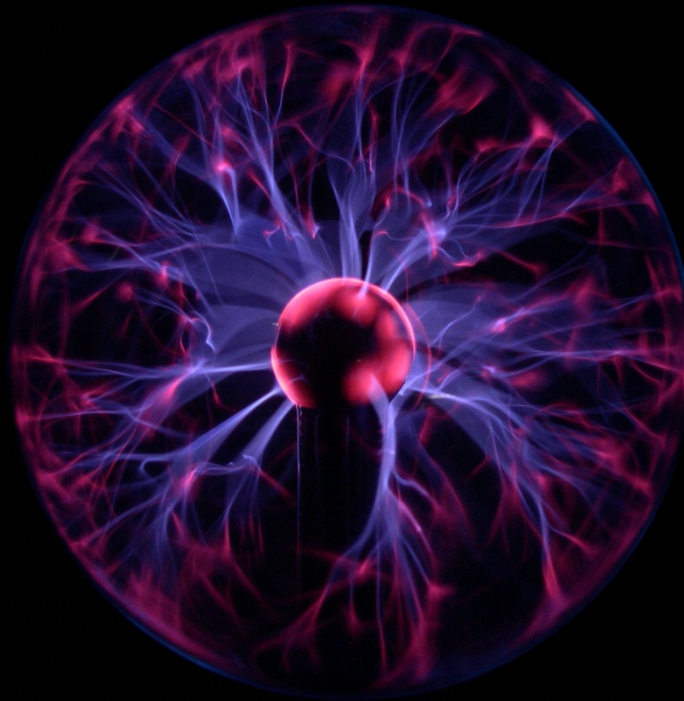
An actual LED TV



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



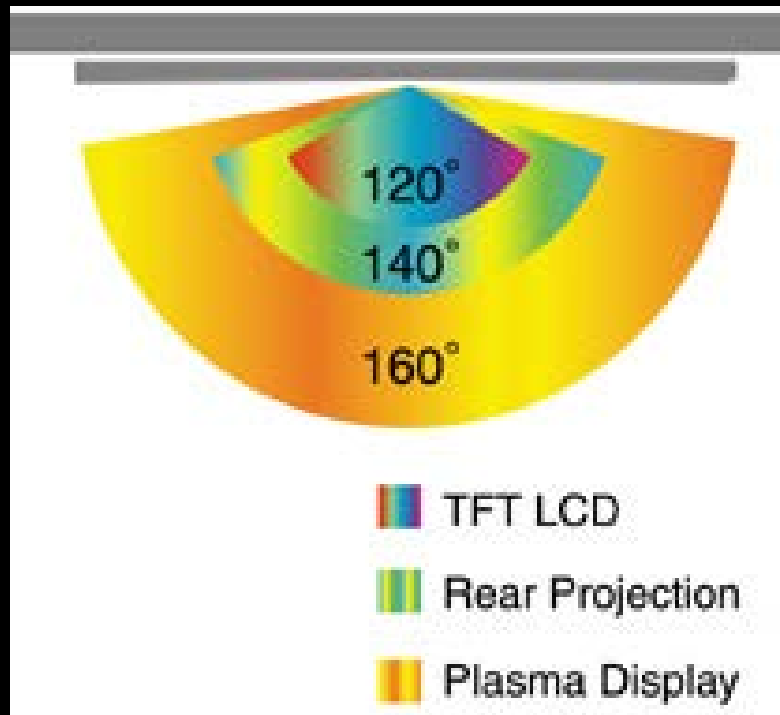
Sharper



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).

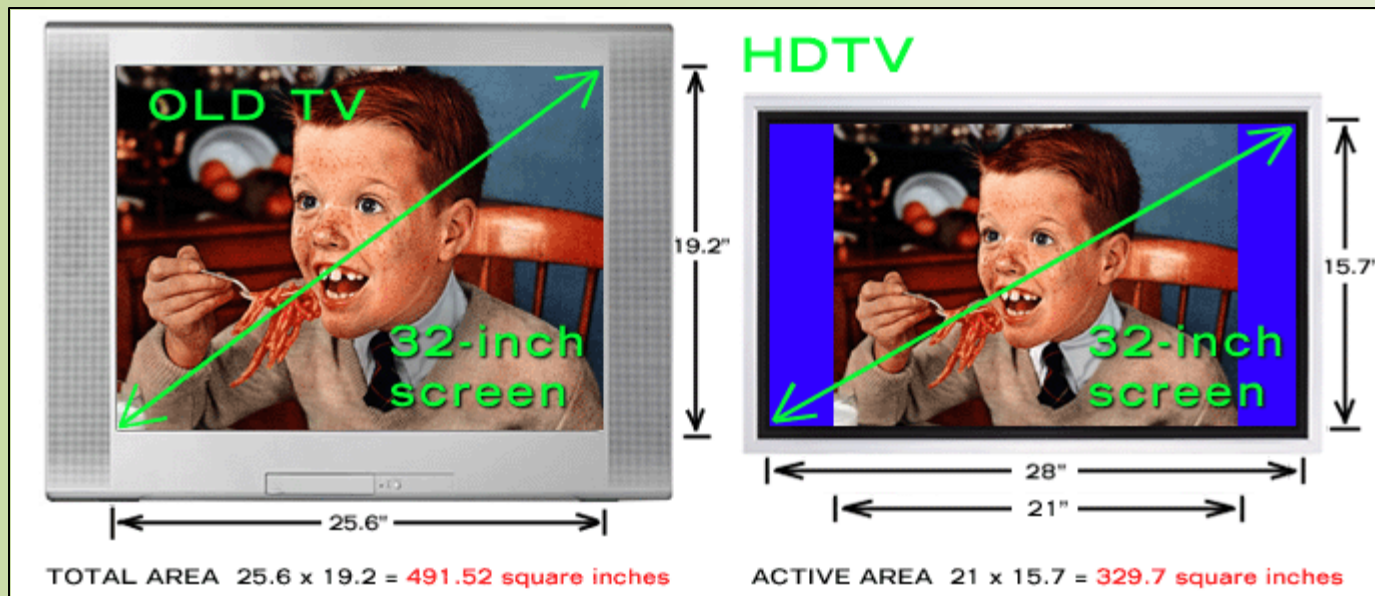
Plasma: Disadvantages

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

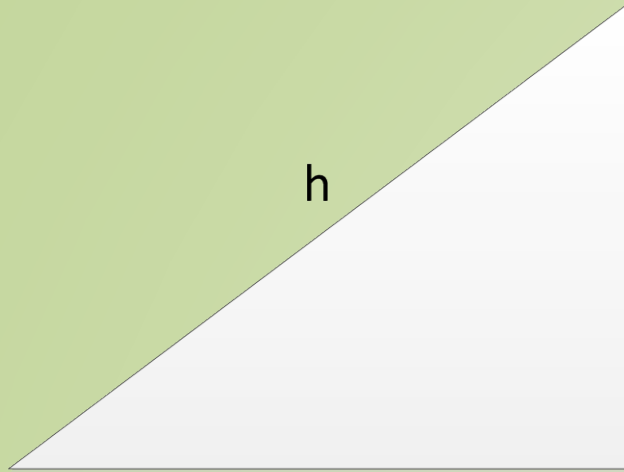


Screen Size

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

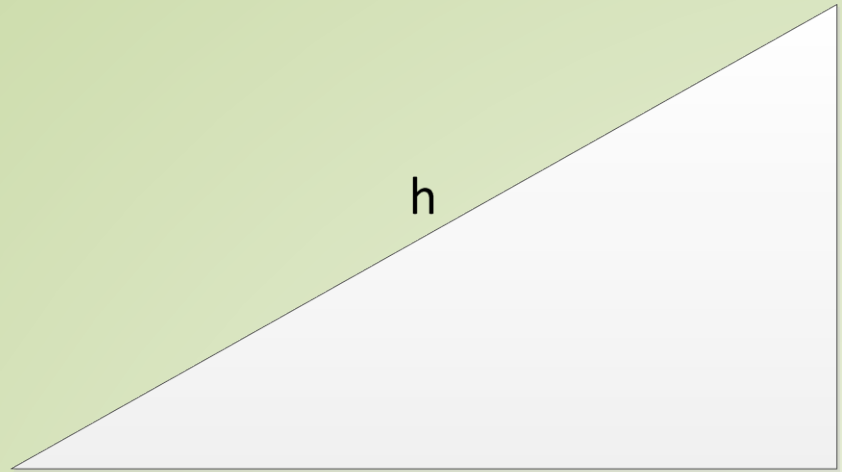


Screen Size



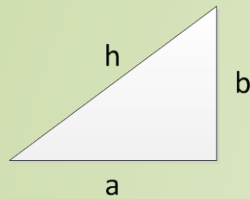
12

9



16

9



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

Screen Size

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

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

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

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

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

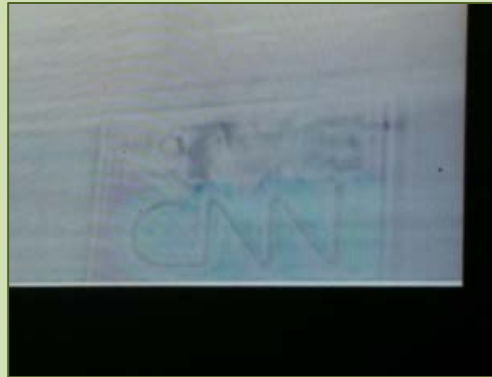
- To find the diagonal of the appropriate 16:9 replacement for a 4:3 display, multiply the diagonal of the 4:3 display by **1.22**.

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

